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US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2008

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with contributions from (listed alphabetically)

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Editorial Notes

Report History: This report is the twelth in a series – which began in 1995 – compiling marine mammal stock assessments for US Atlantic and Gulf of Mexico waters. The first report was issued in the *NOAA Technical Memorandum NMFS-SEFSC* series. The eleven subsequent reports have been issued in the *NOAA Technical Memorandum NMFS-NE* series.

Editorial Treatment: To distribute this report quickly, it has not undergone the normal technical and copy editing by the Northeast Fisheries Science Center's (NEFSC's) Editorial Office as have most other issues in the *NOAA Technical Memorandum NMFS-NE* series. Other than the four covers and first two preliminary pages, all writing and editing have been performed by – and all credit for such writing and editing rightfully belongs to – those so listed on the title page.

Species Names: The NEFSC Editorial Office's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's lists of scientific and common names for fishes, mollusks, and decapod crustaceans and to follow the Society for Marine Mammalogy's guidance on scientific and common names for marine mammals. Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species.

Statistical Terms: The NEFSC Editorial Office's policy on the use of statistical terms in all technical communications is generally to follow the International Standards Organization's handbook of statistical methods.

Obtaining/Viewing Copies: Paper copies of the first report can be obtained from the NMFS Southeast Fisheries Science Center's headquarters (75 Virginia Beach Dr., Miami, FL 33149; 305-361-4284). Paper copies of the second through tenth reports, as well as copies of this report, can be obtained from the NEFSC's headquarters (166 Water St., Woods Hole, MA 02543; 508-495-2228). Additionally, all eleven reports are available (as of the publication date of this issue) online in PDF format at: *http://www.nefsc.noaa.gov/psb/assesspdfs.htm*.

Internet Availability: This issue of the NOAA Technical Memorandum NMFS-NE series is being as a paper and Web document in HTML (and thus searchable) and PDF formats and can be accessed at: http://www.nefsc.noaa.gov/nefsc/publications/

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ACKNOWLEDGMENTS

EXECUTIVE SUMMARY

Under the 1994 amendments of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) were required to generate stock assessment reports (SAR) for all marine mammal stocks in waters within the U.S. Exclusive Economic Zone (EEZ). The first reports for the Atlantic (includes the Gulf of Mexico) were published in July 1995 (Blaylock *et al.* 1995). The MMPA requires NMFS and USFWS to review these reports annually for strategic stocks of marine mammals and at least every 3 years for stocks determined to be non-strategic. The second edition of the SARs (1996 assessments) was published in October 1997 and contained all the previous reports, but major revisions and updating were only completed for strategic stocks (Waring *et al.* 1997). In subsequent annual reports, including this current 2008 edition, updated reports are indicated by the corresponding year date-stamp at the top right corner of the report and are included in the main body of the document. Stock assessments not updated in the current year are included, in full, in Appendix IV. Also included in this report as appendices are: 1) a summary of serious injury/mortality estimates of marine mammals in observed U.S. fisheries (Appendix I), 2) a summary of NMFS records of large whale/human interactions examined for this assessment (Appendix II), 3) detailed fisheries information (Appendix III), and 4) the 1995 USFWS West Indian manatee assessments (Appendix V).

Table 1 contains a summary, by species, of the information included in the stock assessments, and also indicates those that have been revised since the 2007 publication. A total of 42 Atlantic and Gulf of Mexico stock assessment reports were revised for 2008. In addition, a new report was added this year for the Atlantic stock of the rough-toothed dolphin, bringing the total number of reports up to 59. Most of the proposed changes incorporate new information into sections on population size and/or mortality estimates. The revised SARs include 9 strategic and 34 non-strategic stocks.

This report was prepared by staff of the Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC). NMFS staff presented the reports at the January 2008 meeting of the Atlantic Scientific Review Group (ASRG), and subsequent revisions were based on their contributions and constructive criticism. This is a working document and individual stock assessment reports will be updated as new information becomes available and as changes to marine mammal stocks and fisheries occur. The authors solicit any new information or comments which would improve future stock assessment reports.

INTRODUCTION

Section 117 of the 1994 amendments to the Marine Mammal Protection Act (MMPA) requires that an annual stock assessment report (SAR) for each stock of marine mammals that occurs in waters under USA jurisdiction, be prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), in consultation with regional Scientific Review Groups (SRGs). 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 NOAA Assistant Administrator for Fisheries. 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 non-strategic stocks.

Following enactment of the 1994 amendments, the NMFS and USFWS 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 through 2008 SARs. In 1997 and 2004 SARs were not produced.

In this document, major revisions and updating of the SARs were completed for Atlantic and Gulf of Mexico strategic stocks and stocks for which significant new information were available. These are identified by the October 2008 date-stamp at the top right corner at the beginning of each report.

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

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.

TABLE 1. A SUMMARY(including footnotes) OF ATLANTIC MARINE MAMMAL STOCK ASSESSMENT REPORTS FOR STOCKS OF MARINE MAMMALS UNDER NMFS AUTHORITY THAT OCCUPY WATERS UNDER USA JURISDICTION.

Total Annual S.I. (serious injury) and Mortality and Annual Fisheries S.I and Mortality are mean annual figures for the period 2002-2006. The "SAR revised" column indicates 2008 stock assessment reports that have been revised relative to the 2007 reports (Y=yes N=no). If abundance, mortality, PBR or status has been revised, this is indicated with the designation "a", "m", "p" and "status" respectively. For those species not updated in this edition, the year of last revision is indicated. Unk = unknown and undet=undetermined (PBR for species with outdated abundance estimates is considered "undetermined").

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
North Atlantic right whale	Western Atlantic	NEC	325	0	325	0	0.1	0	3.8[a]	1.4[a]	Y	Y a,m
Humpback whale	Gulf of Maine	NEC	847	.55	549	0.04	0.1	1.1	4.4[b]	3.0[b]	Y	Y m
Fin whale	Western North Atlantic	NEC	2,269	.37	1,678	0.04	0.1	3.4	2.0[c]	0.8[c]	Y	Y m
Sei whale	Nova Scotia	NEC	207	.62	128	0.04	0.1	0.3	0.6	0.2	Y	Y m
Minke whale	Canadian east coast	NEC	3,312	.74	1,899	0.04	0.5	19	2.2[d]	1.8[d]	N	Y m
Blue whale	Western North Atlantic	NEC	unk	unk	unk	0.04	0.1	unk	0.2	0	Y	N (2002)
Sperm whale	North Atlantic	NEC	4,804	.38	3,539	0.04	0.1	7.1	0.2	0	Y	N 2007
Dwarf sperm whale	Western North Atlantic	SEC	395[e]	.40	285[e]	0.04	0.4	2.0	0	0	N	N (2007)
Pygmy sperm whale	Western North Atlantic	SEC	395[e]	.40	285[e]	0.04	0.4	2.0	0	0	Y	N (2007)
Killer whale	Western North Atlantic	NEC	unk	unk	unk	0.04	0.5	unk	0	0	N	N (1995)
Pygmy killer whale	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	N (2007)
Northern bottlenose whale	Western North Atlantic	NEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y
Cuvier's beaked whale	Western North Atlantic	NEC	3,513[f]	.63	2,154[f]	0.04	0.4	17	1.8	1.2[g]	N	Y status
Mesoplodon beaked whales	Western North Atlantic	NEC	3,513[f]	.63	2,154[f]	0.04	0.4	17	1.8	1.2[g]	N	Y status
Melon-headed whale	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	N (2007)
Risso's dolphin	Western North Atlantic	NEC	20,479	.59	12,920	0.04	0.48	124	25	25(.32)	N	Y m
Pilot whale, long-finned	Western North Atlantic	NEC	31,139[h]	.27	24,866[h]	0.04	0.5	249	167[h]	167(.14)	N	Y m
Pilot whale, short-finned	Western North Atlantic	SEC	31,139[h]	.27	24,866[h]	0.04	0.5	249	167[h]	167(.14)	N	Y m

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Atlantic white-sided dolphin	Western North Atlantic	NEC	63,368	.27	50,883	0.04	0.5	509	352	352(.09)	N	Y m
White-beaked dolphin	Western North Atlantic	NEC	2,003	.94	1,023	0.04	0.5	10	0	0	N	N (2007)
Short-beaked common dolphin	Western North Atlantic	NEC	120,743	.23	99,975	0.04	0.5	1,000	161	161(.10)	N	Y m
Atlantic spotted dolphin	Western North Atlantic	SEC	50,978	.42	36,235[j]	0.04	0.5	362	6	6(1.0)	N	N (2007)
Pantropical spotted dolphin	Western North Atlantic	SEC	4,439	.49	3,010	0.04	0.5	30	6	6(1.0)	N	N (2007)
Striped dolphin	Western North Atlantic	NEC	94,462	.40	68,558	0.04	0.5	686	0	0	N	N (2007)
Fraser's dolphin	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	N (2007)
Rough-toothed dolphin	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y (new report)
Clymene dolphin	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	undet	0	0	N	N (2007)
Spinner dolphin	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	N (2007)
Bottlenose dolphin	Western North Atlantic, offshore	SEC	81,588[i]	.17	70,775[i]	0.04	0.4	566	unk[r]	unk[r]	N[r]	Y m
Bottlenose dolphin	Western North Atlantic, coastal	SEC	unk[j]	unk[j]	unk[j]	0.04	0.5	unk[j]	unk[j]	unk[j]	Y	Y m
Harbor porpoise	Gulf of Maine/Bay of Fundy	NEC	89,054	.47	60,970	0.04	0.5	610	874[k]	866(.13)[k]	Y	Y m
Harbor seal	Western North Atlantic	NEC	99,340	.097	91,546	0.12	0.5	2,746	621	611 (.15)	N	Y m
Gray seal	Western North Atlantic	NEC	unk	unk	unk	0.12	1.0	unk	836	331(.21)	N	Y m
Harp seal	Western North Atlantic	NEC	unk	unk	unk	0.12	0.5	unk	443,299[l]	80(.31)	N	Y a, m
Hooded seal	Western North Atlantic	NEC	unk	unk	unk	0.12	0.75	unk	5,199[m]	25(.82)	N	N (2007)
Sperm whale	Northern Gulf of Mexico Oceanic	SEC	1,665	.20	1,409	0.04	0.1	2.8	0	0	Y	Y
Bryde's whale	Northern Gulf of Mexico Oceanic	SEC	15	1.98	5	0.04	0.5	0.1	0	0	N	Y
Cuvier's beaked whale	Northern Gulf of Mexico Oceanic	SEC	65	.67	39	0.04	0.5	0.4	0	0	N	Y status

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Blainville's beaked whale	Northern Gulf of Mexico Oceanic	SEC	57[n]	1.40	24	0.04	0.5	0.2[n]	0	0	N	Y status
Gervais' beaked whale	Northern Gulf of Mexico Oceanic	SEC	57[n]	1.40	24	0.04	0.5	0.2[n]	0	0	N	Y status
Bottlenose dolphin	Northern Gulf of Mexico Continental shelf	SEC	17,777	.32	13,667	0.04	0.5	136	unk	unk	N	Y a,p
Bottlenose dolphin	Northern Gulf of Mexico Coastal	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	Y	Y Stranding data
Bottlenose dolphin	Northern Gulf of Mexico Oceanic	SEC	3,708	.42	2,641	0.04	0.5	26	unk	unk	N	Y
Bottlenose dolphin	Gulf of Mexico bay, sound, and estuarine	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	Y	Y Stranding data
Atlantic spotted dolphin	Northern Gulf of Mexico (Outer continental shelf and Oceanic)	SEC	37,611	.28	29,844[o]	0.04	0.5	298[o]	0	0	N	Y a,p
Pantropical spotted dolphin	Northern Gulf of Mexico Oceanic	SEC	34,067	.18	29,311	0.04	0.5	293	0	0	N	Y
Striped dolphin	Northern Gulf of Mexico Oceanic	SEC	3,325	.48	2,266	0.04	0.5	23	0	0	N	Y
Spinner dolphin	Northern Gulf of Mexico Oceanic	SEC	1,989	.48	1,356	0.04	0.5	14	0	0	N	Y
Rough-toothed dolphin	Northern Gulf of Mexico (Outer continental shelf and Oceanic)	SEC	2,653	.42	1,890[p]	0.04	0.5	18[p]	0	0	N	Y a,p
Clymene dolphin	Northern Gulf of Mexico Oceanic	SEC	6,575	.36	4,901	0.04	0.5	49	0	0	N	Y
Fraser's dolphin	Northern Gulf of Mexico Oceanic	SEC	unk	unk	unk	0.04	0.5	undet	0	0	N	Y
Killer whale	Northern Gulf of Mexico Oceanic	SEC	49	.77	28	0.04	0.5	0.3	0	0	N	Y
False killer whale	Northern Gulf of Mexico Oceanic	SEC	777	.56	501	0.04	0.5	5.0	0	0	N	Y
Pygmy killer whale	Northern Gulf of Mexico Oceanic	SEC	323	.60	203	0.04	0.5	2.0	0	0	N	Y
Dwarf sperm whale	Northern Gulf of Mexico Oceanic	SEC	453[e]	.35	340[e]	0.04	0.5	3.4[e]	0	0	N	Y
Pygmy sperm whale	Northern Gulf of Mexico Oceanic	SEC	453[e]	.35	340[e]	0.04	0.5	3.4[e]	0	0	N	Y

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Melon-headed whale	Northern Gulf of Mexico Oceanic	SEC	2,283	.76	1,293	0.04	0.5	13	0	0	N	Y Stranding data
Risso's dolphin	Northern Gulf of Mexico Oceanic	SEC	1,589	.27	1,271	0.04	0.5	13	0	0	N	Y
Pilot whale, short-finned[q]	Northern Gulf of Mexico Oceanic	SEC	716	.34	542	0.04	0.5	5.4	0	0	N	Y

a. The total estimated human-caused mortality and serious injury to right whales is estimated at 3.8 per year (USA waters, 2.4; Canadian waters, 1.4). This is derived from two components: 1) non-observed fishery entanglement records at 1.4 per year (USA waters, 0.6; Canadian waters, 0.8), and 2) ship strike records at 2.4 per year (USA waters, 1.8; Canadian waters, 0.6).

b. The total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as 4.4 per year (USA waters, 4.0; Canadian waters, 0.4). This average is derived from two components: 1) incidental fishery interaction records 3.0 (USA waters, 2.6; Canadian waters, 0.4); 2) records of vessel collisions, 1.4 (USA waters, 1.4; Canadian waters, 0).

c. This is based on a review of NMFS records from 2002 to 2006, that yielded an average of 2.0 human caused mortality; 1.2 ship strikes (0.8 in USA waters and 0.4 in Canadian waters) and 0.8 fishery interactions/entanglements (0 in Canadian waters and 0.8 in USA waters).

d. During 2002-2006, the USA total annual estimated average human-caused mortality is 2.2 minke whales per year, plus a pending number from the bycatch estimate. This is derived from three components: a yet to be determined number of minke whales per year from USA fisheries using observer data (one minke whale bycatch was observed but this number has yet to be statistically extended), 1.8 minke whales per year from USA fisheries using strandings and entanglement data, and 0.4 minke whales per year from ship strikes.

e. This estimate may include both the dwarf and pygmy sperm whales.

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

g. This is the average mortality of undifferentiated beaked whales (*Mesoplodon* spp.)

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

i. Estimates may include sightings of the coastal form.

j. Several seasonal management units have been defined for the coastal bottlenose dolphin. Each has a unique abundance estimate, PBR and mortality estimate provided in the Western North Atlantic coastal bottlenose dolphin species section of the text.

k. The total annual estimated average human-caused mortality is 874 (CV=0.13) harbor porpoises per year. This is derived from three components: 866 harbor porpoise per year (CV=0.13) from USA fisheries using observer and MMAP data, 2 per year (unknown CV) from Canadian fisheries using observer data, and 5.7 per year from USA unknown fisheries using strandings data.

l. The total estimated human caused annual mortality and serious injury to harp seals was 443,299. Estimated annual human caused mortality in US waters is 83, derived from two components: 1) 80 harp seals (CV=0.31) from the observed US fisheries and 3 from average 2002-2006 stranding mortalities resulting from non-fishery human interactions. The remaining mortality is derived from five components: 1) 2002-2006 average catches of Northwest Atlantic harp seals by Canada, 330,509; 2) 2002-2006 average Greenland Catch, 75,085; 3) 715 average catches in the Canadian Arctic ; 4) 8,995 average bycatches in the Newfoundland lumpfish fishery; and 5) 102,647 average struck and lost animals.

m. This is derived from three components: 1) 5,173 from 2001 to 2005 (2001=3,960; 2002=7,341; 2003=5,446, 2004=5,270; and 2005=3,846) average catches of Northwest Atlantic population of hooded seals by Canada and Greenland; 2) 25 hooded seals (CV=0.82) from the observed U.S. fisheries; and 3) one hooded seal from average 2001-2005 stranding mortalities resulting from non-fishery human interactions.

n. This estimate includes Gervais' beaked whales and Blaineville's beaked whales.

o. This is the sum (37,611) of the minimum number of Atlantic spotted dolphins seen in the outer continental shelf (37,611) and the oceanic (0) regions combined, and the PBR is based on the sum.

p. This is the sum (2,653) of the minimum number of rough-toothed dolphins seen in the outer continental shelf (1,145) and the oceanic (1,508) regions combined, and the PBR is based on the sum.

q. This estimate includes all *Globicephala sp.*, though it is presumed that only short-finned pilot whales are present in the Gulf of Mexico.

r. Strategic status determination for the current year will be completed when fishery bycatch estimates are finalized. Status reported is that of the most recently published stock assessment report.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western North Atlantic right whale population ranges from calving grounds in coastal waters off the southeastern United States to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence. Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland. In addition, recent resightings of photographically identified individuals have been made off Iceland, in the old Cape Farewell whaling ground east of Greenland (Hamilton *et al.* 2007), and northern Norway (Jacobsen *et al.* 2004). The September 1999 Norwegian sighting represents one of only two published sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. The few published records from the Gulf of Mexico (Moore and Clark 1963; Schmidly *et al.* 1972) represent either distributional anomalies, normal wanderings of occasional animals, or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. Whatever the case, the location of much of the population is unknown during the winter. Offshore (greater than 30 miles) surveys flown off the coast of northeastern Florida and southeastern Georgia from 1996 to 2001 had 3 sightings in 1996, 1 in 1997, 13 in 1998, 6 in 1999, 11 in 2000 and 6 in 2001 (within each year, some were repeat sightings of previously recorded individuals). Several of the years that offshore surveys were flown were some of the lowest count years for calves and for numbers of right whales in the Southeast recorded since comprehensive surveys began in the calving grounds. Therefore, the frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear.

Research results suggest the existence of six major habitats or congregation areas for western North Atlantic right whales: the coastal waters of the southeastern United States; the Great South Channel; Georges Bank/Gulf of Maine; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf. However, movements within and between habitats may be more extensive than thought. In 2000, one whale was photographed in Florida waters on 12 January, then again eleven days later (23 January) in Cape Cod Bay, less than a month later off Georgia (16 February), and back in Cape Cod Bay on 23 March, effectively making the round-trip migration to the Southeast and back at least twice during the winter season. (Brown and Marx 2000). Results from satellite tags clearly indicate that sightings separated by perhaps two weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Mate *et al.* 1997; Baumgartner and Mate 2005). Systematic surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting the calving grounds may extend as far north as Cape Fear. Four of the calves were not sighted by surveys conducted further south. One of the cows photographed was new to researchers, having effectively eluded identification over the period of its maturation (McLellan *et al.* 2004). The Northeast Fisheries Science Center conducts an extensive multi-year aerial survey program throughout the Gulf of Maine region; this program is intended to better establish the distribution of right whales, including evaluating inter-annual variability in right whale occurrence in previously poorly studied habitats.

New England waters are an important feeding habitat for right whales, which feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*) in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are likely a primary characteristic of the spring, summer, and fall right whale habitats (Kenney *et al.* 1986; 1995). While feeding in the coastal waters off Massachusetts has been better studied than in other areas, right whale feeding has also been observed on the margins of Georges Bank, in the Great South Channel, 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 beginning to emerge (Baumgartner *et al.* 2003; Baumgartner and Mate 2003). NMFS (National Marine Fisheries Service) and Center for Coastal Studies aerial surveys during springs of 1999-2006 found right whales along the

Northern Edge of Georges Bank, in the Great South Channel, in Georges Basin, and in various locations in the Gulf of Maine including Cashes Ledge, Platts Bank and Wilkinson Basin. The consistency with which right whales occur in such locations is relatively high, but these new data further highlight high interannual variability in right whale use of some habitats.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified five mtDNA haplotypes in the western North Atlantic right whale (Malik *et al.* 1999). Schaeff *et al.* (1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*), and found the former to be significantly less diverse, a finding broadly replicated from sequence data by Malik *et al.* (2000). These findings might be indicative of inbreeding in the population, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure in right whales, using DNA extracted from museum and archaeological specimens of baleen and bone, has suggested that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al.* 1997; 2000). However, the virtual extirpation of the eastern stock and its lack of recovery in the last hundred years strongly suggests population subdivision over a protracted (but not evolutionary) timescale. Genetic studies concluded that the principal loss of genetic diversity occurred prior to the 18th century (Waldick *et al.* 2002). However, revised conclusions of species composition in North American Basque whaling archaeological sites (Rastogi *et al.* 2004) contradict the previously held belief that Basque whaling during the 16th and 17th centuries was principally responsible for the loss of genetic diversity.

High-resolution (using 35 microsatellite loci) genetic profiling has been completed for 66% of all identified North Atlantic right whales through 2001. This work has improved our understanding of genetic variability, number of reproductively active individuals, reproductive fitness, parentage and relatedness of individuals (Frasier *et al.* 2007).

One emerging result of the genetic studies is the importance of obtaining biopsy samples from calves on the calving grounds. Only 60% of all known calves are seen with their mothers in summering areas, when their callosity patterns are stable enough to reliably make a photo-ID match later in life. The remaining 40% of all calves born are not seen on a known summering ground. Because the calf's genetic profile is the only reliable way to establish parentage, if the calf is not sampled when associated with its mother early on, then it is not possible to link it with a calving event or to its mother, and information such as age and familial relationships is lost. From 1980 to 2001, there were 64 calves born that were not sighted later with their mothers and thus unavailable to provide age-specific mortality information (Frasier *et al.* 2007). An additional interpretation of paternity analyses is that the population size may be larger than was previously thought. Fathers for only 45% of known calves have been genetically determined. However, genetic profiles were available for 69% of all photo-identified males (Frasier 2005). The conclusions was that the majority of these calves must have different fathers which cannot be accounted for by unsampled males and the population of males must be larger (Frasier 2005). This inference of additional animals that have never been captured photographically and/or genetically suggests the existence of habitats of potentially significant use that remain unknown.

POPULATION SIZE

Based on a census of individual whales identified using photo-identification techniques and an assumption of mortality of whales not seen in seven years, the western North Atlantic stock size was estimated to be 295 individuals in 1992 (Knowlton *et al.* 1994). An updated analysis using the same method gave an estimate of 299 animals in 1998 (Kraus *et al.* 2001). An IWC workshop on status and trends of western North Atlantic right whales gave a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be substantially greater than this (Best *et al.* 2001). A review of the photo-ID recapture database on 30 May 2007 indicated that 325 individually recognized whales in the catalog were known to be alive during 2003. With the exception of calves of the year and a few probably unique but as yet uncatalogued individuals, this number represents a nearly complete census and therefore represents a minimum population size. This count has no associated coefficient of variation.

Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers were thought to have taken right whales during the 1500s in the Strait of Belle Isle region (Aguilar 1986), however, recent genetic analysis has shown that nearly all of the remains found in that area are, in fact, those of bowhead whales (Rastogi *et al.* 2004; Frasier *et al.* 2007). 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 *et al.* 2001; Reeves *et al.* 2007). A modest but persistent whaling effort along the coast of 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, Reeves and Mitchell could conclude only that there were at least hundreds of right whales present in the western North Atlantic during the late 1600s. Reeves *et al.* (1992) plotted a series of population trajectories using historical data and assuming a present day population size of 350 animals. The results suggested that there may have been at least 1,000 right whales in the population during the early to mid-1600s, with the greatest population decline occurring in the early 1700s. The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. Based on back calculations using the present population size and growth rate, the population may have numbered fewer than 100 individuals by 1935 when international protection for right whales came into effect (Hain 1975; Reeves *et al.* 1992; Kenney *et al.* 1995). However, little is known about the population dynamics of right whales in the intervening years.

Minimum Population Estimate

The western North Atlantic population size was estimated to be at least 325 individuals in 2003 based on a census of individual whales identified using photo-identification techniques. This value is a minimum and does not include animals that were alive prior to 2003, but not recorded in the individual sightings database as seen during from 1 January 2004 to 30 May 2007 (note that matching of photos from 2006 and 2007 is not complete). It also does not include calves known to be born during 2003, but not yet entered into the catalog.

Current Population Trend

The population growth rate reported for the period 1986-1992 by Knowlton *et al.* (1994) was 2.5% (CV=0.12), suggesting that the stock was showing signs of slow recovery. However, work by Caswell *et al.* (1999) suggested that crude survival probability declined from about 0.99 in the early 1980s to about 0.94 in the late 1990s. The decline was statistically significant. Additional work conducted in 1999 was reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001); the workshop concluded based on several analytical approaches that survival had indeed declined in the 1990s. Although capture heterogeneity could negatively bias survival estimates, the workshop concluded that this factor could not account for the entire observed decline, which appeared to be particularly marked in adult females. Another workshop was convened by NMFS in September 2002, and reached similar conclusions regarding the decline in the population (Clapham 2002).

Recent mortalities, including those in the first half of 2005, suggest an increase in the annual mortality rate (Kraus *et al.* 2005). Calculations based on demographic data through 1999 (Fujiwara and Caswell 2001) indicated that this mortality rate increase would reduce population growth by approximately 10% per year (Kraus *et al.* 2005). Of these recent mortalities, six were adult females, three of which were carrying near-term fetuses. Furthermore, four of these females were just starting to bear calves, and since the average lifetime calf production is 5.25 calves (Fujiwara and Caswell 2001), the deaths of these females represent a lost reproductive potential of as many as 21 animals.

Despite the preceding, examination of the minimum number alive population index calculated from the individual sightings database, as it existed on 30 May 2007, for the years 1990-2003 (Figure 1) suggests a positive trend in numbers. These data reveal a significant increase in the number of catalogued whales alive during this period, but with significant variation due to apparent losses exceeding gains during 1998-1999. Mean growth rate for the period was 1.8%.
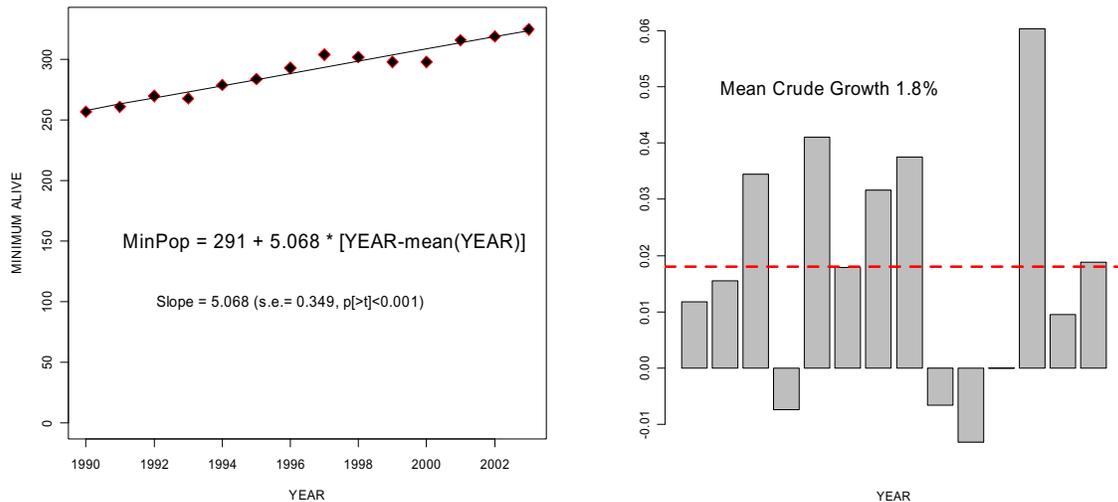
Figure 1. Minimum number alive (a) and crude annual growth rate (b) for cataloged North Atlantic right whales. Minimum number of cataloged individuals known to be alive in any given year includes all whales known to be alive prior to that year and seen in that year or subsequently plus all whales newly cataloged that year. It does not include calves born that year but not yet cataloged.

The minimum number alive may increase slightly in later years as analysis of the backlog of unmatched but high-quality photographs proceeds, with animals matched to previously known individuals added to the catalog as newly identified whales. For example, the minimum number alive for 2002 was calculated to be 313 from a 15 June 2006 data set and revised to 325 using the 30 May 2007 data.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

Total reported calf production and calf mortalities from 1993 to 2007 are shown below in Table 1. The mean calf production for this fifteen year period was 15.6 (13.7-17.7; 95% C.I). In addition, one calf was reported as a serious injury in 2002 and during the 2005 calving season three adult females were found dead with near term fetuses.

An updated analysis of calving interval through the 1997/1998 season suggests that mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al.* 2001). This conclusion is supported by modeling work reviewed by the IWC workshop on status and trends in this population (Best *et al.* 2001); the workshop agreed that calving intervals had indeed increased and further that the reproductive rate was approximately half that reported from studied populations of *E. australis*. A workshop on possible causes of reproductive failure was held in April 2000 (Reeves *et al.* 2001). Factors considered included contaminants, biotoxins, nutrition/food limitation, disease and inbreeding problems. While no conclusions were reached, a research plan to further investigate this topic was developed. Analyses completed since that workshop found that in the most recent years, calving intervals were closer to three years (Kraus *et al.* 2007).

An analysis of the age structure of this population suggests that it contains a smaller proportion of juvenile whales than expected (Hamilton *et al.* 1998; Best *et al.* 2001), which may reflect lowered recruitment and/or high juvenile mortality. In addition, it is possible that the apparently low reproductive rate is due in part to an unstable age structure or to reproductive senescence on the part of some females. However, few data are available on either factor and senescence has not been documented for any baleen whale.

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Table 1: North Atlantic right whale calf production and mortality, 1993-2007		
Year[a]	Reported calf production	Reported calf mortalites
1993	8	2
1994	9	
1995	7	
1996	22	3
1997	20	1
1998	6	1
1999	4	
2000	1	
2001	31	4
2002	21	2
2003	19	
2004	17	
2005	28	
2006	19	
2007	22	
a. includes December of the previous year		

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is specified as the product of minimum population size, one-half the maximum net productivity rate and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). However, recent publications report unacceptable levels of mortality (Best *et al.* 2001), and forecasts of a high probability that North Atlantic right whales will go extinct in 200 years if anthropogenic mortality is not curtailed (Fugiwara and Caswell 2001) suggest that the application of the PBR control rule is inappropriate for this species. Therefore, the PBR for this population is set to zero.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For 2002 through 2006, the minimum annual rate of human-caused mortality and serious injury to right whales averaged 3.8 per year (U.S. waters, 2.4; Canadian waters, 1.4). This is derived from: 1) fishery entanglement records at 1.4 per year (U.S. waters, 0.6; Canadian waters, 0.8), and 2) ship strike records at 2.4 per year (U.S. waters, 1.8; Canadian waters, 0.6). Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates of this report to reflect the effective range of this stock. It is also important to stress that serious injury determinations are made based upon the best available information; these determinations may change with the availability of new information (Cole *et al.* 2005; Nelson *et al.* 2007; Glass *et al.* 2008). For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries. For more information on determinations for this period, see Glass *et al.* (2008).

Background

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

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

increasingly lethal as the whale grows (Cole *et al.* 2005; Nelson *et al.* 2007).

A serious injury was defined in 50 CFR part 229.2 as an injury that is likely to lead to mortality. We therefore limited the serious injury designation to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death (Cole *et al.* 2005; Nelson *et al.* 2007; Glass *et al.* 2008). Determinations of serious injury were made on a case-by-case basis following recommendations from the workshop conducted in 1997 on differentiating serious and non-serious injuries (Angliss and DeMaster 1998). Injuries that impeded a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury may increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. This conservative approach likely underestimates serious injury rates.

With these caveats, the total estimated annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) is 3.8 right whales per year (U.S. waters 2.4; Canadian waters, 1.4). As with entanglements, some injury or mortality due to ship strikes is almost certainly undetected, particularly in offshore waters. Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or necropsied) represent lost data, some of which may relate to human impacts. For these reasons, the estimate of 3.8 right whales per year must be regarded as a minimum estimate (Glass *et al.* 2008).

Further, the small population size and low annual reproductive rate of right whales suggest that human sources of mortality may have a greater effect relative to population growth rates than for other whales. The principal factors believed to be retarding growth and recovery of the population are ship strikes and entanglement with fishing gear. Between 1970 and 1999, a total of 45 right whale mortalities were recorded (IWC [International Whaling Commission] 1999; Knowlton and Kraus 2001; Glass *et al.* 2008). Of these, 13 (28.9%) were neonates that were believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) resulted from ship strikes, 3 (6.7%) were related to entanglement in fishing gear (in two cases lobster gear, and one gillnet gear), and 13 (28.9%) were of unknown cause. At a minimum, therefore, 42.2% of the observed total for the period and 50% of the 32 non-calf deaths were attributable to human impacts (calves accounted for three deaths from ship strikes).

Young animals, ages 0-4 years, are apparently the most impacted portion of the population (Kraus 1990).

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

Fishery-Related Serious Injury and Mortality

Reports of mortality and serious injury relative to PBR as well as total human impacts are contained in records maintained by the New England Aquarium and the NMFS Northeast and Southeast Regional Offices (Table 2). From 2002 through 2006, 7 of 19 records of mortality or serious injury (including records from both USA and Canadian waters) involved entanglement or fishery interactions. Information from an entanglement event often does not include the detail necessary to assign the entanglements to a particular fishery or location.

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period 2002 through 2006, there were at least four documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious-injury determination. A yearling male, #3120, first sighted off the North Carolina coast on 4/7/02, may have avoided serious injury due to being partially disentangled on 8/25/02 by researchers in the Bay of Fundy, Canada. An unidentified right whale was disentangled in the Bay of Fundy, Canada on 7/09/03. The gear was tentatively identified as US lobster gear and other unknown gear. On 12/6/04, a one-year-old of unknown gender, #3314, was sighted with line wrapped on both its head and tail which would likely have been fatal. Following more than three weeks of attempts, the constricting fishing gear was removed. On 12/3/05, #3445—the 2004 calf of #2145—was first sighted off Brunswick, Georgia, with line across its back and around its right flipper. Over 300 feet of trailing line was removed. This whale was resighted on 6/12/06, apparently gear-free. Sometimes, even with disentanglement, an animal may die of injuries sustained from fishing gear. A female yearling right whale, #3107 (see Table 2) was first sighted with gear wrapping its caudal peduncle on 6 July 2002 near Briar Island, Nova Scotia. Although the gear was removed on 1 September by the New England Aquarium disentanglement team, and the animal seen alive on an aerial survey on 1 October, its carcass washed ashore at

Nantucket on 12 October, 2002 with deep entanglement injuries on the caudal peduncle.

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

The only bycatch of a right whale was observed by the Northeast Fisheries Observer Program in the pelagic drift gillnet fishery in 1993, but no mortalities or serious injuries have been documented in any of the other fisheries monitored by NMFS.

Entanglement records from 1990 through 2006 maintained by NMFS Northeast Regional Office (NMFS, unpublished data) included 45 confirmed right whale entanglements, including right whales in weirs, in gillnets, and in trailing line and buoys. Because whales often free themselves of gear following an entanglement event, scarring may be a better indicator of fisheries interaction than entanglement records. In an analysis of the scarification of right whales, 338 of 447 (75.6%) whales examined during 1980-2002 were scarred at least once by fishing gear (Knowlton *et al.* 2005). Further research using the North Atlantic Right Whale Catalogue has indicated that, annually, between 14% and 51% of right whales are involved in entanglements (Knowlton *et al.* 2005). 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 whales were either released or escaped on their own, although several whales were 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. The number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

Other Mortality

Ship strikes are a major cause of mortality and injury to right whales (Kraus 1990; Knowlton and Kraus 2001). Records from 2002 through 2006 have been summarized in Table 2. For this time frame, the average reported mortality and serious injury to right whales due to ship strikes was 2.4 whales per year (U.S. waters, 1.8; Canadian waters, 0.6). In 2000, two right whales were sighted in the Bay of Fundy with large open wounds that were likely the result of collisions with vessels. Right whale #2820, a male of unknown age, was first seen injured on 9 July 2000. He was sighted intermittently throughout the remainder of that summer, was seen again in the Bay of Fundy in 2001 and seen once in 2002. The second whale, #2660, was a five-year-old female who was sighted with a wound on the left side of her head, just forward of the blowholes. She was seen with a calf in December 2005. Although both of these injuries were gruesome in appearance, in the absence of a chronic stressor (i.e., entangling fishing gear), they were apparently not fatal.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2002 through December 2006.						
Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
7/6/02	mortality	Yearling Female #3107 11m	Observed alive off Briar Island, NS		P	Carcass ashore on Nantucket, MA; caudal peduncle severely lacerated where entangled; gear consistent with inshore lobster fishery

Date	Type	Age/Sex	Location			Description
8/22/02	serious injury	Adult Female #1815	Scotian Shelf, Canada		P	Line tightly wrapped around head and tail stock; no gear recovered
8/22/02	mortality	Yearling Female 12.6m	off Ocean City, MD	P		Large laceration on dorsal surface
8/30/02	serious injury	age & sex unknown #3210	Bay of Fundy, NS		P	Line tightly wrapped around rostrum; resighted in 2004 in poor condition; no gear recovered
1/14/03	serious injury	Adult Female #2240	Jacksonville, FL		P	Body condition poor; no gear recovered
10/02/03	mortality	Adult Female #2150 15m (est)	Digby, NS	P		Large fracture in skull; subdermal hemorrhage
2/7/04	mortality	Adult Female #1004 16m	Virginia Beach, VA	P		Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete
9/6/04	mortality	Adult Female #2301 15m (est)	Roseway Basin, NS		P	Extensive constricting line on head and left flipper; found dead March 3, 2005 on Ship Shoal Island, VA
11/24/04	mortality	Adult Female #1909 14.9m	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed
1/12/05	mortality	Adult Female #2143 13m	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
3/10/05	serious injury	age & sex unknown #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
4/28/05	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures
1/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
1/16/06	serious injury	Calf 5m (est)	Corpus Christi Bay, TX		P	Wrapping laceration with heavy cyamid load on dorsal surface of calf; vertebral processes noticeable indicating fat loss

Date	Type	Animal	Location			Description
1/22/06	mortality	Calf 5.6m	off Ponte Vedra Beach, FL		P	Significant pre-mortem lesions from entanglement in apparent monofilament netting
3/11/06	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface
7/24/06	mortality	age unknown Female 9.6m	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs
8/24/06	mortality	Adult Female 14.7m	Roseway Basin, NS	P		16 fractured vertebrae; dorsal blubber bruise from head to genital region
12/30/06	mortality	Yearling Male #3508 12.6m	off Brunswick, GA	P		20 propeller lacerations along right side of head and back with associated hemorrhaging

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

b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

STATUS OF STOCK

The size of this stock is considered to be extremely low relative to OSP in the U.S. Atlantic EEZ, and this species is listed as endangered under the ESA. The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999). A Recovery Plan has been published for the North Atlantic right whale and is in effect (NMFS [National Marine Fisheries Service] 2005). 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). A National Marine Fisheries Service ESA status review in 1996 concluded that the western North Atlantic population remains endangered. This conclusion was reinforced by the International Whaling Commission (Best *et al.* 2001), which expressed grave concern regarding the status of this stock. Relative to populations of southern right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in this population. The total level of human-caused mortality and serious injury is unknown, but reported human-caused mortality and serious injury was a minimum of 3.8 right whales per year from 2002 through 2006. Given that PBR has been set to zero, no mortality or serious injury for this stock can be considered insignificant. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the North Atlantic right whale is an endangered species.

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HUMPBACK WHALE (*Megaptera novaeangliae*):
Gulf of Maine Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

In the western North Atlantic, humpback whales feed during spring, summer and fall over a geographic range encompassing the eastern coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990). Other North Atlantic feeding grounds occur off Iceland and northern Norway, including off Bear Island and Jan Mayen (Christensen *et al.* 1992; Palsbøll *et al.* 1997). These six regions represent relatively discrete subpopulations, fidelity to which is determined matrilineally (Clapham and Mayo 1987). Genetic analysis of mitochondrial DNA (mtDNA) has indicated that this fidelity has persisted over an evolutionary timescale in at least the Icelandic and Norwegian feeding grounds (Palsbøll *et al.* 1995; Larsen *et al.* 1996). Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes (Waring *et al.* 1999). Indeed, earlier genetic analyses (Palsbøll *et al.* 1995), based upon relatively small sample sizes, had failed to discriminate among the four western North Atlantic feeding areas. However, genetic analyses often reflect a timescale of thousands of years, well beyond those commonly used by managers. Accordingly, the decision was made to reclassify the Gulf of Maine as a separate feeding stock; this was based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. This reclassification has subsequently been supported by new genetic analyses based upon a much larger collection of samples than those

Figure 1. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth*

utilized by Palsbøll *et al.* (1995). These analyses have found significant differences in mtDNA haplotype frequencies among whales sampled in four western feeding areas, including the Gulf of Maine (Palsbøll *et al.* 2001). During the 2002 Comprehensive Assessment of North Atlantic humpback whales, the International Whaling Commission acknowledged the evidence for treating the Gulf of Maine as a separate management unit (IWC 2002).

During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf to establish the occurrence and population identity of the animals found in this region, which lies between the well-studied populations of the Gulf of Maine and Newfoundland. Photographs from both surveys have now been compared to the overall North Atlantic Humpback Whale Catalogue and a large regional catalogue from the Gulf of Maine (maintained by the College of the Atlantic and the Center for Coastal Studies, respectively); this work is summarized in Clapham *et al.* (2003). The match rate between the Scotian Shelf and the Gulf of Maine was 27% (14 of 52 Scotian Shelf individuals from both years). Comparable rates of exchange were obtained from the southern (28%, n=10 of 36 whales) and northern (27%, *n*=4 of 15 whales) ends of the Scotian Shelf, despite the additional distance of nearly 100 nautical miles (one whale was observed in both areas). In contrast, all (36 of 36) humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine

(including Georges Bank, southwestern Nova Scotia and the Bay of Fundy) had been previously observed in the Gulf of Maine region. The sighting histories of the 14 Scotian Shelf whales matched to the Gulf of Maine suggested that many of them were transient through the latter area. There were no matches between the Scotian Shelf and any North Atlantic feeding ground, except the Gulf of Maine; however, instructive comparisons are compromised by the often low sampling effort in other regions in recent years. Overall, it appears that the northern range of many members of the Gulf of Maine stock does not extend onto the Scotian Shelf.

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

Not all whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported 38 humpback whale strandings 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; in addition, the small size of many of these whales strongly suggested that they had only recently separated from their mothers. Wiley *et al.* (1995) concluded that these areas were becoming an increasingly important habitat for juvenile humpback whales and that anthropogenic factors may negatively impact whales in this area. There have also been a number of wintertime humpback sightings in coastal waters of the southeastern U.S. (NMFS unpublished data; New England Aquarium unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is unknown.

A key question with regard to humpback whales off the southeastern and mid-Atlantic states is their population identity. This topic was investigated using fluke photographs of living and dead whales observed in the region (Barco *et al.* 2002). In this study, photographs of 40 whales (alive or dead) were of sufficient quality to be compared to catalogs from the Gulf of Maine (the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (42.9%) matched to the Gulf of Maine, 4 (19.0%) to Newfoundland and 1 (4.8%) to the Gulf of St Lawrence. Of 19 dead humpbacks, 6 (31.6%) were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of recent photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region. Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks for more than one purpose.

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al.* 1986; 1990). Humpback whales are frequently piscivorous when in New England waters, feeding on herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes. In the northern Gulf of Maine, euphausiids are also frequently taken (Paquet *et al.* 1997). Commercial depletion of herring and mackerel led to an increase in sand lance in the southwestern Gulf of Maine in the mid 1970s with a concurrent decrease in humpback whale abundance in the northern Gulf of Maine. Humpback whales were densest over the sandy shoals in the southwestern Gulf of Maine favored by the sand lance during much of the late 1970s and early 1980s, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the mid 1980s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased markedly during 1992-1993, along with a major influx of herring (P. Stevick, pers. comm.). Humpback whales were few in nearshore Massachusetts waters in the 1992-1993 summer seasons. They were more abundant in the offshore waters of Cultivator Shoal and on the Northeast Peak on Georges Bank and on Jeffreys Ledge; these latter areas are traditional locations of herring occurrence. In 1996 and 1997, sand lance and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly

continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Center for Coastal Studies and College of the Atlantic).

In early 1992, a major research program known as the Years of the North Atlantic Humpback (YONAH) (Smith *et al.* 1999) was initiated. This was a large-scale, intensive study of humpback whales throughout almost their entire North Atlantic range, from the West Indies to the Arctic. During two primary years of field work, photographs for individual identification and biopsy samples for genetic analysis were collected from summer feeding areas and from the breeding grounds in the West Indies. Additional samples were collected from certain areas in other years. Results pertaining to the estimation of abundance and to genetic population structure are summarized below.

POPULATION SIZE

North Atlantic Population
The overall North Atlantic population (including the Gulf of Maine), derived from genetic tagging data collected by the YONAH project on the breeding grounds, was estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Palsbøll *et al.* 1997). Because the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed a result of sampling bias, lower rates of migration among females, or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size. Photographic mark-recapture analyses from the YONAH project provided an ocean-basin-wide estimate of 11,570 animals during 1992/1993 (CV=0.068, Stevick *et al.* 2003), and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (CV=0.138, 95% CI=8,000 to 13,600) (Smith *et al.* 1999). In the northeastern North Atlantic, Øien (2001) estimated from sighting survey data that there were 889 (CV=0.32) humpback whales in the Barents and Norwegian Seas region.

Gulf of Maine stock - earlier estimates
Estimating abundance for the Gulf of Maine stock has proved problematic. Three approaches have been investigated: mark-recapture estimates, minimum population size from photo-ids, and line-transect sample estimates. Most of the mark-recapture estimates were affected by heterogeneity of sampling, which was heavily focused on the southwestern Gulf of Maine. However, an estimate of 652 (CV=0.29) derived from the more extensive and representative YONAH sampling in 1992 and 1993 is probably less subject to this bias.

The minimum population size approach used photo-identification data to estimate the minimum number of humpback whales known to be alive in a particular year, 1997. By determining the number of identified individuals seen either in that year, or in both a previous and subsequent year, it is possible to determine that at least 497 humpbacks were alive in 1997. This figure is also likely to be negatively biased, again because of heterogeneity of sampling. A similar calculation for 1992 (which would correspond to the YONAH estimate for the Gulf of Maine) yields a figure of 501 whales.

In 1999 a line-transect sighting survey was conducted from 28 July to 31 August by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212 km. However, in light of the information on stock identity of Scotian Shelf humpback whales noted above, only the portions of the survey covering the Gulf of Maine were used; surveys blocks along the eastern coast of Nova Scotia were excluded. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000; Clapham *et al.* 2003). These surveys yielded an estimate of 816 humpbacks (CV=0.45). However, given that the rate of exchange between the Gulf of Maine and both the Scotian Shelf and mid-Atlantic region is not zero, this estimate is likely to be conservative. Accordingly, inclusion of data from 25% of the Scotian Shelf survey area (to reflect the match rate of 25% between the Scotian Shelf and the Gulf of Maine) gives an estimate of 902 whales (CV=0.41). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, and should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

Gulf of Maine Stock - Recent surveys and abundance estimates
An abundance estimate of 521 (CV=0.67) humpback whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was

derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 359 (CV=0.75) humpback whales was obtained from a line-transect sighting survey conducted from 12 June to 4 August 2004 by a ship and plane. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100 m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

An abundance estimate of 847 animals (CV=0.55) was derived from a line-transect sighting survey conducted during August 2006 which covered 10,676 km of trackline from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the Gulf of St. Lawrence. (Table 1; Palka pers. comm.) Because the Scotian shelf was surveyed in only 2006, the 25% correction factor (described above) was applied to only the 2006 abundance estimate.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Gulf of Maine humpback whales is 847 animals (CV=0.55). The minimum population estimate for this stock is 549 animals.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales.			
Month/Year	**Type**	**N**	**CV**
Aug 2002	S. Gulf of Maine to Maine	521	0.67
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	359	0.75
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	847	0.55

Current Population Trend

As detailed below, current data suggest that the Gulf of Maine humpback whale stock is steadily increasing in size. This is consistent with an estimated average trend of 3.1% (SE=0.005) in the North Atlantic population overall for the period 1979-1993 (Stevick *et al.* 2003), although there are no feeding-area-specific estimates.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Barlow and Clapham (1997) applying an interbirth interval model to photographic mark-recapture data, estimated the population growth rate of the Gulf of Maine humpback whale stock at 6.5% (CV=0.012). Maximum net productivity is unknown for this population, although a theoretical maximum for any humpback population can be calculated using known values for biological parameters (Brandão *et al.* 2000; Clapham *et al.* 2001). For the Gulf of Maine stock, data supplied by Barlow and Clapham (1997) and Clapham *et al.* (1995) give values of 0.96 for survival rate, 6 years as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate. From this, a maximum population growth rate of 0.072 is obtained according to the method described by Brandão *et al.* (2000). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) is close to the maximum for this stock.

Clapham *et al.* (2003) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The population growth estimate was either 0% (for a calf survival rate of 0.51) or 4.0% (for a calf survival rate of 0.875). Although confidence limits were not provided (because maturation parameters could not be estimated), both estimates of population growth rate are outside the 95% confidence intervals of the previous estimate of 6.5% for the period 1979 to 1991 (Barlow and Clapham 1997). It is unclear whether this apparent decline is an artifact resulting from a shift in distribution; indeed, such a shift occurred during exactly the period (1992-1995) in which survival rates declined. It is possible that this shift resulted in calves born in those years imprinting on (and thus subsequently returning to) areas other than those in which intensive sampling occurred. If the decline is real, it may be related to known high mortality among young-of-the-year whales in the waters off the

U.S. mid-Atlantic states. However, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth.

In light of the uncertainty accompanying the more recent estimates of population growth rate for the Gulf of Maine stock, the maximum net productivity rate was assumed to be the default value of 0.04 for cetaceans (Barlow *et al.* 1995).

Current and maximum net productivity rates are unknown for the North Atlantic population overall. As noted above, Stevick *et al.* (2003) calculated an average population growth rate of 3.1% (SE=0.005) for the period 1979-1993.

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Gulf of Maine stock is 549 whales. The maximum productivity rate is the default value of 0.04. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the Gulf of Maine humpback whale stock is 1.1 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2002 through 2006, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 4.4 animals per year (U.S. waters, 4.0; Canadian waters, 0.4). This value includes incidental fishery interaction records, 3.0 (U.S. waters, 2.6; Canadian waters, 0.4); and records of vessel collisions, 1.4 (U.S. waters, 1.4; Canadian waters, 0) (Glass *et al.* 2008).

In contrast to stock assessment reports before 2007, these averages include humpback mortalities and serious injuries that occurred in the southeastern and mid-Atlantic states that could not be confirmed as involving members of the Gulf of Maine stock. In past reports, only events involving whales confirmed to be members of the Gulf of Maine stock were counted against the PBR. Starting in the 2007 report, we assumed whales were from the Gulf of Maine unless they were identified as members of another stock. At the time of this writing, no whale was identified as a member of another stock. These determinations may change with the availability of new information. Canadian records were incorporated into the mortality and serious injury rates, to reflect the effective range of this stock as described above. For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.

Serious injury was defined in 50 CFR part 229.2 as an injury that is likely to lead to mortality. We therefore limited serious injury designations to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death. Determinations of serious injury were made on a case-by-case basis following recommendations from the workshop conducted in 1997 on differentiating serious and non-serious injuries (Angliss and DeMaster 1998). Injuries that impeded a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury might increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. For these reasons, the human impacts listed in this report represent a minimum estimate.

To better assess human impacts (both vessel collision and gear entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are significant human impacts beyond those recorded in the fishery observer data. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements (Robbins and Mattila 2001). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts.

Background

As with right whales, human impacts (vessel collisions and entanglements) may be slowing recovery of the humpback whale population. Of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition

did not preclude examination for human impacts), Wiley *et al.* (1995) reported that 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 suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al.* (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region was produced by Barco *et al.* (2002). Between 1990 and 2000, there were 52 known humpback whale mortalities in the waters of the U.S. mid-Atlantic states. Inspection of length data from 48 of these whales (18 females, 22 males, and 8 of unknown sex) suggested that 39 (81.2%) were first-year animals, 7 (14.6%) were immature and 2 (4.2%) were adults. However, sighting histories of five of the dead whales indicate that some were small for their age, and histories of live whales further indicate that the proportion of mature whales in the mid-Atlantic may be higher than suggested by the stranded sample.

Robbins and Mattila (2001) reported that males were more likely to be entangled than females. Their scarring data suggested that yearlings were more likely than other age classes to be involved in entanglements. Finally, female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting that entanglement may significantly impact reproductive success.

Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of interactions 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) was reported annually between 1979 and 1988, and 12 of 66 humpback whales entangled in 1988 died (Lien *et al.* 1988). Two humpbacks were reported entangled in fishing gear in Newfoundland and Labrador waters in 2005. One towed away the gear and was not re-sighted, and the other was released alive (Ledwell and Huntington 2006). Eighty-four humpbacks were reported entangled in fishing gear in Newfoundland and Labrador from 2000 to 2006 (W. Ledwell, pers. comm.). Volgenau *et al.* (1995) reported 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 were the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

Disturbance by whale watching may be an important issue in some areas of the population's range, notably the coastal waters of New England where the density of whale watching traffic is seasonally high. However, no studies have been conducted to address this question.

As reported by Wiley *et al.* (1995), injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 2002 through 2006, 9 records had some evidence of a collision with a vessel. Of these, 7 were mortalities as a result of the collision. No whale involved in the recorded vessel collisions had been identified as a member of a stock other than the Gulf of Maine stock at the time of this writing (Glass *et al.* 2008).

Fishery-Related Serious Injuries and Mortalities

A description of Fisheries is provided in Appendix III. Two mortalities were observed in the pelagic drift gillnet fishery, one in 1993 and the other in 1995. In winter 1993, a juvenile humpback was observed entangled and dead in a pelagic drift gillnet along the 200-m isobath northeast of Cape Hatteras. In early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank. 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 NMFS. A number of these records (11 entanglements involving lobster pot/trap gear) from the 1990-1994 period were the basis used to reclassify the lobster fishery (62 FR 33, Jan. 2, 1997).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period 2002 through 2006 were reviewed. Humpbacks were involved in 162 reported events. Of these, 70 of the 79 reported entanglements could be confirmed (Glass *et al.* 2008). Entanglements accounted for eight mortalities and six serious injuries. With no evidence to the contrary, all events were assumed to involve members of the Gulf of Maine stock. While these records are not statistically quantifiable in the same way as observer fishery records, they provide some indication of the frequency of entanglements.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2002 - December 2006. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock. This is in contrast to prior reports (Glass *et al.* 2008).

Date[a]	Report Type[b]	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
2/08/02	mortality	Juvenile Female 8.4m	off Cape Henry, VA	P		3 large lacerations; hemorrhaging; broken bones
3/24/02	mortality	Juvenile Male 8.0m	off Virginia Beach, VA		P	Deep cuts on caudal peduncle and tail indicative of embedded line; no gear recovered
6/03/02	mortality	age & sex unknown 9.9m	off Cape Elizabeth, ME		P	Deep cuts on caudal peduncle indicative of embedded line; state water lobster fishery
6/17/02	serious injury	age & sex unknown 10.2m (est)	Cape Cod, MA		P	Fluke severely damaged by line; whale emaciated
8/01/02	mortality	Yearling Male 9.3m	Long Island, NY	P		Large hematoma posterior to blow holes
10/01/02	mortality	Calf Female 7.5m	Plymouth, MA		P	Found wrapped in line; extensive bruising; no gear recovered
6/06/03	mortality	Juvenile Female 8.3m	Chesapeake Bay mouth, VA	P		Major trauma to right side of head; hematoma
7/09/03	serious injury	Calf of Shockwave sex unknown	Bay of Fundy, NS		P	Constricting entanglement on a young whale; no gear recovered
7/12/03	serious injury	age & sex unknown	Oregon Inlet, NC		P	Entangled in substantial amount of gear; no gear recovered

8/15/03	mortality	Calf sex unknown 7.3m (est)	Petit Manan Island, ME		P	Floating offshore wrapped in line
8/16/03	serious injury	age & sex unknown	Cape Cod, MA		P	Poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system, surface buoy system and endline
8/18/03	serious injury	age & sex unknown	Cape Cod, MA		P	Extensive entanglement; no gear recovered
7/11/04	serious injury	Juvenile sex unknown "Lucky"	Briar Island, NS		P	Entanglement on a young whale
10/03/04	mortality	age unknown Male 15m (est)	Georges Bank		P	Fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	Calf Female 8.0m	Bethany Beach, DE	P		Hematoma and skeletal fracturing
1/09/06	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
3/17/06	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
3/25/06	serious injury	Juvenile sex unknown 8m (est)	Flagler Beach, FL		P	Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys

8/06/06	serious injury	age & sex unknown	Georges Bank		P	Multiple constricting wraps around head; line cutting into upper lip; wraps around both flippers; no gear recovered
8/20/06	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth continuing back to multiple wraps around peduncle. Resighted 9/6/06
8/23/06	serious injury	age & sex unknown 12m (est)	Great South Channel		P	Flukes necrotic and nearly severed as a result of entanglement; pale skin and emaciated; gear recovered included heavy line and wire trap
10/15/06	mortality	Juvenile Female 10.1 m	off Fenwick Island, DE	P	S	Large laceration, penetrating through the bone, across rostrum with accompanying fractures; no gear, but marks around right flipper consistent with entanglement; subdermal hemorrhaging and bone trauma at entanglement point

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989). The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other unrecorded mortalities occurred during this event. 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 concern.

In July 2003, an Unusual Mortality Event was recorded in offshore waters when an estimated minimum of 12-15 humpback whales died in the vicinity of the Northeast Peak of Georges Bank. Preliminary tests of samples taken from some of these whales were positive for domoic acid at low levels, but it is currently unknown what levels would affect the whales and therefore no definitive conclusions can yet be drawn regarding the cause of this event or its effect on the status of the Gulf of Maine humpback whale population. Seven humpback whales were considered part of a large whale UME in New England in 2005. Twenty-one dead humpback whales found between 10 July and 31 December 2006 triggered a humpback whale UME declaration, still considered ongoing at the end of 2006. Causes of these UME events have not been determined.

STATUS OF STOCK

The status of the North Atlantic humpback whale population was the topic of an International Whaling Commission Comprehensive Assessment in June 2001, and again in May 2002. These meetings conducted a

detailed review of all aspects of the population and made recommendations for further research (IWC 2002). Although recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the U.S. Atlantic EEZ. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). There are insufficient data to reliably determine current population trends for humpback whales in the North Atlantic overall. The average annual rate of population increase was estimated at 3.1% (SE=0.005, Stevick *et al.* 2003). As noted above, an analysis of demographic parameters for the Gulf of Maine (Clapham *et al.* 2003) suggested a lower rate of increase than the 6.5% reported by Barlow and Clapham (1997), but results may have been confounded by distribution shifts. The total level of U.S. fishery-caused mortality and serious injury is unknown, but reported levels are more than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant or approaching zero mortality and serious injury rate. In particular, the continued high level of mortality among humpback whales off the U.S. mid-Atlantic states (Barco *et al.* 2002) is a concern given that many of these animals are known to be from the Gulf of Maine. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, <u>and</u> because the North Atlantic humpback whale is an endangered species.

As part of a large-scale assessment called More of North Atlantic Humpbacks (MoNAH) project, extensive sampling was conducted on humpbacks in the Gulf of Maine/Scotian Shelf region and the primary wintering ground on Silver Bank during 2004-2005. These data are being analyzed along with additional data from the U.S. mid-Atlantic to estimate abundance and refine knowledge of the North Atlantic humpback whales' population structure. The work is intended to update the YONAH assessment in preparation for a possible status review under the Endangered Species Act.

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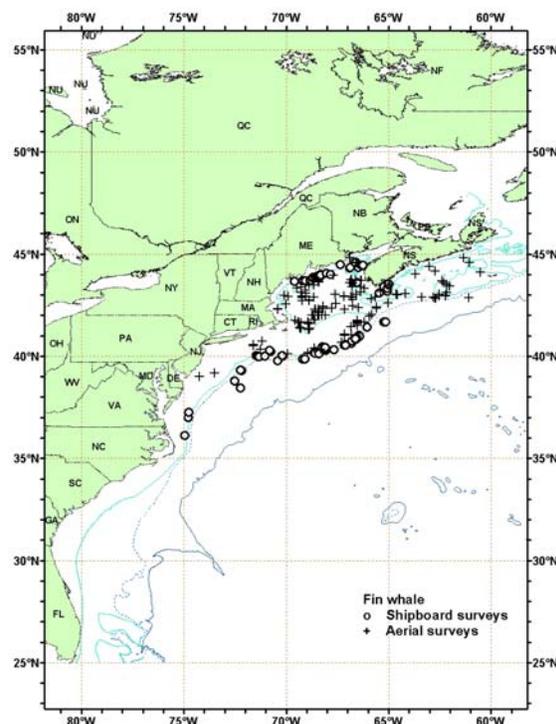## Western North Atlantic Stock

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

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

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 much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are probably the dominant large cetacean species during all seasons, having the largest standing stock, the largest

Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Hain *et al.* 1992; Kenney *et al.* 1997).

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

fin whales were taken at three whaling stations. The station at Blandford, Nova Scotia, took 1,402 fin whales.

Hain *et al.* (1992), based on an analysis of neonate stranding data, suggested that calving takes place during October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occurs for most of the population. Results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean distribution of fin whales. It is likely that fin whales occurring in the U. S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support in the data; in the North Pacific, year-round monitoring of fin whale calls found no evidence for large-scale migratory movements (Watkins *et al.* 2000).

POPULATION SIZE

The best abundance estimate available for the western North Atlantic fin whale stock is 2,269 (CV= 0.37). This August 2006 estimate is recent and provides an estimate when the largest portion of the population was within the study area. However, this estimate must be considered extremely conservative in view of the incomplete coverage of the known habitat of the stock and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas. Estimates for animals identified as fin whales were calculated separately from animals identified as either fin or sei whales. The final estimate of fin whales was the sum of the estimate of animals identified as fin whales plus a proportion of the estimate of animals identified as fin or sei whales, where the proportion was defined as the percent of fin whales out of the total number of positively identified fin whales and sei whales.

Earlier abundance estimates

An abundance of 2,200 (CV=0.24) fin whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane. The survey covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 1995).

An estimate of abundance of 2,814 (CV=0.21) fin whales was derived from a 28 July to 31 August 1999 line-transect sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, and should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

Recent surveys and abundance estimates

An abundance estimate of 2,933 (CV=0.49) fin whales was obtained from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 1,925 (CV=0.55) fin whales was derived from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance of 2,269 (CV=0.37) fin whales was estimated from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; Palka pers. comm.). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

Table 1. Summary of recent abundance estimates for western North Atlantic fin 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
Aug 2002	S. Gulf of Maine to Maine	2,933	0.49
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	1,925	0.55
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,269	0.37

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 2,269 (CV=0.37). The minimum population estimate for the western North Atlantic fin whale is 1,678.

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. Based on photographically identified fin whales, Agler *et al.* (1993) estimated that the gross annual reproduction rate was at 8%, with a mean calving interval of 2.7 years.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,678. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or 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

For the period 2002 through 2006, the minimum annual rate of human-caused mortality and serious injury to fin whales was 2.0 per year (U.S. waters, 1.6; Canadian waters, 0.4). This value includes incidental fishery interaction records, 0.8 (U.S. waters, 0.8; Canadian waters, 0); and records of vessel collisions, 1.2 (U.S. waters, 0.8; Canadian waters, 0.4) (Glass *et al.* 2008). No fishery-related mortality or serious injury to fin whales was observed by NMFS fishery observers during 2002 through 2006.

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related mortalities or serious injuries of fin whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured fin whales for the period 2002 through 2006 on file at NMFS found two records with substantial evidence of fishery interactions causing mortality, and two records resulting in serious injury (Table 2), which results in an annual rate of serious injury and mortality of 0.8 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observer fishery records, they give a minimum count of entanglements for the species. In addition to the records above, there are were four additional records of entanglement within the period that either lacked substantial

evidence for a serious injury determination, or did not provide the detail necessary to determine if an entanglement had been a contributing factor in the mortality.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
7/28/02	mortality	age & sex unknown	Georges Bank		P	Heavy line seen on tail stock; appeared embedded; no gear recovered
2/12/04	serious injury	age & sex unknown	Pea Island, NC		P	Entangled whale noticeably emaciated; no gear recovered
2/25/04	mortality	Adult Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae; ruptured aorta
6/30/04	mortality	age & sex unknown 12m (est)	Georges Bank		P	Freshly dead; heavy line constricting mid-section; no gear recovered
9/26/04	mortality	age & sex unknown 15m (est)	St. Johns, NB	P		Fresh carcass on bow of ship
3/26/05	mortality	Adult[c] Female 16.3m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/05	mortality	Adult[c] Female 18.8m	Southampton, NY	P		Subdermal hemorrhaging
8/23/05	mortality	Juvenile[c] Male 13.7m	Port Elizabeth, NJ	P		Brought in on bow of ship
9/11/05	mortality	Juvenile[c] Male 11 m	Bonne Esperance, QC	P		Bottom jaw completely severed/broken
9/17/06	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME		P	Pale skin overall; cyamid load at point of attachment; emaciated

Table 2. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January 2002 - December 2006.

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. The gender and length were misreported in the 2006 Stock Assessment Report. This table shows the correct values.

Other Mortality

After reviewing NMFS records for 2002 through 2006, six were found that had sufficient information to confirm the cause of death as collisions with vessels (Table 2) (Glass *et al.* 2008). These records constitute an annual rate of serious injury or mortality of 1.2 fin whales from vessel collisions. NMFS data include three additional records of fin whale collisions with vessels, but the available supporting documentation is insufficient to determine if the whales sustained mortal injuries from the encounters. The number of fin whales taken at 3 whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974). Reports of non-directed takes of fin whales are fewer over the last two decades than for other endangered large whales such as right and humpback whales.

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 trend for fin whales. The total level of human-caused mortality and serious injury is unknown. NMFS records represent coverage of only a portion of the area surveyed for the population estimate for the stock. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the fin whale is listed as an endangered species under the ESA. A Draft Recovery Plan for fin whales has been prepared and is available for review (NMFS 2006).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Mitchell and Chapman (1977) reviewed the sparse evidence on stock identity of northwest Atlantic sei whales, and suggested two stocks - a Nova Scotia stock and a Labrador Sea stock. The range of the Nova Scotia stock includes the continental shelf waters of the northeastern 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, and the "Nova Scotia stock" is used here as the management unit for this stock assessment. The IWC boundaries for this stock are from the U.S. east coast to Cape Breton, Nova Scotia, thence east to longitude 42° W.

Indications are that, at least during the feeding season, a major portion of the Nova Scotia sei whale stock 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 spring, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys in 1999, 2000 and 2001 found concentrations of sei and right whales along the Northern Edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain *et al.* 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975) reported that sei whales off Nova Scotia were often distributed closer to the 2,000 m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn *et al.*

Figure 1. *Distribution of sei whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

2002). In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al.* 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling *et al.* 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide (Jonsgård and Darling 1977).

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.

POPULATION SIZE

The total number of sei whales in the U.S. Atlantic EEZ is unknown. However, five abundance estimates are available for portions of the sei whale habitat: from Nova Scotia during the 1970s, in the U.S. Atlantic EEZ during the springs of 1979-1981, and in the U.S. and Canadian Atlantic EEZ during the summers of 2002, 2004, and 2006. The August 2006 abundance estimate (207 CV=0.62) is considered the best available for the Nova Scotia stock of sei whales because it is the most recent. However, this estimate must be considered extremely conservative in view of the known range of the sei whale in the entire western North Atlantic, and the uncertainties regarding population structure and whale movements between
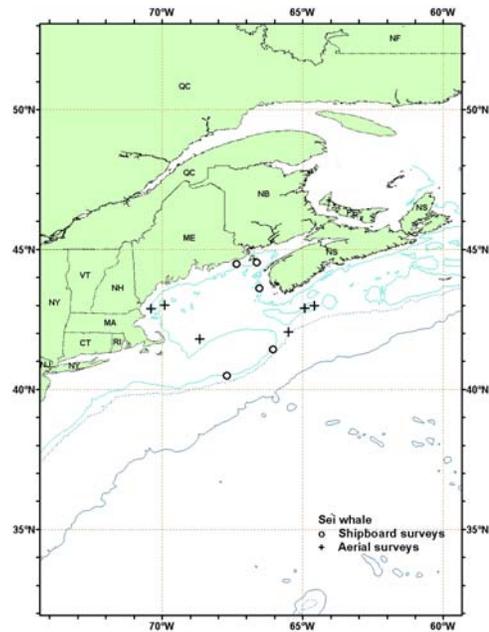
surveyed and unsurveyed areas. Estimates for animals identified as sei whales were generated independently from estimates of animals identified as either fin or sei whale. The final estimate of sei whales was the sum of the estimate of animals identified as sei whales and a portion of the estimate of animals identified as fin or sei whales, where the portion was defined as the percent of sei whales out of the total number of positively identified fin whales and sei whales.

Earlier abundance estimates

(Mitchell and Chapman 1977), based on tag-recapture data, estimated the Nova Scotia, Canada, stock to contain between 1,393 and 2,248 sei whales. Based on census data, they estimated a minimum Nova Scotian population of 870 sei whales. An abundance estimate of 280 sei whales was generated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). 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 for $g(0)$, the probability of detecting an animal group on the track line. The CETAP report suggested, however, that correcting the estimated abundance for dive time would increase the estimate to approximately the same as Mitchell and Chapman's (1977) tag-recapture estimate. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 71 (CV=1.01) sei whales was obtained from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of $g(0)$ used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 386 (CV=0.85) sei whales was derived from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN)(Table 1; Palka 2006). Of this, 6,180 km of trackline was within known sei whale habitat, from the 100 m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed. Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the trackline. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 207 (CV=0.62) sei whales was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

Table 1. Summary of recent abundance estimates for Nova Scotia sei 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
Aug 2002	S. Gulf of Maine to Maine	71	1.01
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	386	0.85
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	207	0.62

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 sei whales is 207 (CV=0.62). The minimum population estimate for the Nova Scotia stock of the sei whale is 128.

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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 128. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sei whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Nova Scotia stock of the sei whale is 0.3.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2002 through 2006, the minimum annual rate of human-caused mortality and serious injury to sei whales was 0.6 per year. This value includes incidental fishery interaction records, 0.2, and records of vessel collisions, 0.4 (Glass *et al.* 2008). The first ship-strike record within the period was an 11-meter male discovered 19 February 2003, outside of Norfolk Naval Base in Norfolk, Virginia. A large gash into muscle tissue extended from behind dorsal midline on left side almost all the way around to the ventral midline on the right sides through blubber layer and into some muscle. Histopathology results supported perimortem trauma. Another ship-strike mortality was reported when a fresh sei whale carcass was brought in on the bow of a ship 17 April 2006 to Baltimore, Maryland. The fishery entanglement serious injury was discovered on Jeffreys Ledge on 16 September 2006. Previous NMFS records of human-caused sei whale mortalities include one from 17 November 1994, when a sei whale carcass was observed on the bow of a container ship as it docked in Boston, Massachusetts, and one from 2 May 2001 when the carcass of a 13-meter female sei whale slid off the bow of a ship arriving in New York harbor.

Fishery Information

No confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured sei whales for the period 2002 through 2006 on file at NMFS found one record with substantial evidence of fishery interactions causing serious injury (Table 2), which results in an annual rate of serious injury and mortality of 0.2 sei whales from fishery interactions. While these records are not statistically quantifiable in the same way as the observer fishery records, they give a minimum count of entanglements for the species.

Table 2. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2002- 2006.						
Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
2/19/03	mortality	age unknown Male 11.0m	Norfolk, VA	P		Large gash into muscle, hematoma and abrasions
4/17/06	mortality	Juvenile Male 10.9m	Baltimore, MD	P		Brought in on bow of ship, freshly dead; massive hemorrhaging on right side; large blood clot behind head; several broken ribs

9/16/06	serious injury	age & sex unknown	Jeffreys Ledge		P	Constricting wrap cutting into skin; no gear recovered

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

b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

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 sei whales. The total level of U.S. fishery-caused mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the sei whale is listed as an endangered species under the ESA. A Recovery Plan for sei whales has been written and is awaiting legal clearance.

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

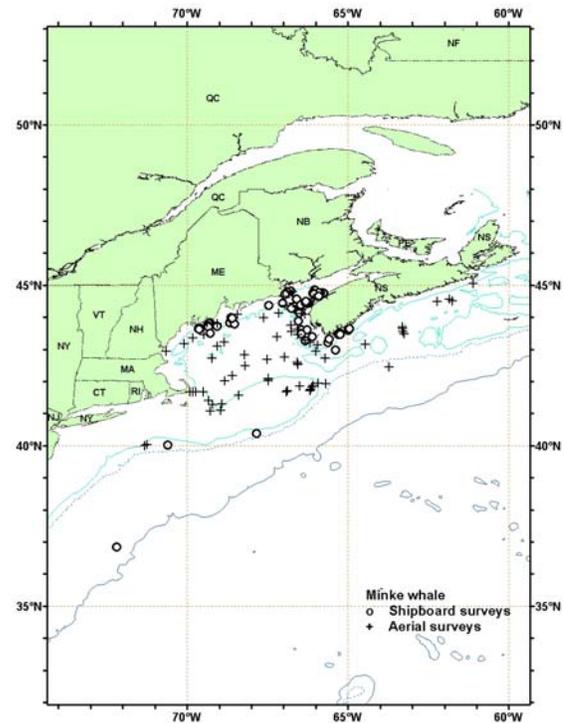### STOCK DEFINITION AND GEOGRAPHIC RANGE

Minke whales have a cosmopolitan distribution, being distributed 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 divisions were defined by examining segregation by sex and length, catch distributions, sightings, marking data and pre-existing ICES boundaries. However, there were very few data from the Canadian East Coast population.

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

The minke whale is common and widely distributed within the U.S. Atlantic Exclusive Economic Zone (EEZ) (CETAP 1982). There appears to be a strong seasonal component to minke whale distribution. Spring and summer are times of relatively widespread and common occurrence, and when the whales 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, minke whales generally occupy 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 the mid-ocean south and east of Bermuda. As with several other cetacean species, the possibility of a deep-ocean component to the distribution of minke whales exists but remains unconfirmed.

Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, ten estimates are available for portions of the habitat: a 1978-1982 estimate; a shipboard survey estimate from the summers of 1991 and 1992; a shipboard estimate from June and July 1993; an estimate made from a combination of shipboard and aerial surveys conducted during July to September 1995; an aerial survey estimate of the entire Gulf of St. Lawrence conducted in August to September 1995; an aerial survey estimate from the northern Gulf of St. Lawrence conducted during July and August 1996; an aerial/shipboard survey conducted from Georges Bank to the mouth of the Gulf of St. Lawrence during July and August 1999; and aerial surveys conducted during the summers of 2002, 2004, and 2006 (Table 1; Figure 1). The best available current abundance estimate for minke whales, 3,312 (CV=0.74), is obtained from the 2006 aerial survey because this survey is recent and covered the largest portion of the animal's habitat.

Earlier estimates

An abundance estimate of 320 minke whales (CV=0.23) was derived from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 2,650 (CV=0.31) minke whales was obtained 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. An abundance estimate of 330 minke whales (CV=0.66) was calculated 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 (NMFS 1993). An abundance estimate of 2,790 (CV=0.32) minke whales was obtained 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 (Palka 2006). Kingsley and Reeves (1998) estimated there were 1,020 (CV=0.27) minke whales in the entire Gulf of St. Lawrence in 1995 and 620 minke whales (CV=0.52) in the northern Gulf of St. Lawrence in 1996. During the 1995 survey, 8,427 km of track lines were flown in an area encompassing 221,949 km^2 in August - September. During the 1996 survey, 3,993 km of track lines were flown in an area encompassing 94,665 km^2 in July - August.

An abundance estimate of 2,998 (CV=0.19) minke whales was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1). Total track line length was 8,212 km. Using methods similar to the 1995 Virginia to Gulf of St. Lawrence survey, shipboard data were analyzed using the modified direct duplicate method that accounts for school size bias and *g(0)*. Aerial data were not corrected for *g(0)* (Palka 2000).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, and should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

Recent surveys and abundance estimates

An abundance estimate of 756 (CV=0.90) minke whales was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 600 (CV=0.61) minke whales was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed. (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 3,312 (CV=0.74) minke whales was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.).

Table 1. Summary of abundance estimates for the Canadian east coast stock of 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
Aug 2002	S. Gulf of Maine to Maine	756	0.90
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	600	0.61

Table 1. Summary of abundance estimates for the Canadian east coast stock of 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
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	3,312	0.74

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 3,312 animals (CV=0.74). The minimum population estimate for the Canadian East Coast minke whale is 1,899 animals.

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 are that females mature between 6 and 8 years of age, and pregnancy rates are approximately 0.86 to 0.93. Based on these parameters, the calving interval is between 1 and 2 years. Calves are probably born during October to March after 10 to 11 months gestation and nursing lasts for less than 6 months. Maximum ages are not known, but for Southern Hemisphere minke whales maximum age appears to be about 50 years (IWC 1991; Katona *et al.* 1993).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,899. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or 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 Canadian east coast minke whale is 19.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

Recent minke whale takes have been observed in—or attributed to—the Northeast bottom trawl, Northeast/mid-Atlantic lobster trap/pot, and unknown fisheries, although not all takes have resulted in mortalities (Tables 2 to 6).

Data to estimate the mortality and serious injury of minke whales come from the Northeast Fisheries Science Center Observer Program and from records of strandings and entanglements in U.S. waters. For the purposes of this report, only those strandings and entanglement records considered confirmed human-caused mortalities or serious injuries are shown in Tables 3 through 5.

During 2002 to 2006, the U.S. total annual estimated average human-caused mortality was 2.2 minke whales per year (CV=unknown), plus an unknown bycatch estimate from the Northeast bottom trawl fishery. This is derived from three components: an unknown number of minke whales per year from U.S. fisheries using observer data, 1.8 minke whales per year (unknown CV) from U.S. fisheries using strandings and entanglement data, and 0.4 minke whales per year from ship strikes (Glass *et al.* 2008). During 1997 to 2001, there were no confirmed mortalities or serious injuries in Canadian waters as reported by the various, small-scale stranding and observer data collection programs in Atlantic Canada. No additional information is available on Canadian mortalities from 2002 to present.

Fishery Information
    Detailed fishery information is reported in Appendix III.

Earlier Interactions
     Little information is available about fishery interactions that took place before the 1990s. Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976. A minke whale was caught and released alive in the Japanese tuna longline fishery in 3,000 m of water, south of Lydonia Canyon on Georges Bank, in September 1986 (Waring *et al.* 1990).
    Two minke whales were observed taken in the Northeast sink gillnet fishery between 1989 and the present. The take in July 1991, south of Penobscot Bay, Maine resulted in a mortality, and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge, was released alive.
    A minke whale was trapped and released alive from a herring weir off northern Maine in 1990.
    Four minke whale mortalities were observed in the Atlantic pelagic drift gillnet fishery during 1995.
    One minke whale was reported caught in an Atlantic tuna purse seine off Stellwagen Bank in 1991 (D. Beach, NMFS NE Regional Office, pers. comm.) and another in 1996. The minke caught during 1991 was released uninjured after a crew member cut the rope wrapped around the tail. The minke whale caught during 1996 escaped by diving beneath the net.
    One minke whale, reported in the strandings and entanglement database maintained by the New England Aquarium and the Northeast Regional Office/NMFS, was taken in a 6-inch gill net on 6 July 1998 off Long Island, New York. This take was assigned to the mid-Atlantic gillnet fishery. No other minke whales have been taken in this fishery during observed trips in 1993 to 2006.

U.S.
Northeast Bottom Trawl
    The fishery is active in New England waters in all seasons. Detailed fishery information is reported in Appendix III. One freshly dead minke whale was caught in 2004 on the northeast tip of Georges Bank in US waters (Table 2). An expanded bycatch estimate has not been generated. With only one observed take, it is not possible to obtain an accurate bycatch estimate.
Northeast/Mid-Atlantic Lobster Trap/Pot Fishery
    The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 7 minke whale mortalities and serious injuries that were attributed to the lobster fishery during 1990 to 1994; 1 in 1990 (may be serious injury), 2 in 1991 (1 mortality and 1 serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62FR33, 2 January 1997). The 1 confirmed minke whale mortality during 1995 was attributed to the lobster fishery. No confirmed mortalities or serious injuries of minke whales occurred in 1996. From the 4 confirmed 1997 records, 1 minke whale mortality was attributed to the lobster trap fishery. One minke whale was disentangled and released alive from lobster gear on 21 August 2002 (Table 4). One minke whale mortality was attributed to this fishery for 2002 (Tables 3 and 5). The 28 June 2003 mortality, while wrapped in lobster gear, cannot be confirmed to have become entangled in the area, and so is not attributed to the fishery. Annual mortalities due to this fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997, 0 in 1998 to 2001, 1 in 2002, and 0 in 2003 to 2006. Estimated average annual mortality related to this fishery during 2002 to 2006 was 0.2 minke whales per year (Table 3; 10/15/02 animal in Table 5).
Unknown Fisheries
    The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, include 36 records of minke whales within U.S. waters for 1975-1992. The gear include unspecified fishing nets, unspecified cables or lines, fish traps, weirs, seines, gillnets, and lobster gear. A review of these records is not complete. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock, which came ashore on the Jacksonville, Florida jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.).
    The audited NE Regional Office/NMFS entanglement/stranding database contains records of minke whales, of which the confirmed mortalities and serious injuries from the last five years are reported in Table 5. Mortalities (and serious injuries) that were likely a result of a fishery interaction with an unknown fishery include 3 (0) in 1997, 3 (0)

in 1999, 1 (1) in 2000, 2 (0) in 2001, 1 (0) in 2002, 5 (0) in 2003, 2 (0) in 2004, 0 (0) in 2005 and 0 (0) in 2006. Examination of minke entanglement records from 1997 indicates that 4 out of 4 confirmed records of mortality were likely a result of fishery interactions. One was attributed to the lobster pot fishery (see above), and three were not attributed to any particular fishery because the information from the entanglement event often did not contain the necessary details. Of the five mortalities in 1999, two were attributed to an unknown trawl fishery and three to some other fishery. Of the two interactions with an unknown fishery in 2000, one was a mortality and one was a serious injury. In 2001, the two confirmed fishery interactions were both from an unknown fishery. In 2002, there was one mortality in an unknown fishery. In 2003, 5 of 5 confirmed mortalities were due to interactions with an unknown fishery. In 2004, of the three confirmed mortalities, two were due to an interaction with an unknown fishery (Tables 3 and 5). In 2005 and 2006 there were no mortalities attributed to fishery interactions.

In general, an entangled or stranded cetacean could be an animal that is part of an expanded bycatch estimate from an observed fishery and thus it is not possible to know if an entangled or stranded animal is an additional mortality. During 1997 to 2003 and in 2005-2006, no minke whales were observed taken in any fishery observed by the NEFSC Observer Program, therefore, the strandings from those years in which mortalities were attributable to fishery interactions can be added into the human-caused mortality estimate. During 2002 to 2006, as determined from strandings and entanglement records, the estimated average annual mortality is 1.6 minke whales per year in unknown fisheries (Table 3).

CANADA

Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, in cod traps in Newfoundland, and in herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no minke whales were observed taken.

Herring Weirs

During 1980 to 1990, 15 of 17 minke whales were released alive from herring weirs in the Bay of Fundy. During January 1991 to September 2002, 26 minke whales were trapped in herring weirs in the Bay of Fundy. Of these 26, 1 died (H. Koopman, pers. comm.) and several (number unknown) were released alive and unharmed (A. Westgate, pers. comm.).

Other Fisheries

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

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

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

In 2005, four minke whales were reported entangled in fishing gear in Newfoundland and Labrador. Two (entangled in salmon net and mackerel trap gear) were released alive and two (involved with whelk pot and toad crab pot fisheries) were dead (Ledwell and Huntington 2006). A total of 26 minkes have been reported entangled in fishing gear in Newfoundland for 2000 to 2006 (W. Ledwell, pers. comm.)

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 CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Bottom Trawl	02-06	unk	Obs. Data	.01, .03, .04, .05, .06	0, 0, 1, 0, 0	unk[c]	unk[c]	unk[c]
Total								unk[c]

a) Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Science Center (NEFSC) Fisheries Observer Program.
b) Observer coverage for trawl fishery is measured in trips.
c) Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated..

Table 3. From strandings and entanglement data, summary of confirmed incidental mortalities and serious injuries of minke whales (*Balaenoptera acutorostrata*) by commercial fishery: includes years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), mortalities and serious injuries assigned to this fishery (Assigned Mortality), and mean annual mortality and serious injuries. See Table 4 for details. (NA=Not Available)

Fishery	Years	Vessels	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Northeast/Mid-Atlantic Lobster Trap/Pot	02-06	1997=6880 2000=7539 licenses	Entanglement & Strandings	1, 0, 0, 0, 0	0.2
Unknown Fisheries	02-06	NA	Entanglement & Strandings	1, 5, 2, 0, 0	1.6
TOTAL					1.8 (CV=unk)

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

Table 4. Summary of minke whales (*Balaenoptera acutorostrata*) released alive, by commercial fishery, years sampled (Years), ratio of observed mortalities recorded by on-board observers to the estimated mortality (Ratio), the number of observed animals released alive and injured (Injured), and the number of observed animals released alive and uninjured (Uninjured). (NA = Not Available)

Fishery	Years	Ratio	Injured	Uninjured
Lobster trap pot	None	NA	1[a]	0
Pelagic longline	02-06	0	0	1[b]

a. Minke whale disentangled and released alive from lobster gear by owner of gear on 21 August 2002 near Mount Desert Island, ME.
b. Minke whale released alive from pelagic longline gear in 2003.

Table 5. Summarized records of mortality and serious injury likely to result in mortality. Canadian East Coast stock of minke whales, January 2002 - December 2006. This listing includes only confirmed records related to U.S. commercial fisheries and/or ship strikes in U.S. waters. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date[a]	Report Type[b]	Age, Sex, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
7/17/02	mortality	Female, 4.6m (est)	Bar Harbor, ME		P	Unknown fishery; carcass had a rope scar on the peduncle with associated hemorrhaging; additional bruising around the epiglottis and larynx; no gear recovered
10/15/02	mortality	Female, 5.1m	Gloucester, MA		P	Lobster fishery; whale was entangled through the mouth and around the pectoral flippers; gear from state water lobster fishery was still on the whale
5/24/03	mortality	Adult Male, 7.6m	Gloucester, MA		P	Unknown fishery; line marks on head and dorsal fin; no line present; cut across back anterior to dorsal fin; no gear recovered
5/31/03	mortality	Juvenile Female 3.6m (est)	Martha's Vineyard, MA		P	Unknown fishery; whale stranded live wrapped in about 15 feet of 5.5 inch mesh netting, probably trawl gear
6/28/03	mortality	Yearling Male, 5.1m	Chatham, MA		P	Unknown fishery; wrapped in lobster gear
8/9/03	mortality	Juvenile Female, 3.5m (est)	Harwich, MA		P	Unknown fishery; hemorrhaging in areas with net marks on whale; no gear recovered

9/13/03	mortality	Juvenile Female, 6m (est)	Casco Bay, ME		P	Unknown fishery; freshly dead; external chaffing marks and belly slit open; no gear recovered
5/6/04	mortality	Adult Female, 7.7m	Martha's Vinyard, MA		P	Unknown fishery; constricting line marks on peduncle; indications of drowning from internal exam
6/1/04	mortality	Juvenile Female, 6.5m	Chatham, MA	P		Large area of subdermal hemorrhaging
7/19/04	mortality	Adult Female, 7.9m	Eastham, MA		P	Unknown fishery; extensive entanglement markings; no gear recovered
08/04[c]	mortality	age & sex unknown 4m (est)	Georges Bank		P	Bottom Otter Trawl: fresh dead, rigid, had to cut out of net, rope in mouth
5/23/05	mortality	Juvenile Male, 5.9m	Port Elizabeth, NJ	P		Ribs shattered; liver ruptured; evidence of internal hemorrhaging

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson *et al.* 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.
c. Additional record which was not included in previous reports

Other Mortality

Minke whales have been and continue to be 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 minke populations are presently still being harvested at low levels.

U.S.

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

During 1999 to 2003, no minke whale was confirmed struck by a ship. During 2004 and 2005, one minke whale mortality was attributed to ship strike in each year (Table 5). During 2006, no minke whale was confirmed struck by a ship. Thus, during 2002 to 2006, as determined from stranding and entanglement records, the estimated annual average was 0.4 minke whales per year struck by ships.

In October 2003, an Unusual Mortality Event was declared involving minke whales and harbor seals along the coast of Maine. Two of the seven criteria established to designate such an event were met by these species. Specifically, there was a marked increase in mortalities when compared with historical records, and the mortalities

were occurring in a localized area of the Maine coast. From 11 to 30 September 2003, nine minke whales were reported along the mid-coast to southern Maine. Results from analyses for biotoxins failed to show the presence of either saxitoxin or domoic acid (by ELISA and Receptor Binding Assay). Most whale carcasses that were examined appeared to be in good body condition immediately prior to death. Since October 2003, the number of minke whale stranding reports has returned to normal. There were two minke whale stranding mortalities in North Carolina in 2005 but in neither case could cause of death be attributed to human causes (Glass *et al.* 2008). There were 7 minke whale stranding mortalities reported along the US Atlantic coast in 2006. Three were in New Jersey, one in Massachusetts, one in Rhode Island, and two in the EEZ. One of the stranding mortalities from New Jersey was reported with signs of human interaction due to pieces of plastic found in the stomach.

CANADA

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

Whales and dolphins stranded between 1997 and 2006 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows (Table 6): 4 minke whales stranded in 1997 (1 in June and 3 in July), 0 documented strandings in 1998 to 2000, 1 in September 2001, 4 in 2002 (1 in July, 1 in August, and 2 in November), 2 in 2003 (1 in August and 1 in October), 0 in 2004, 3 in 2005 (1 in June and 2 in August), and 8 in 2006 (1in January, 2 in May, 1 in July, 1 in August, 1 in Nov (live) and 2 in December).

The Whale Release and Strandings program has reported nine minke whale stranding mortalities in Newfoundland and Labrador between 2001 and 2006 (Ledwell and Huntington 2001; 2002; 2003; 2004; 2006; 2007).

Table 6. Documented number of stranded minke whales along the Atlantic coast of Canada during 2002 to 2006 by year, according to records maintained by the Canadian Marine Animal Response Society and the Whale Release and Strandings Program.

Area	YEAR					
	2002	2003	2004	2005	2006	Total
Nova Scotia	4	2	0	3	8	17
Newfoundland and Labrador	1	1	2	1	1	6
Total	5	3	2	4	9	23

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). The total U.S. 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 human-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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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 (NMFS 1993; 1996).

Northern bottlenose whales are distributed in the North Atlantic from Nova Scotia to about 70º in the Davis Strait, along the east coast of Greenland to 77º 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). Wimmer and Whitehead (2004) identified individuals moving between several Scotian Shelf canyons more than 100 km from the Gully. Whitehead and Wimmer (2005) estimated a population of 163 animals (95% confidence interval 119-214), with no statistical significant population trend. These individuals are believed to be year-round residents and all age and sex classes are present (Gowans and Whitehead 1998; Gowans *et al.* 2000; Hooker *et al.* 2002). Mitchell and Kozicki (1975) reported stranding records in the Bay of Fundy and as far south as Rhode Island. Lucas and Hooker (2000) documented three stranded individuals on Sable Island, Nova Scotia, Canada.

Figure 1: *NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

Several genetic studies have been undertaken in the waters off Nova Scotia (Dalebout *et al.* 2001; Hooker *et al.* 2001a; Hooker *et al.* 2001b; Hooker *et al.* 2002; Dalebout *et al.* 2006). Dalebout *et al.* (2006) found distinct differences in the nuclear and mitochondrial markers for the small populations of bottlenose whales of the Gully, Labrador and Iceland. Stock definition is currently unknown for those individuals inhabiting/visiting U.S. waters.
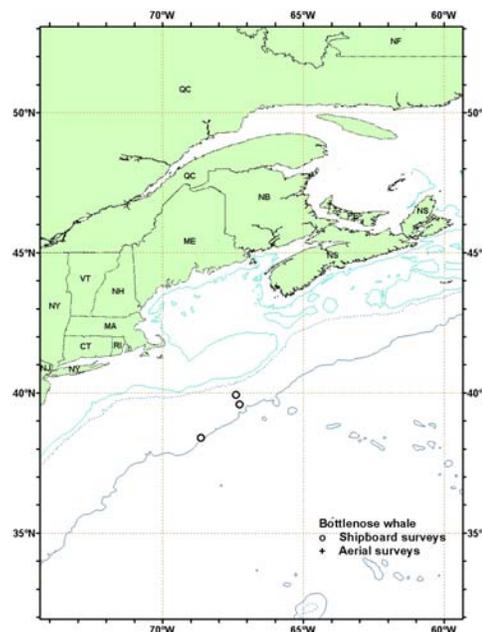
POPULATION SIZE

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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stock, 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 to 1967 (Mitchell 1977; Mead 1989).

Fishery Information

The only documented fishery interaction with northern bottlenose whales occurred in 2001 in the U.S. NED experimental pelagic longline fishery in Canadian waters. The animal was released alive, but considered a serious injury (Garrison 2003).

Other Mortality

In 2006, two northern bottlenose whales stranded alive in Delaware Bay. This mother calf pair was first reported stranded in New Jersey, where volunteers pushed them off the beach. The two animals restranded in Delaware, where the calf was encouraged back into the water and was last seem swimming, but the mother stranded dead. This is believed to be the southern most U.S. stranding record for this species.

STATUS OF STOCK

The status of northern bottlenose whales relative to OSP in U.S. Atlantic EEZ is unknown; however, the 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 Canadian Scotian Shelf population was designated by Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as of Special Concern. Its status was uplisted to Endangered in November 2002, based on its small population estimate and the potential threat posed by oil and gas development in and around the population's prime habitat. This population was legally listed under the Species at Risk Act in 2006 (COSEWIC 2002; DFO 2007). This species is not listed as threatened or endangered under the U.S. Endangered Species Act. There are insufficient data to determine population trends for this species. The total level of U.S. fishery-caused mortality and serious injury is unknown. 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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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; Mignucci-Giannoni *et al.* 1999; MacLeod *et al.* 2006). Stock structure in the 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; Waring *et al.* 2001; Hamazaki 2002; Palka 2006). Most sightings were in late spring or summer.
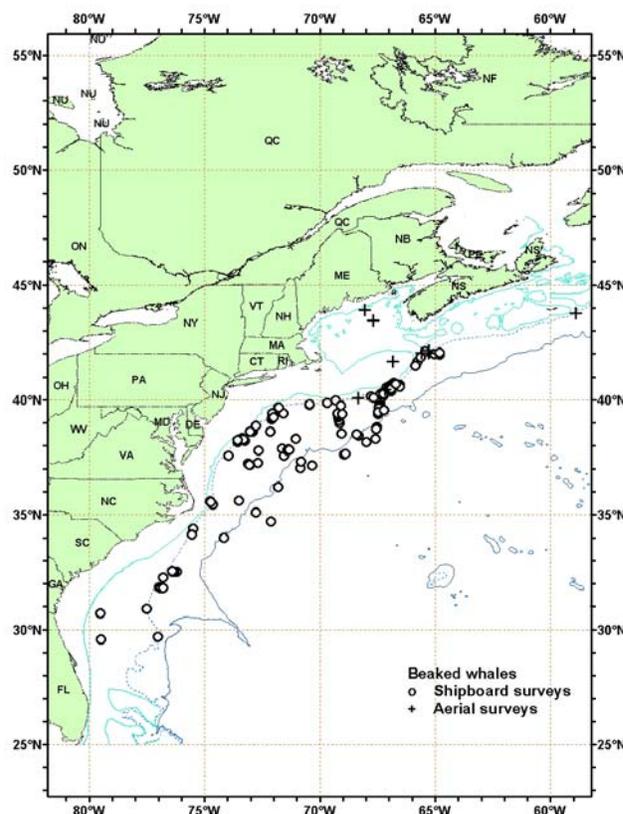
POPULATION SIZE

The total number of Cuvier's beaked whales off the eastern U.S. and Canadian Atlantic coast is unknown.

However, several estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions are available for select time periods (Barlow *et al.* 2006). Sightings are almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV=0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV=0.78), and from the southern U.S. Atlantic is 674 (CV=0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Figure 1. *Distribution of beaked whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer 1998, 1999, 2002, 2004 and 2006. Isobaths are 100 m. 1.000 m. and 4.000 m.*

Earlier abundance estimates

An abundance 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 (CETAP 1982). An abundance estimate of 442 (CV=0.51) undifferentiated beaked whales was obtained from an August 1990 shipboard line-transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (NMFS 1990; Waring *et al.* 1992). An abundance estimate of 262 (CV=0.99) undifferentiated beaked whales was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11aircraft (NMFS 1991). An abundance 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 (NMFS 1993). An abundance 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 (NMFS 1994). An abundance 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 (Palka 2006). An abundance estimate of 3,141 (CV=0.34) undifferentiated beaked whales was obtained from the sum of the estimate of 2,600 undifferentiated beaked whales (CV=0.40) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 541 (CV=0.55) undifferentiated beaked whales, obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 822 (CV=0.81) undifferentiated beaked whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of $g(0)$ used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance of 2,839 (CV=0.78) for beaked whales was estimated from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland $(38^{\circ}N)$ to the Bay of Fundy $(45^{\circ}N)$ (Table 1; Palka 2006). Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias $g(0)$ and group-size bias and analyzed using line-transect distance analysis (Palka, 1995; Buckland *et al.*, 2001). The resulting abundance estimate for beaked whales between Florida and Maryland was 674 animals (CV=0.36*)*.

An abundance estimate of 922 (CV=1.47) undifferentiated beaked whales was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

Although the 1990-2006 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 1990-2004 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. 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.

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
Aug 2002	S. Gulf of Maine to Maine	822	0.81
Jun-Aug 2004	Maryland to the Bay of Fundy	2,839	0.78
Jun-Aug 2004	Florida to Maryland	674	0.36
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	3,513	0.63
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47

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 3,513 (CV=0.63). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,154. 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 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 is 6.1 m for females, and 5.5 m for males, maximum age for females were 30 growth layer groups (GLG's) and for males was 36 GLG's, which may be annual layers (Mitchell 1975; Mead 1984; Houston 1990).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated complex of beaked whales is 2,154. 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 0.4 because the CV for the fishery mortality estimate exceeds 0.8. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 17. It is not possible to determine the PBR for only Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2002-2006 total average estimated annual mortality of beaked whales in fisheries in the U.S. Atlantic EEZ was 1.8 and is derived from four components: 1) average annual fishery bycatch of one animal (Table 2), one stranded animal entangled in fishing gear, 3) two animals that were ship struck, and 4) one animal with ingested debris—see other mortality text and Table 2.

Fishery Information

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.

Total annual estimated average fishery related mortality or serious injury of this stock in 2002-2006 in the U.S. fisheries listed below was 1 beaked whale (CV=1.0). Detailed fishery information is reported in Appendix III.

Earlier Interactions

There is no historical information available that documents incidental mortality of beaked whales in either U.S. or Canadian Atlantic coast fisheries (Read 1994). The only documented bycatch prior to 2003 of beaked whales is in the pelagic drift gillnet fishery (now prohibited). The bycatch only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October. Forty-six fishery-related beaked whale mortalities were observed between 1989 and 1998. These included 24 Sowerby's, 4 True's, 1 Cuvier's and 17 undifferentiated beaked whales. Recent analyses of biological samples (genetics and morphological analysis) have been used to determine species identifications for some of the bycaught animals. Estimated bycatch mortality by species is available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. 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) and 12 in 1993 (0.16). The 1994-1998 bycatch estimates (and CV) by 'species' are:

Year	Cuvier's	Sowerby's	True's	*Mesoplodon* spp.
1994	1 (0.14)	3 (0.09)	0	0
1995	0	6 (0)	1 (0)	3 (0)
1996	0	9 (0.12)	2 (0.26)	2 (0.25)
1997	NA	NA	NA	NA
1998	0	2 (0)	2 (0)	7 (0)

During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part". Annual mortality estimates do not include any animals injured and released alive.

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions were reported prior to 2003 or in 2005-2006. The estimated average combined mortality in 2002-2006 was 1 beaked whale (CV=1.0)(Table 2).

Table 2. Summary of the incidental mortality of Beaked Whales (*Ziphius cavirostris* and *Mesoplodon* 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 observed mortalities and serious injuries recorded by on-board observers , the estimated annual mortality and serious injury‑, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[c]	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) [b]	02-06	87, 63, 60, 60, 63	Obs. Data Logbook	.05, .09, .09, .06, .07	0, 1, 0, 0, 0	0, 0, 0, 0, 0	0, 5.3[e], 0, 0, 0	0, 0, 0, 0, 0	0, 5.3, 0, 0, 0	0, 1.0, 0, 0, 0	1(1.0)
TOTAL											1 (1.0)

58

a	Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).
b	2003 SI estimates were taken from Table 10 in Garrison and Richards (2004).
c	Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

Other Mortality

From 1992 to 2000, a total of 53 beaked whales stranded along the U.S. Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This includes: 28 (includes one tentative identification) Gervais' beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus; 2 animals that stranded in September 1998 in South Carolina showed signs of fishery interactions); 2 True's beaked whales; 5 Blainville's beaked whales; 1 Sowerby's beaked whale; 13 Cuvier's beaked whales (one 1996 animal had propeller marks, and one 2000 animal had a longline hook in the lower jaw) and 4 unidentified animals.

One stranding of Sowerby's beaked whale was recorded on Sable Island, Canada between 1970 and 1998 (Lucas and Hooker 2000). The whale's body was marked by wounds made by the cookiecutter shark (*Isistius brasiliensis*), which has previously been observed on beaked whales (Lucas and Hooker 2000).

Also, several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with Naval activities. During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whale occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001;NMFS 2001; Cox *et al.* 2006). Four Cuvier's, 2 Blainville's and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsies of 6 dead beaked whales revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox *et al.* 2006).

During 2002-2006, twenty-eight beaked whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 2).

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.						
State	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
Maine	*M. mirus* (1)	*M. bidens* (1)[b]				2
Massachusetts					*Ziphius* (1)	1
New Jersey				*Ziphius* (1)		1
Virginia	*M. Europaeus* (2)[a]	*M. mirus* (1)[c]				3
North Carolina	Unid. (1)	*M. europeaus* (2) *Mesoplodon* sp. (1)	*M. densirostris* (1)	*M. europeaus* (2) *M. densirostris* (1)	*M. densirostris* (1)	9

				M. densirostris (1)		
South Carolina	*Ziphius* (1)	*Ziphius* (2)		*M. densirostris* (1)		4
Georgia			*M. bidens* (1)	*Ziphius* (1)[e]	*Ziphius* (1)	3
Florida	--	*Ziphius* (1) *M. europaeus* (1)	*M. europeaus* (1)	*Mesoplodon sp.* (1)		4
Puerto Rico			*M. densirostris* (1)			1
Total	5	9	4	7	3	28[d]

[a] Ship strike was the likely cause of death for one animal

[b] Boat strike was the likely cause of death

[c] Entanglement in fishing gear was the likely cause of death

[d] The cause of death for most of the stranded animals could not be determined.

[e] Plastic debris found in the stomach.

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in the U.S. Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total U.S. fishery mortality and serious injury for this group 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 average annual human-related mortality and serious injury does not exceed PBR.
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continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV=0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV=0.78), and from the southern U.S. Atlantic is 674 (CV=0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 120 (CV=0.71) undifferentiated beaked whales was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 442 (CV=0.51) undifferentiated beaked whales was obtained from an August 1990 shipboard line-transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (NMFS 1990; Waring *et al.* 1992). An abundance of 262 (CV=0.99) undifferentiated beaked whales was estimated from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000-m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11aircraft (NMFS 1991). An abundance 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 (NMFS 1993). An abundance 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 (NMFS 1994). An abundance 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 (Palka 2006). An abundance estimate of 3,141 (CV=0.34) undifferentiated beaked whales was obtained from the sum of the estimate of 2,600 undifferentiated beaked whales (CV=0.40) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 541 (CV=0.55) undifferentiated beaked whales, obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 822 (CV=0.81) undifferentiated beaked whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance of 2,839 (CV=0.78) for beaked whales was estimated from a line transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50 m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias (*g(0)*) and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for beaked whales between Florida and Maryland was 674 animals (CV=0.36*)*.

An abundance estimate of 922 (CV=1.47) undifferentiated beaked whales was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

Although the 1990-2006 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-

2004 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. 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.

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
Aug 2002	Georges Bank to Maine coast	822	0.81
Jun-Aug 2004	Maryland to the Bay of Fundy	2,839	0.78
Jun-Aug 2004	Florida to Maryland	674	0.36
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	3,513	0.63
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47

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 3,513 (CV=0.63). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,154. It is not possible to determine the minimum population estimate of only *Mesoplodon* beaked whales.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3 m, length at sexual maturity 6.1 m for females, and 5.5 m for males, maximum age for females were 30 growth layer groups (GLG's) and for males was 36 GLG's, which may be annual layers (Mead 1984).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated complex of beaked whales is 2,154. 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 0.4 because the CV for the fishery mortality estimate exceeds 0.8. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 17. It is not possible to determine the PBR for only *Mesoplodon* beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2002-2006 total average estimated annual mortality of beaked whales in fisheries in the U.S. Atlantic EEZ is 1.8 and is derived from four components: 1) average annual fishery bycatch of one animal (Table 2), 2) one stranded animal entangled in fishing gear, 3) two animals that were ship struck, and 4) one animal with ingested debris - see other mortality

text and Table 3.

Fishery Information

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.

Estimated annual average fishery-related mortality or serious injury of this stock in 2002-2006 in the U.S. fisheries listed below was 1 beaked whale (CV=1.0)(Table 2). Detailed fishery information is reported in Appendix III.

Earlier Interactions

There is no historical information available that documents incidental mortality in either U.S. or Canadian Atlantic coast fisheries (Read 1994). The only documented bycatch prior to 2003 of beaked whales is in the pelagic drift gillnet fishery (now prohibited). The bycatch only occurred from Georges Canyon to Hydrographer Canyon along the continental shelf break and continental slope during July to October (Northridge 1996). Forty-six fishery-related beaked whale mortalities were observed between 1989 and 1998. These included: 24 Sowerby's; 4 True's; 1 Cuvier's; and 17 undifferentiated beaked whales. Recent analysis of biological samples (genetics and morphological analysis) has been used to determine species identifications for some of the bycaught animals. Estimates of bycatch mortality by species are available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. 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) and 12 in 1993 (0.16). The 1994-1998 bycatch estimates (and CV) by 'species' are:

Year	Cuvier's	Sowerby's	True's	*Mesoplodon* spp.
1994	1 (0.14)	3 (0.09)	0	0
1995	0	6 (0)	1 (0)	3 (0)
1996	0	9 (0.12)	2 (0.26)	2 (0.25)
1997	NA	NA	NA	NA
1998	0	2 (0)	2 (0)	7 (0)

During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part". Annual mortality estimates do not include any animals injured and released alive.

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions were reported prior to 2003 or in 2004 - 2006. The estimated average combined mortality in 2002-2006 was 1 beaked whale (CV=1.0)(Table 2).

Table 2. Summary of the incidental mortality of Beaked Whales (*Ziphius cavirostris* and *Mesoplodon* 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 observed mortalities and serious injuries recorded by on-board observers , the estimated annual mortality and serious injury–, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[c]	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) [b]	02-06	87, 63, 60, 60, 63	Obs. Data Logbook	.04, .05, .09, .09, .06, .07	0, 1, 0, 0, 0	0, 0, 0, 0, 0	0, 5.3 [e], 0, 0, 0	0, 0, 0, 0, 0	0, 5.3, 0, 0, 0	0, 1.0, 0, 0, 0	1(1.0)
TOTAL											1 (1.0)

[a]   Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).
[b]   2003 SI estimates were taken from Table 10 in Garrison and Richards (2004).
[c]   Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

Other Mortality

From 1992 to 2001, a total of 63 beaked whales stranded along the U.S. Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This includes: 35 (includes one tentative identification) Gervais' beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus; 2 animals that stranded in September 1998 in South Carolina showed signs of fishery interactions; one Florida 2001 animal showed signs of acoustic or blunt trauma); 2 True's beaked whales; 5 Blainville's beaked whales; 1 Sowerby's beaked whale; 13 Cuvier's beaked whales (one 1996 animal had propeller marks, and one 2000 animal had a longline hook in the lower jaw) and 7 unidentified animals. One stranding of Sowerby's beaked whale was recorded on Sable Island, Canada between 1970 and 1998 (Lucas and Hooker 2000). The whale's body was marked by wounds made by the cookiecutter shark (*Isistius brasiliensis*), which has previously been observed on beaked whales (Lucas and Hooker 2000).

Also, several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with naval activities. During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whale and Blainville's beaked whale occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 was associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; NMFS 2001; Cox *et al.* 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown, since none of the whales have been resighted. Necropsy of 6 dead beaked whales revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Cox *et al.* 2006).

During 2002-2006, twenty-nine beaked whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 3).

Table 3. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.

State	2002	2003	2004	2005	2006	Total
Maine	*M. mirus* (1)	*M. bidens* (1)[b]				2
Massachusetts					*Ziphius* (1)	1
New Jersey				*Ziphius* (1)		1
Virginia	*M. Europaeus* (2)[a]	*M. mirus* (1)[c]				3
North Carolina		*M. europeaus* (2)		*M. europeaus* (2)		
	M. Europaeus (1)[e]	*M. mirus* (1)	*M. densirostris* (1)	*M. densirostris* (1)	*M. densirostris* (1)	9
South Carolina	*Ziphius* (1)	*Ziphius* (2)		*M. densirostris (1)*		4
Georgia			*M. bidens* (1)	*Ziphius* (1)[e]	*Ziphius* (1)	3
Florida		*Ziphius* (1)				
	--	*M. europaeus* (1)	*M. europeaus* (1)	*M. densirostris* (1)		4
Puerto Rico	*M. densirostris* (1)		*M. densirostris* (1)			1
Total	6	9	4	7	3	29[d]

[a] Ship strike was the likely cause of death for one animal

[b] Boat strike was the likely cause of death

[c] Entanglement in fishing gear was the likely cause of death

[d] The cause of death for most of the stranded animals could not be determined.

[e] Plastic debris found in the stomach.

STATUS OF STOCK

The status of *Mesoplodon* 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. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total U.S. fishery mortality and serious injury for this group 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 average annual human-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and temperate seas, and in the Northwest Atlantic occur from Florida to eastern Newfoundland (Leatherwood *et al.* 1976; Baird and Stacey 1990). Off the northeast U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne *et al.* 1984). In winter, the range is in the mid-Atlantic Bight and extends outward 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 along the continental shelf edge and in deeper oceanic waters sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring *et al.* 1992; 1993). There is no information on stock structure of Risso's dolphin in the western North Atlantic, or to determine if separate stocks exist in the Gulf of Mexico and Atlantic. In 2006, a rehabilitated adult male Risso's dolphin stranded and released in the Gulf of Mexico off Florida was tracked via satellite to waters off Delaware (Wells 2006). The Gulf of Mexico and Atlantic stocks are currently being treated as two separate stocks.

Figure 1. *Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100- m, 1,000- m, and 4,000-m depth contours.*

POPULATION SIZE

Total numbers of Risso's dolphins off the U.S. or Canadian Atlantic coast are unknown, although eight abundance estimates are available from selected regions for select time periods. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for Risso's dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 20,479 (CV=0.59), where the estimate from the northern U.S. Atlantic is 15.053 (CV=0.78), and from the southern U.S. Atlantic is 5,426 (CV=0.54). This joint estimate is considered best because these two surveys together have the most complete coverage of the population's habitat.

Earlier abundance estimates

An abundance estimate of 4,980 Risso's dolphins (CV=0.34) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 11,017 (CV=0.58) Risso's dolphins was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m
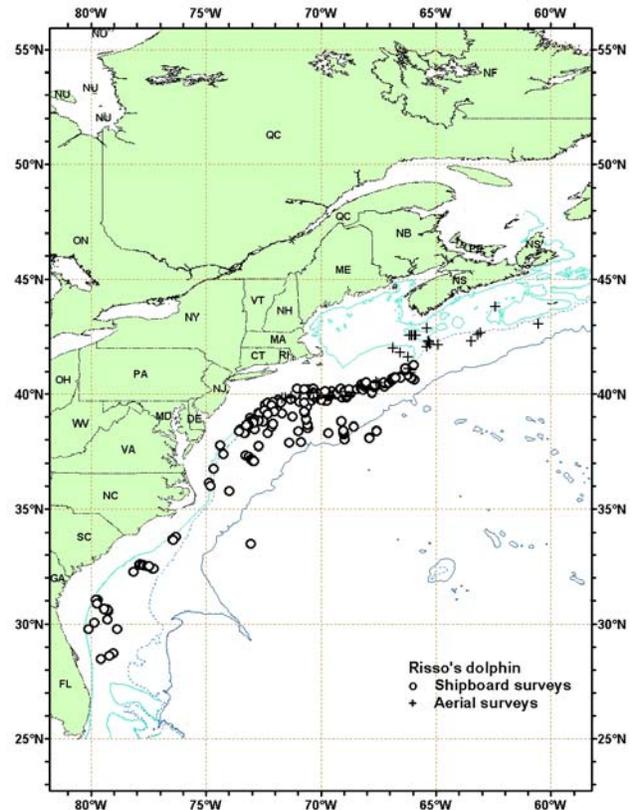
isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 6,496 (CV=0.74) and 16,818 (CV=0.52) Risso's dolphins were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircraft (NMFS 1991). An abundance estimate of 212 (CV=0.62) Risso's dolphins was obtained 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 (NMFS 1993). A 1995 abundance estimate of 5,587 (CV=1.16) Risso's dolphins was obtained 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. An abundance estimate of 28,164 (CV=0.29) Risso's dolphins was obtained from the sum of the estimate of 18,631 (CV=0.35) Risso's dolphins from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 9,533 (CV=0.50) Risso's dolphins, estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 9,311 (CV=0.76) Risso's dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1,000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 15,053 (CV=0.78) Risso's dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and recorded a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias (*g(0)*) and group-size bias employing line-transect distance analysis and the direct duplicate estimator (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for Risso's dolphins between Florida and Maryland was 5,426 (CV=0.54).

An abundance estimate of 14,408 (CV=0.38) Risso's dolphins was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2,000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka, pers. comm.). The value of g*(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

Table 1. Summary of abundance estimates for the western North Atlantic Risso's dolphin. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	N_{best}	**CV**
Aug 2002	Georges Bank to Maine coast	9,311	0.76
Jun-Aug 2004	Maryland to Bay of Fundy	15,053	0.78

Jun-Aug 2004	Florida to Maryland	5,426	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	20,479	0.59
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	14,408	0.38

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 20,479 (CV=0.59), obtained from the 2004 surveys. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,920.

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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 12,920. The maximum productivity rate is 0.04, the default value for cetaceans (Barlow *et al.* 1995). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.48 because the CV of the average mortality estimate is between 0.3 and 0.6 (Wade and Angliss 1997). PBR for the western North Atlantic stock of Risso's dolphin is 124.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 25 Risso's dolphins (CV=0.32; Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Fisheries Conservation and Management Act in that year, an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. 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).

In the pelagic drift gillnet fishery fifty-one Risso's dolphin mortalities were observed between 1989 and 1998. One animal was entangled and released alive. Bycatch occurred during July, September and October along continental shelf edge canyons off the southern New England coast. Estimated annual mortality and serious injury (CV in parentheses) attributable to the drift gillnet fishery was 87 in 1989 (0.52), 144 in 1990 (0.46), 21 in 1991 (0.55), 31 in 1992 (0.27), 14 in 1993 (0.42), 1.5 in 1994 (0.16), 6 in 1995 (0), 0 in 1996, no fishery in 1997, 9 in 1998 (0).

In the pelagic pair trawl fishery, one mortality was observed in 1992. Estimated annual fishery-related mortality

(CV in parentheses) attributable to the pelagic pair trawl fishery was 0.6 dolphins in 1991 (1.0), 4.3 in 1992 (0.76), 3.2 in 1993 (1.0), 0 in 1994 and 3.7 in 1995 (0.45).

Pelagic Longline

Pelagic longline bycatch estimates of Risso's dolphins in 1998, 1999, and 2000 were obtained from Yeung (1999), Yeung *et al.* (2000), and Yeung (2001), respectively. Bycatch estimates for 2001 and 2002, 2003, 2004 and 2005 were obtained from Garrison (2003), Garrison and Richards (2004), Garrison (2005), and Fairfield-Walsh and Garrison (2006). Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod. Excluding the Gulf of Mexico, from 1992 to 2000 one mortality was observed in both 1994 and 2000, and 0 in other years. The observed numbers of seriously-injured but released alive individuals from 1992 to 2006 were, respectively, 2, 0, 6, 4, 1, 0, 1, 1, 1, 6, 4, 2, 2, 0, and 0 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999; Yeung 1999; Yeung *et al.* 2000; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007) (Table 2). Estimated annual fishery-related mortality (CV in parentheses) was 17 animals in 1994 (1.0), 41 in 2000 (1.0), 24 in 2001(1.0), 20 in 2002 (0.86), and 0 in 2003 to 2006 (Table 2). Seriously injured and released alive animals were estimated to be 54 dolphins (0.7) in 1992, 0 in 1993, 120 (0.57) in 1994, 103 (0.68) in 1995, 99 (1.0) in 1996, 0 in 1997, 57 (1.0) in 1998, 22 (1.0) in 1999, 23 (1.0) in 2000, 45 (0.7) in 2001, 8 (1.0) in 2002, 40 (0.63) in 2003 28(0.72) in 2004, 3(1.0) in 2005, and 0 in 2006 (Table 2). The annual average combined mortality and serious injury for 2002-2006 is 20 Risso's dolphins (CV=0.38; Table 2).

Northeast Sink Gillnet

Estimated annual mortalities (CV in parentheses) from this fishery are: 0 in 1999, 15 (1.06) in 2000, 0 in 2001-2004, 15 in 2005 (0.93), and 0 in 2006 (Table 2). The 2002-2006 average mortality in this fishery is 3 Risso's dolphins (CV=0.93).

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

Fishery	Years	Vessels[b]	Data Type[a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) [c]	02-06	87, 63, 60, 60, 63	Obs. Data Logbook	.05, .09, .09, .06, .07	4, 2, 2, 0, 0	0, 0, 0, 0, 0	8, 40, 28, 3, 0	20[d], 0, 0, 0, 0	28, 40, 28, 3, 0	.67, .63, .72, 1.0, 0	20 (0.38)
Pelagic Longline - NED-E area only [c]	02-03	14, 11	Obs. Data Logbook	1, 1	3, 0	0, 1	3, 0	0, 1	3, 1	0, 1.0	2 (1.0)
Northeast Sink Gillnet	02-06	1993=349 1998=301	Obs. Data Weighout Trip Logbook	.02, .03, .06, .07, 04	0, 0, 0, 0, 0	0, 0, 0, 1, 0	0, 0, 0, 0, 0	0, 0, 0, 15, 0	0, 0, 0, 15, 0	0, 0, 0, .93, 0	3 (0.93)
TOTAL											25 (0.32)

a	Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. The Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the coastal gillnet fishery. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).
b	Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.
c	An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison 2003; Garrison and Richards 2004) The NED area was reopened in June 2004, so 2004 - 2006 bycatch analysis includes this area.
d	Note that the 2002 estimate of Risso's dolphin mortality is estimated from observed mortality rates in previous years (1998-2002) due to a gap in coverage during the 3rd quarter of 2002.

Other mortality

From 2002 to2006, 77 Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NMFS unpublished data). Six animals during this time period had indications of human interaction, three of which were fishery interactions. In eastern Canada, one Risso's dolphin stranding was reported on Sable Island, Nova Scotia from 1970-1998 (Lucas and Hooker 2000).

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans, including one Risso's dolphin, stranded mostly along the outer (eastern) coast of Virginia's barrier islands

A Mid-Atlantic Offshore Small Cetacean UME was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. Three Risso's dolphins were involved in this UME.

Table 3. Risso's dolphin (*Grampus griseus*) reported strandings along the U.S. Atlantic coast, 2002-2006.

STATE	2002	2003	2004	2005	2006	TOTALS
Maine	0	0	2	0	1	3
New Hampshire	0	0	0	0	0	0
Massachusetts[ad]	5	10	4	8	1	28
Rhode Island	0	0	1	1	0	2
Connecticut	0	0	0	0	0	0
New York	1	0	3	4	1	9
New Jersey	0	0	0	5	0	5
Delaware	0	0	1	1	0	2
Maryland	1	2	1	2	1	7
Virginia[b]	0	1	1	4	1	7
North Carolina[c]	2	1	2	2	1	8
South Carolina	0	0	0	0	0	0
Georgia	0	0	0	0	0	0
Florida	1	1	3	0	0	5
EZ	0	0	1	0	0	1
TOTAL	10	15	19	27	6	77

a. One of the 2004 animals was mutilated, fluke cut off.
b. One of the 2005 animals showed signs of fishery interaction.
c. One of the 2006 animals showed signs of fishery interaction.
d. 2003 includes 8 animals mass stranded in Massachusetts, 3 of which were released alive.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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 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. There are insufficient data to determine population trends for this species. The total U. S. fishery mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, can not be considered to be insignificant and approaching a zero mortality and serious injury rate. The 2002-2006 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of pilot whales in the western Atlantic—the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, some of the descriptive material below refers to *Globicephala* sp., and is identified as such. The species is considered to occur from Canada to Cape Hatteras. NMFS is currently conducting research to improve the understanding of species delineation and distribution.

Pilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeast U.S. coast in winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999; Hamazaki 2002). 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). Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring *et al.* 1992; NMFS unpublished data).
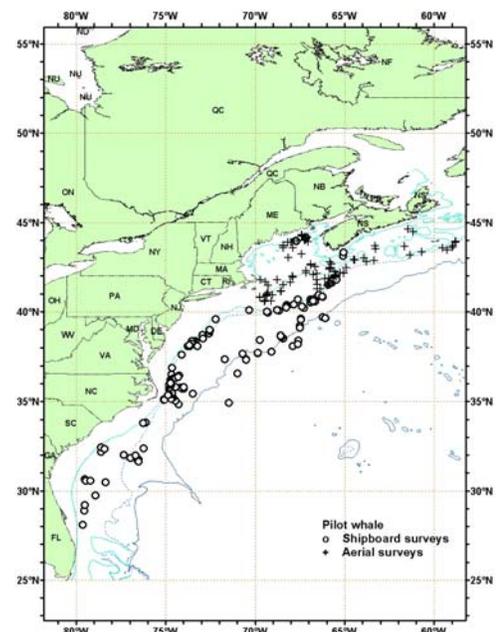
The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Sergeant 1962; Leatherwood *et al.* 1976; Abend 1993; Buckland *et al.* 1993; Abend and Smith 1999). The stock structure of the North Atlantic population is uncertain (ICES 1993; Fullard *et al.* 2000). Morphometric (Bloch and Lastein 1993) and genetic (Siemann 1994; Fullard *et al.* 2000) studies have provided little support for stock structure across the Atlantic (Fullard *et al.* 2000). However,

Figure 1. *Distribution of pilot whales sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are at the 100 m, 1,000 m. and 4.000 m depth contours.*

Fullard *et al.* (2000) have proposed a stock structure that is related to sea surface temperature: 1) a cold-water population west of the Labrador/North Atlantic current, and 2) a warm-water population that extends across the Atlantic in the Gulf Stream.

POPULATION SIZE

The total number of long-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). Because long-finned and short-finned pilot whales are difficult to distinguish at sea, seasonal abundance estimates are reported for *Globicephala* sp., both long-finned and short-finned pilot whales. The best abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,728 (CV=0.34) + 15,411 (CV=0.43) = 31,139 (CV=0.27) whales) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Earlier estimates

Mitchell (1974) used cumulative catch data from the 1951-1961 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 and 96,000 long-finned pilot whales. An abundance estimate of 11,120 (CV=0.29)

Globicephala sp. was obtained from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 3,636 (CV=0.36) *Globicephala* sp. was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundances estimates of 3,368 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. were derived from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircrafts (NMFS 1991). An abundance estimate of 668 (CV=0.55) *Globicephala* sp. was obtained 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 (NMFS 1993a). A 1995 abundance estimate of 9,776 (CV=0.55) *Globicephala* sp. was generated from the sum of the estimates of 8,176 (CV=0.65) *Globicephala* sp. from the U.S. 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, and 1,600 (CV=0.65) *Globicephala* sp. from Canadian aerial surveys in late August and early September in the Gulf of St. Lawrence in 1995 and 1998 (Kingsley and Reeves 1998). An abundance estimate of 14,909 (CV=0.26) *Globicephala* sp. was obtained from the sum of the estimate of 9,800 *Globicephala* sp. (CV=0.34) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 5,109 (CV=0.41) *Globicephala* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0)*, the probability of detecting a group on the track line used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 15,728 (CV=0.34) *Globicephala* sp. was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths>50 m) between Florida and Maryland (27.5ºN and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 15,411 animals (CV=0.43).

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

Table 1. Summary of abundance estimates for the western North Atlantic *Globicephala* sp. by 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
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to the Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	15,411	0.43
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	31,139	0.27
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by (Wade and Angliss 1997). The best estimate of abundance for *Globicephala* sp. is 31,139 animals (CV=0.27) derived from the 2004 surveys. The minimum population estimate for *Globicephala* sp. is 24,866.

Current Population Trend

There are insufficient data to determine population trends for *Globicephala* sp.

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 obtained from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth of 177 cm; mean length at sexual maturity of 490 cm for males and 356 cm for females; age at sexual maturity of 12 years for males and 6 years for females; mean adult length of 557 cm for males and 448 cm for females; and maximum age of 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data 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 different analytical techniques.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Globicephala* sp. is 24,866. 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 the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic *Globicephala* sp. is 249. It is not possible to determine the PBR for only long-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 167 pilot whales (CV=0.14; Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

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.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch 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 bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

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 pilot whales (90%) was 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. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0).

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. 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.

Two interactions with pilot whales in the Atlantic tuna purse seine fishery were observed in 1996. In one interaction, the net was pursed around one pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001, with no marine mammals observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none since then. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 7 (CV=1.10) in 1998.

One pilot whale take was observed in the *Illex* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

One pilot whale take was observed in the *Loligo* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1999. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 0 between 1996 and 1998, and 49 in 1999 (CV=0.97). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

There was one observed take in the Southern New England/Mid-Atlantic Bottom Trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 in 1996-1998, and 228 (CV= 1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom fishery.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF).

For more details on earlier fishery interactions see Waring *et al.* (2007).

Pelagic Longline

Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2006 128 pilot whales (including 2 identified as short-finned pilot whales) were released alive, including 73 that were considered seriously injured (of which 1 was identified as a short-finned pilot whale), and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007). January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch 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 bycatch occurred between the 20 and 50 fathom isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, and 16 (CV=1.00) in 2006. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV=0.51) in 1995 including 37 estimated short-finned pilot whales (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV=0.58), 52 in 2002 (CV=0.48), 21 in 2003 (CV=0.78), 74 in 2004 (CV=0.42), 212 (CV=0.21) in 2005, and 169 (CV=0.47) in 2006. The average 'combined' annual mortality in 2002-2006 was 109 pilot whales (CV=0.20) (Table 2).

An experimental fishery was conducted on six vessels operating in the Gulf of Mexico and off the U.S. east coast in 2005, with 100% observer coverage achieved during this experimental fishery. During this experiment, different hook baiting techniques standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" fishing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including one which was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the mid-Atlantic bottom trawl in 2000, four in 2005, and one in 2006. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38(CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, and 37 (CV=0.34) in 2006. The 2002-2006 average mortality attributed to the Mid-Atlantic bottom trawl was 34 animals (CV=0.15).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, four in 2005, and one in 2006. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, and 14 (0.28) in 2006. The 2002-2006 average mortality attributed to the northeast bottom trawl was 17 animals (CV=0.14).

Northeast Mid-Water Trawl – Including Pair Trawl

The observer coverage in this fishery was highest after 2003, though a few trips in earlier years were observed (Table 2). A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-

trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities were: unknown in 2001-2002, 1.9 (CV=0.56) in 2003, and 1.4 (CV=0.58) in 2004, 1.1(CV=0.68) in 2005, and 0 in 2006 (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during 2002-2006 was 1 (CV=0.35).

Mid-Atlantic Mid-Water Trawl Fishery (Including Pair Trawl)
The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). No pilot whales were observed bycaught in this fishery between 2002 and 2006, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities were unknown in 2002, 3.9 (CV=0.46) in 2003, 8.1 (CV=0.38) in 2004, 7.5 (CV=0.76) in 2005, and 0 in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2002-2006 was 5 (CV=0.34).

CANADA
An unknown number of pilot whales have also been taken in Newfoundland, Labrador, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; and Atlantic Canada cod traps (Read 1994).

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of 47 incidental catches were recorded, which included 1 long-finned pilot whale. The incidental mortality rate for pilot whales was 0.007/set.

In Canada, the fisheries observer program places observers on all foreign fishing vessels, on between 25% and 40% of large Canadian vessels (greater than 100ft), and on approximately 5% of small vessels (Hooker *et al.* 1997). Fishery observer effort off the coast of Nova Scotia during 1991-1996 varied on a seasonal and annual basis, reflecting changes in fishing effort (see Figure 3, Hooker *et al.* 1997). During the 1991-1996 period, long-finned pilot whales were bycaught (number of animals in parentheses) in bottom trawl (65); midwater trawl (6); and longline (1) gear. Recorded bycatches by year were: 16 in 1991, 21 in 1992, 14 in 1993, 3 in 1994, 9 in 1995 and 6 in 1996. Pilot whale bycatches occurred in all months except January-March and September (Hooker *et al.* 1997).

There was one record of incidental catch in the offshore Greenland halibut fishery that involved one long-finned pilot whale in 2001; no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury 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 observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[d]	02-06	unk	Obs. Data Dealer	.01, .01, .03, .03, .02	0, 0, 0, 0, 0	0, 0, 0, 4, 1	0, 0, 0, 0, 0	38, 31, 35, 31, 37	38, 31, 35, 31, 37	.36, .31, .33, .31, .34	34 (.15)

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Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]							Estimated Mortality
Northeast Bottom Trawl[d]	02-06	unk	Obs. Data Dealer Data VTR Data	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	0, 0, 0, 2, 4, 1	0, 0, 0, 0, 0	22, 20, 15, 15, 14	22, 20, 15, 15, 14	.26, .26, .29, .30, .28	17 (.14)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[e]	02-06	20, 23, 25, 31, 23	Obs. Data Dealer Data VTR Data	.003, .018, .064, .084, .089	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk, 3.9, 8.1, 7.5, 0	unk, 3.9, 8.1, 7.5, 0	unk, .46, .38, .76, 0	5 (.34)
Northeast Mid-Water Trawl - Including Pair Trawl[e]	02-06	27, 28, 22, 25, 25	Obs. Data Dealer Data VTR Data	0, .031, .126, .199, .031	0, 0, 0, 0, 0	0, 0, 1, 0, 0	0, 0, 0, 0, 0	unk, 1.9, 1.4, 1.1, 0	unk, 1.9, 1.4, 1.1, 0	unk, .56, .58, .68, 0	1 (.35)
Pelagic Longline (excluding NED-E)[f]	02-06	87, 63, 60, 60, 63	Obs. Data Logbook	.05, .09, .09, .06, .07	4, 2, 6, 9, 12	0, 0, 0, 0, 1	52, 21, 74, 212, 169	2, 0, 0, 0, 16	54, 21, 74, 212, 185	.46, .77, .42, .21, .47	109 (.20)
Pelagic Longline - NED-E area only[f]	02-03	14, 11	Obs. Data Logbook	1, 1	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	0
2005 Pelagic Longline experimental fishery[g]	05	6	Obs. Data	1	1	0	1	0	1	na	1(na)
TOTAL											167 (.14)

a. Number of vessels in the pelagic longline fishery is based on vessels reporting effort to the pelagic longline logbook. Number of vessels in the Mid-water trawl fisheries is based on vessels reported in the VTR and observer databases.

b. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

c. Observer coverage of the mid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.

d. A new method was used to develop estimates of mortality for the mid-Atlantic and Northeast bottom trawl fisheries during 2000-2006. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2006. NE and MA bottom trawl mortality estimates reported for 2006 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2006 effort. This assumes that fishing practices during 2006 were consistent with fishing practices during the 2000-2005 time period. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in 2009. In addition, the fisheries listed in Table 2 reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The *Illex, Loligo* and Mackerel fisheries are now part of the mid-Atlantic and Northeast bottom trawl fisheries.

e. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year.

f. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from 1 June 2001- 31 December 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison 2003; Garrison and Richards 2004).

g. A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield-Walsh and Garrison 2006).

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2002 to 2006, 72 short-finned pilot whales (*Globicephala macrorhynchus*)*,* 137 long-finned pilot whales (*Globicephala melas*)*,* and 8 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). This includes several mass strandings as follows: 11 long-finned pilot whales mass stranded in Nantucket, Massachusetts in 2000, 57 in 2002 in Dennis, Massachusetts, and 18 in Brewster, Massachusetts in 2005; 28 short-finned pilot whales stranded in Content Passage, Monroe County, Florida (Atlantic side) on 18 April 2003, and 31 short-finned pilot whales stranded on the Outer Banks of North Carolina on 15-16 January 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et al.* 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently, animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980). The fate of the animals, when known, is footnoted in Table 3.

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands including 1 pilot whale (*Globicephala* sp.). Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other potential causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and no cause could be determined for the remaining strandings, including the pilot whale. A final report on this UME is pending (Barco in prep.).

A Mid-Atlantic Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. One short-finned pilot whale (*Globicephala macrorhynchus*) was involved in this UME.

A UME mass stranding of thirty-three short-finned pilot whales, including five pregnant females, near Cape Hatteras, North Carolina occurred from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006), though no single cause for the UME was determined. Evidence is lacking to support a definitive association between this unusual mortality event and naval activity using mid-frequency active sonar in this spatial and temporal vicinity, though this does not preclude the possibility that this mass stranding was a behavioral avoidance to noise exposure associated with the naval activity. The definitive cause of this UME is not known.

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported stranded as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward (Table 3). Long-finned pilot whales (*Globicephala melas*) have been reported stranded as far south as Florida, when 2 long-finned pilot whales were reported stranded in Florida in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification was only moderate. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

Between 2002 and 2006, human and/or fishery interactions were documented as follows: two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1 short-finned pilot whale which stranded in May 2003 in Florida. During a UME in Dare, North Carolina in January 2005, six of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. Two long-finned pilot whales stranded in Virginia in April 2005, one with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, two were reported as exhibiting signs of human interaction, one in Massachusetts and one in Virginia.

In eastern Canada, 37 strandings of long-finned pilot whales (173 individuals) were reported on Sable Island, Nova Scotia from 1970 to 1998 (Lucas and Hooker 2000). This included 130 animals that mass stranded in December 1976, and 2 smaller groups (<10 each) in autumn 1979 and summer 1992. Fourteen strandings were also recorded along Nova Scotia in 1991-1996 (Hooker *et al.* 1997). Several mass live strandings occurred in Nova Scotia recently - 14 pilot whales live mass stranded in 2000 and 3 in 2001 in Judique, Inverness County and 4 pilot whales live mass stranded at Point Tupper, Inverness County, in 2002, though no specification to species was made.

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2002-2006. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2002			2003			2004			2005			2006			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	7[b]	0	0	2	0	0	3	0	0	2	0	0	3	0	0	17
Maine	0	2	0	0	1	0	0	4	0	0	2	0	0	1	0	0	10	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Massachusetts	0	65[c]	0	0	5	0	0	1	0	0	22[m]	0	0	2	0	0	95	0
Rhode Island	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	4	0
New Jersey	0	0	0	0	6[d]	0	0	0	0	0	0	2	1	0	0	1	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	0
Virginia	0	0	0	0	3	0	0	0	1[e]	0	4[n]	0	0	2	0	0	9	1
North Carolina	0	0	0	2	0	1	1[f]	1	1[f]	35[k,l]	1	2	0	0	1	38	2	5
South Carolina	0	0	0	0	1[g]	0	0	0	0	0	0	0	0	0	0	0	1[g]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	29[h,i]	0	0	4	0	0	0	0	0	0	0	0	33	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	0	0	0	1[j]	0	0	0	0	0	1	0	0	0	0	0	2	0
TOTALS - U.S., Puerto Rico, & EEZ	0	68	0	31	18	1	5	10	2	35	35	4	1	6	1	72	137	8

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).

b. Includes 4 mass strandings at Point Tupper, Inverness County on 11 January 2002 - fate unreported.

c. Includes mass stranding of 57 long-finned pilot whales in Dennis, Massachusetts in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later ; ~30 animals euthanized, and ~11 animals died during the strandings.

d. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.

e. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).

f. One short-finned pilot whale (September) and one pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.

g. Only moderate confidence on species identification as long-finned pilot whale.

h. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, Florida (Ocean side) on 19 April 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on 10 August 2003.

i. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.

j. One long-finned pilot whale floating dead on Georges Bank offshore.

k. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.

l. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
m. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December, 2005.
n. Sign of human interaction (a line on the flukes) observed on 2 animals, and one animal was a pregnant female.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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.

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because the 2002-2006 estimated average annual human-related mortality does not exceed PBR. However, the continuing inability to distinguish between species of pilot whales raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). There are two species of pilot whales in the western North Atlantic - the Atlantic or long-finned pilot whale, *Globicephala melas,* and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, much of the descriptive material below refers to *Globicephala* sp. and is identified as such. Sightings of these animals in the U.S. Atlantic EEZ occur in oceanic waters (Mullin and Fulling 2003) and along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2003). Information on stock differentiation for the Atlantic population based on morphological, genetic and/or behavioral data is in progress. Pending these results, the western North Atlantic *Globicephala* sp. population(s) is provisionally being considered a separate stock from the northern Gulf of Mexico stock(s).

Figure 1. Distribution of pilot whale sightings from NEFSC and SEFSC vessel and aerial summer surveys during 2004 and 2006. Isobaths are at 100 m, 1,000 m, and 4,000 m.

POPULATION SIZE

The total number of short-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). Because long-finned and short-finned pilot whales are difficult to identify at sea, seasonal abundance estimates are reported for *Globicephala* sp., both long-finned and short-finned pilot whales. The best abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys. This joint estimate (15,728 + 15,411 = 31,139 whales) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Earlier Estimates

Mitchell (1974) used cumulative catch data from the 1951-1961 drive fisheries 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 and 96,000 long-finned pilot whales, with a range of 50,000-60,000.

An abundance estimate of 11,120 (CV=0.29) *Globicephala* sp. was obtained from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982).

An abundance estimate of 3,636 (CV=0.36) *Globicephala* sp. was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundances estimates of 3,368 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. were derived from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircrafts (NMFS 1991).

An abundance estimate of 668 (CV=0.55) *Globicephala* sp. was obtained 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 (NMFS 1993a).

A 1995 abundance estimate of 9,776 (CV=0.55) *Globicephala* sp. was generated from the sum of the estimates of 8,176 (CV=0.65) *Globicephala* sp. from the U.S. 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, and 1,600 (CV=0.65) *Globicephala* sp. from Canadian aerial surveys in late August and early September in the Gulf of St. Lawrence in 1995 and 1998 (Kingsley and Reeves 1998).

An abundance estimate of 14,909 (CV=0.26) *Globicephala* sp. was obtained from the sum of the estimate of 9,800 *Globicephala* sp. (CV=0.34) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 5,109 (CV=0.41) *Globicephala* sp., estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1,000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of *g(0),* the probability of detecting a group on the track line, used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 15,728 (CV=0.34) *Globicephala* sp. was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0).* Aerial data were collected using the Hiby circle-back line transects method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5°N and 38ºN latitude) was conducted during June-August 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 15,411 animals (CV=0.43).

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2,000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	15,411	0.43
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	31,139	0.27
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35

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

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for *Globicephala* sp. is 31,139 animals (CV=0.27) derived from the 2004 surveys. The minimum population estimate for *Globicephala* sp. is 24,866.

Current Population Trend

There are insufficient data to determine population trends for *Globicephala* sp.

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 obtained from long-finned pilot whales taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth of 177 cm; mean length at sexual maturity of 490 cm for males and 356 cm for females; age at sexual maturity of 12 years for males and 6 years for females; mean adult length of 557 cm for males and 448 cm for females; and maximum age of 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data from animals taken in the Faroe Islands drive fishery for long-finned pilot whales 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 different analytical techniques.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Globicephala* sp. is 24,866. 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 the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic *Globicephala* sp. is 249. It is not possible to determine the PBR for only short-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 167 pilot whales (CV=0.14; Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III. 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.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch 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 bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

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 pilot whales (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. Two animals were also caught in both the hake and tuna longline fisheries (Waring et al. 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0).

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. 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.

Two interactions with pilot whales in the Atlantic tuna purse seine fishery were observed in 1996. In one interaction, the net was pursed around one pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001 with no marine mammals were observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none since then. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 7 in 1998 (CV=1.10).

One pilot whale take was observed in the *Illex* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

One pilot whale take was observed in the *Loligo* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, and Butterfish Trawl fisheries in 1999. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 0 between 1996 and 1998 and 49 in 1999 (CV=.97). These estimates should, however, be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

There was one observed take in the Southern New England/Mid-Atlantic Bottom Trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 from 1996-1998, and 228 (CV= 1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom fishery.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF).

For more details on the earlier fishery interactions see Waring *et al.* (2007).

Pelagic Longline

Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2006, 128 pilot whales were released alive, including 73 that were considered seriously injured, and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007). January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch 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 bycatch occurred between the 20 and 50 fathom isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, and 16 (CV=1.00) in 2006. The estimated

serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV=0.51) in 1995, (includes 37 estimated short-finned pilot whales in 1995 (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV=0.58), 52 in 2002 (CV=0.48), 21 in 2003 (CV=0.78), 74 in 2004 (CV=0.42), 212 in 2005 (CV=0.21), and 169 in 2006 (CV=0.31). The average 'combined' annual mortality in 2002-2006 was 109 pilot whales (CV=0.20) (Table 2).

An experimental fishery was conducted on six vessels operating in the Gulf of Mexico and off the U.S. east coast in 2005, with 100% observer coverage achieved during this experimental fishery. During this experiment, different hook baiting techniques standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" sighing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including one which was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the mid-Atlantic bottom trawl in 2000, four in 2005, and one in 2006. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38 (CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, and 37 (CV=0.34) in 2006. The 2002-2006 average mortality attributed to the mid-Atlantic bottom trawl was 34 animals (CV=0.15).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, four in 2005, and one in 2006. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (0.30) in 2005, and 14 (0.28) in 2006. The 2002-2006 average mortality attributed to the northeast bottom trawl was 17 animals (CV=0.14).

Northeast Mid-Water Trawl – Including Pair Trawl

The observer coverage in this fishery was highest after 2003, though a few trips in earlier years were observed (Table 2). A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities were: unknown in 2001-2002, 1.9 (CV=0.56) in 2003, 1.4 (CV=0.58) in 2004, 1.1(CV=.68) in 2005, and 0 in 2006. (Table 2; Palka pers. comm.). The average annual estimated fishery-related mortality during 2002-2006 was 1 (CV=0.35).

Mid-Atlantic Mid-Water Trawl Fishery (Including Pair Trawl)

The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). No pilot whales were observed bycaught in this fishery between 2002 and 2006, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities were unknown in 2001-2002, 3.9 (CV=0.46) in 2003, 8.1 (CV=0.38) in 2004, 7.5 (CV=.76) in 2005, and 0 in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2002-2006 was 5 (CV=0.34).

CANADA

An unknown number of pilot whales have also been taken in Newfoundland and Labrador, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, and Atlantic Canada cod traps (Read 1994).

Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211 sets), were observed in NAFO Fishing Area 3 (off the Grand Banks) (Lens 1997). A total of

47 incidental catches were recorded, which included 1 long-finned pilot whale. The incidental mortality rate for pilot whales was 0.007/set.

In Canada, the fisheries observer program places observers on all foreign fishing vessels, on between 25% and 40% of large Canadian vessels (greater than 100 ft), and on approximately 5% of small vessels (Hooker *et al.* 1997). Fishery observer effort off the coast of Nova Scotia during 1991-1996 varied on a seasonal and annual basis, reflecting changes in fishing effort (Hooker et al. 1997). During the 1991-1996 periods, long-finned pilot whales were bycaught (number of animals in parentheses) in bottom trawl (65); midwater trawl (6); and longline (1) gear. Recorded bycatches by year were: 16 in 1991, 21 in 1992, 14 in 1993, 3 in 1994, 9 in 1995 and 6 in 1996. Pilot whale bycatches occurred in all months except January-March and September (Hooker et al. 1997).

There was one record of incidental catch in the offshore Greenland halibut fishery that involved one long-finned pilot whale in 2001 although no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury 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 observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl [d]	02-06	unk	Obs. Data Dealer	.01, .01, .03, .03, .02	0, 0, 0, 0, 0	0, 0, 0, 4, 1	0, 0, 0, 0, 0	38, 31, 35, 31, 37	38, 31, 35, 31, 37	.36, .31, .33, .31, .34	34 (.15)
Northeast Bottom Trawl [d]	02-06	unk	Obs. Data Dealer Data VTR Data	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	0, 0, 0, 2, 4, 1	0, 0, 0, 0, 0	22, 20, 15, 15, 14	22, 20, 15, 15, 14	.26, .26, .29, .30, .28	17 (.14)
Mid-Atlantic Mid-Water Trawl - Including Pair Trawl [e]	02-06	20, 23, 25, 31, ??	Obs. Data Dealer Data VTR Data	.003, .018, .064, .084, .089	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk, 3.9, 8.1, 7.5, 0	unk, 3.9, 8.1, 7.5, 0	unk, .46, .38, .76, 0	5 (.34)
Northeast Mid-Water Trawl - Including Pair Trawl [e]	02-06	27, 28, 22, 25, ??	Obs. Data Dealer Data VTR Data	0, .031, .126, .199, .031	0, 0, 0, 0, 0	0, 0, 1, 0, 0	0, 0, 0, 0, 0	unk, 1.9, 1.4, 1.1, 0	unk, 1.9, 1.4, 1.1, 0	unk, .56, .58, .68, 0	1 (.35)
Pelagic Longline (excluding NED-E) [f]	02-06	87, 63, 60, 60, 63	Obs. Data Logbook	.05, .09, .09, .06, .07	4, 2, 6, 9, 12	0, 0, 0, 0, 1	52, 21, 74, 212, 169	2, 0, 0, 0, 16	54, 21, 74, 212, 185	.46, .77, .42, .21, .47	109 (.20)
Pelagic Longline - NED-E area only [f]	02-03	14, 11	Obs. Data Logbook	1, 1	0, 0	0, 0	0, 0	0, 0	0, 0	0, 0	0
2005 Pelagic Longline experimental	05	6	Obs. Data	1	1	0	1	0	1	1.00	1 (1.00)

fishery[g]											
TOTAL											167 (.14)

a.   Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook. Number of vessels in the Mid-water trawl fisheries is based on vessels reported in the VTR and observer databases.

b.   Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

c.   Observer coverage of the mid-Atlantic coastal gillnet fishery is a ratio based on tons of fish landed. Observer coverage for the longline fishery is a ratio based on sets. The trawl fisheries are ratios based on trips.

d.   A new method was used to develop estimates of mortality for the mid-Atlantic and Northeast bottom trawl fisheries during 2000-2006. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2006. NE and MA bottom trawl mortality estimates reported for 2006 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2006 effort. This assumes that fishing practices during 2006 were consistent with fishing practices during the 2000-2005 time period. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in 2009. In addition, the fisheries listed in Table 2 reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The *Illex, Loligo* and Mackerel fisheries are now part of the mid-Atlantic and Northeast bottom trawl fisheries.

e.   The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2003-2006. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year.

f.   An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from 1 June 2001- 31 December 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison 2003; Garrison and Richards 2004)).

g.   A cooperative research program conducted during quarters 2 and 3 in 2005 (Fairfield Walsh and Garrison 2006).

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2002-2006, 72 short-finned pilot whales (*Globicephala macrorhynchus*), 137 long-finned pilot whales (*Globicephala melas*), and 8 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). This includes several mass strandings as follows: 11 long-finned pilot whales mass stranded in Nantucket, Massachusetts in 2000 and 57 in 2002 in Dennis, Massachusetts; 28 short-finned pilot whales stranded in Content Passage, Monroe County, Florida (Atlantic side) on 18 April 2003; and 18 pilot whales (including one pregnant female) were part of a multi-species mass stranding in Barnstable County, Massachusetts on 10 December 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et al.* 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980). The fate of the animals, when known, is footnoted in Table 3.

A Virginia Coastal Small Cetacean Unusual Mortality Event (UME) occurred along the coast of Virginia from 1 May to 31 July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands including 1 pilot whale (*Globicephala* sp.). Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other potential causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and no cause could be determined for the remaining strandings, including the pilot whale. A final report on this UME is pending (Barco in prep.).

A Mid-Atlantic Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. One short-finned pilot whale (*Globicephala macrorhynchus*) was involved in this UME.

A mass stranding of thirty-three short-finned pilot whales, including five pregnant females, occurred near Cape Hatteras, North Carolina from 15-16 January 2005. Gross necropsies were conducted and samples were

collected for pathological analyses (Hohn *et al.* 2006), though no single cause for the UME was determined. Evidence is lacking to support a definitive association between this unusual mortality event and naval activity using mid-frequency active sonar in this spatial and temporal vicinity, though this does not preclude the possibility that this mass stranding was a behavioral avoidance to noise exposure associated with the naval activity. The definitive cause of this UME is not known.

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2002-2006. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2002			2003			2004			2005			2006			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	7[b]	0	0	2	0	0	3	0	0	2	0	0	3	0	0	17
Maine	0	2	0	0	1	0	0	4	0	0	2	0	0	1	0	0	10	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Massachusetts	0	65[c]	0	0	5	0	0	1	0	0	22[m]	0	0	2	0	0	95	0
Rhode Island	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	4	0
New Jersey	0	0	0	0	6[d]	0	0	0	0	0	0	2	1	0	0	1	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	4	0
Virginia	0	0	0	0	3	0	0	0	1[e]	0	4[n]	0	0	2	0	0	9	1
North Carolina	0	0	0	2	0	1	1[f]	1	1[f]	35[k,l]	1	2	0	0	1	38	2	5
South Carolina	0	0	0	0	1[g]	0	0	0	0	0	0	0	0	0	0	0	1[g]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	29[h,i]	0	0	4	0	0	0	0	0	0	0	0	33	0	0
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	0	0	0	1[j]	0	0	0	0	0	1	0	0	0	0	0	2	0
TOTALS - U.S., Puerto Rico, & EEZ	0	68	0	31	18	1	5	10	2	35	35	4	1	6	1	72	137	8

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).

b. Includes 4 mass strandings at Point Tupper, Inverness County on 11 January 2002 - fate unreported.

c. Includes mass stranding of 57 long-finned pilot whales in Dennis, Massachusetts in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later ; ~30 animals euthanized, and ~11 animals died during the strandings.

d. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.

e. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).

f. One short-finned pilot whale (September) and one pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.

g. Only moderate confidence on species identification as long-finned pilot whale.

h. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, Florida (Ocean side) on 19 April 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on 10 August 2003.

i. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
j. One long-finned pilot whale floating dead on Georges Bank offshore.
k. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.
l. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
m. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005.
n. Sign of human interaction (a line on the flukes) observed on 2 animals, and one animal was a pregnant female.

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported as far north as Nova Scotia (1990) and Block Island, Rhode Island (2001), though the majority of the strandings occurred from North Carolina southward (Table 3). Long-finned pilot whales (*Globicephala melas*) have been reported stranded as far south as Florida, when 2 long-finned pilot whales were reported stranded in Florida in November 1998, though their flukes had been apparently cut off, so it is unclear where these animals actually may have died. One additional long-finned pilot whale stranded in South Carolina in 2003, though the confidence in the species identification was only moderate. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

In eastern Canada, 37 strandings of long-finned pilot whales (173 individuals) were reported on Sable Island, Nova Scotia from 1970 to 1998 (Lucas and Hooker 2000). This included 130 animals that mass stranded in December 1976, and 2 smaller groups (<10 each) in autumn 1979 and summer 1992. Fourteen strandings were also recorded along Nova Scotia in 1991-1996 (Hooker et al. 1997). Several mass live strandings occurred in Nova Scotia recently - 14 pilot whales live mass stranded in 2000 and 3 in 2001 in Judique, Inverness County and 4 pilot whales live mass stranded at Point Tupper, Inverness County, in 2002, though no specification to species was made.

Between 2002 and 2006, human and/or fishery interactions were documented as follows: two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1 short-finned pilot whale which stranded in May 2003 in Florida. During a UME in Dare, North Carolina in January 2005, six of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. Two long-finned pilot whales stranded in Virginia in April 2005, one with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, two were reported as exhibiting signs of human interaction, one in Massachusetts and one in Virginia.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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.

A potential human-caused source of mortality is from polychlorinated biphenyls (PCBs) and chlorinated pesticides (DDT, DDE, dieldrin, etc.), moderate levels of which have been found in pilot whale blubber (Taruski *et al.* 1975; Muir *et al.* 1988; Weisbrod *et al.* 2000). Weisbrod *et al.* (2000) reported that bioaccumulation levels were more similar in whales from the same stranding group than animals of the same sex or age. Also, high levels of toxic metals (mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Island drive fishery (Nielsen *et al.* 2000). Similarly, Dam and Bloch (2000) found very high PCB levels in pilot whales in the Faroes. The population effect of the observed levels of such contaminants is unknown.

STATUS OF STOCK

The status of short-finned pilot whales relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total fishery-related mortality and serious injury for *Globicephala* sp. 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 2002-2006 estimated average annual human related mortality does not exceed PBR. However, the continuing inability to distinguish between species of pilot whales raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

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ATLANTIC 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 in 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; Hamazaki 2002). Distribution of sightings, strandings and incidental takes suggest the possible existence of three stock units: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka *et al.* 1997). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence population comes from a virtual absence of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records, and was obvious during abundance surveys conducted in the summers of 1995 and 1999 which covered waters from Virginia to the Gulf of St. Lawrence. White-sided dolphins were seen frequently in Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only a few sightings were recorded between these two regions.

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) on to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sightings data indicate seasonal shifts in distribution (Northridge *et al.* 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to

Figure 1. *Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species' range.

Prior to the 1970s, 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 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the decrease in herring and increase in sand lance in the continental shelf waters (Katona *et al.* 1993; Kenney *et al.* 1996).

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown, although eight estimates from select regions are available from: 1) spring, summer and autumn 1978-1982; 2) July-September 1991-1992; 3) June-July 1993; 4) July-September 1995; 5) July-August 1999; 6) August 2002; 7) June-July 2004; and 8) August 2006. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 63,368 (CV=0.27), an average of the surveys conducted in August within the last 8 years (2002 and 2006). An average is used to account for the large inter-annual variability of the abundance estimates for this species. This variability may be associated with the water temperature and prey patterns.
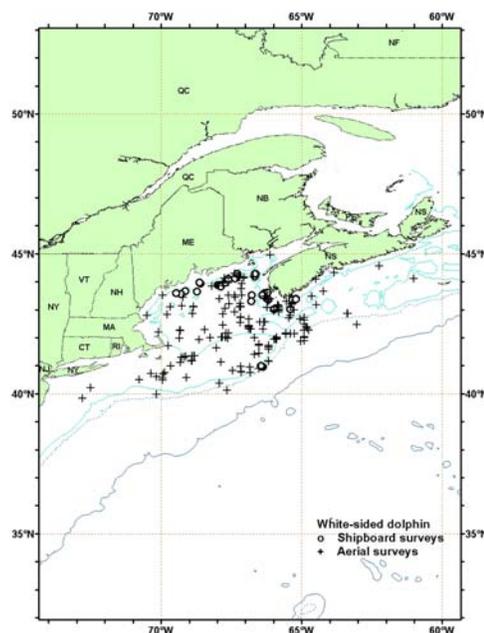
Earlier abundance estimates

An abundance estimate of 28,600 white-sided dolphins (CV=0.21) was obtained 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 (Blaylock *et al.* 1995). An abundance estimate of 20,400 (CV=0.63) white-sided dolphins was obtained 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 *et al.* 1997). An abundance estimate of 729 (CV=0.47) white-sided dolphins was obtained 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 (NMFS 1993). An abundance estimate of 27,200 (CV=0.43) white-sided dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered 32,600 km in waters from Virginia to the mouth of the Gulf of St. Lawrence. Kingsley and Reeves (1998) estimated that there were 11,740 (CV=0.47) white-sided dolphins in the Gulf of St. Lawrence during 1995 and 560 (CV=0.89) white-sided dolphins in the northern Gulf of St. Lawrence during 1996. It is assumed these estimates apply to the Gulf of St. Lawrence stock. During the 1995 survey, 8,427 km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993 km of track lines were flown in an area of 94,665 km^2 during July and August.

An abundance estimate of 51,640 (CV=0.38) white-sided dolphins was obtained from a 28 July to 31 August 1999 line-transect sighting survey conducted from a ship and an airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212 km. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) which accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000). The 1999 estimate is larger than the 1995 estimate due, at least in part, to the fact that the 1999 survey covered the upper Bay of Fundy and the northern edge of Georges Bank for the first time and white-sided dolphins were seen in both areas. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate 109,141 (CV=0.30) white-sided dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 2,330 (CV=0.80) white-sided dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 17,594 (CV=0.30) white-sided dophins was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

The average abundance estimate of white-sided dolphins from surveys conducted in August during the last 8 years (2002 and 2006) is 63,368 (CV=0.27). An average was used to incorporate the large inter-annual variability and thus provide an average number of white-sided dolphins that could be within the Gulf of Maine-western Scotian shelf region.

Table 1. Summary of recent abundance estimates for western North Atlantic stock of 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
Aug 2002	S. Gulf of Maine to Maine	109,141	0.30
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	2,330	0.80
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	17,594	0.30

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 western North Atlantic stock of white-sided dolphins is 63,368 (CV=0.27). The minimum population estimate for these white-sided dolphins is 50,883.

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 110cm; length at sexual maturity is 230-240 cm for males, and 201-222 cm for females; age at sexual maturity is 8-9 years for males and 6-8 years for females; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 50,883. 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 the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of white-sided dolphin is 509.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 352 (CV=0.10) white-sided dolphins (Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III

Earlier Interactions

NMFS observers in the Atlantic foreign mackerel fishery 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 9 documented takes by U.S. vessels involved in joint-venture fishing operations

in which U.S. captains transfer their catches to foreign processing vessels. No incidental takes of white-sided dolphins were observed in the Atlantic mackerel JV fishery when it was observed in 1998.

During 1991 to 2006, two white-sided dolphins were observed taken in the Atlantic pelagic drift gillnet fishery, both in 1993. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 4.4 (.71) in 1989, 6.8 (.71) in 1990, 0.9 (.71) in 1991, 0.8 (.71) in 1992, 2.7 (0.17) in 1993 and 0 from 1994 to 2006. There was no fishery during 1997.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted during 2001 on Georges Bank from August to December. No white-sided dolphins were incidentally captured. Two white-sided dolphins were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF). During TALFF fishing operations all nets fished by the foreign vessel are observed. The total mortality attributed to the Atlantic herring JV and TALFF mid-water trawl fisheries in 2001 was 2 animals.

The mid-Atlantic gillnet fishery occurs year round from New York to North Carolina and has been observed since 1993. One white-sided dolphin was observed taken in this fishery during 1997. None were observed taken in other years. The estimated annual mortality (CV in parentheses) attributed to this fishery was 0 for 1993 to 1996, 45 (0.82) for 1997, 0 for 1998 to 2001, unknown in 2002 and 0 in 2003-2006.

U.S.
Northeast Sink Gillnet
This fishery occurs year round from in the Gulf of Maine, Georges Bank and in southern New England waters. Between 1990 and 2006 there were 56 white-sided dolphin mortalities observed in the Northeast sink gillnet fishery. Most were taken in waters south of Cape Ann during April to December. In recent years, the majority of the takes have been east and south of Cape Cod. During 2002, one of the takes was off Maine in the fall Mid-coast Closure Area in a pingered net. Estimated annual fishery-related mortalities (CV in parentheses) were 49 (0.46) in 1991, 154 (0.35) in 1992, 205 (0.31) in 1993, 240 (0.51) in 1994, 80 (1.16) in 1995, 114 (0.61) in 1996 (Bisack 1997), 140 (0.61) in 1997, 34 (0.92) in 1998, 69 (0.70) in 1999, 26 (1.00) in 2000, 26 (1.00) in 2001, 30 (0.74) in 2002, 31 (0.93) in 2003, 7 (0.98) in 2004, 59 (0.49)in 2005, and 41(.71) in 2006. Average annual estimated fishery-related mortality during 2002-2006 was 34 white-sided dolphins per year (0.33) (Table 2).

Northeast Bottom Trawl
Eighty-three mortalities were documented between 1991 and 2006 in the Northeast bottom trawl fishery; 1 during 1992, 0 in 1993, 2 in 1994, 0 in 1995-2001, 1 in 2002, 12 in 2003, 16 in 2004, 47 in 2005, and 4 in 2006. Estimated annual fishery-related mortalities (CV in parentheses) were 110 (0.97) in 1992, 0 in 1993, 182 (0.71) in 1994, 0 in 1995-1999, 137 (0.34) in 2000, 161 (0.34) in 2001, 170 (0.32) in 2002, 216 (0.27) in 2003, 200 (0.30) in 2004, 213 (0.28) in 2005, and 164 (0.34) in 2006. The 2002-2006 average mortality attributed to the northeast bottom trawl was 193 animals (CV=0.13; Table 2).

Northeast Mid-water Trawl Fishery (Including Pair Trawl)
The observer coverage in this fishery was highest after 2003, though a few trips in earlier years were observed (Table 2). A white-sided dolphin was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) during July 2003 in a haul that was targeting (and primarily caught) herring, and 3 white-sided dolphins were taken in 2005 in paired trawls targeting herring. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data from paired and single Northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 24 (0.56) in 2003, 19 (0.58) in 2004, 15(.68) in 2005, and 19 (.44) in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2002-2006 was 19 (0.27).

Mid-Atlantic Mid-water Trawl Fishery (Including Pair Trawl)
The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). A white-sided dolphin was observed taken in the pair trawl fishery near Hudson Canyon (off New Jersey) during February 2004 in a haul that was targeting mackerel. Five white-sided dolphins were taken in paired trawls targeting mackerel in 2005 and three were taken in 2006. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic

mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 51 (0.46) in 2003, 105 (0.38) in 2004, 97(.76) in 2005, and 54 (.57) in 2006 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2002-2006 was 77 (0.30).

Mid-Atlantic Bottom Trawl Fishery
     One white-sided dolphin incidental take was observed in 1997, resulting in a mortality estimate of 161 (CV=1.58) animals. No takes were observed from 1998 through 2004 or in 2006, and one take was observed in 2005. Estimated annual fishery-related mortalities (CV in parentheses) were 27 (0.17) in 2000, 27 (0.19) in 2001, 25 (0.17) in 2002, 31 (0.25) in 2003, 26 (0.20) in 2004, 38 (0.29) in 2005, and 26 (0.25) in 2006. The 2002-2006 average mortality attributed to the mid-Atlantic bottom trawl was 29 animals (CV=0.11).

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 [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[d]	02-06	1993=349 1998=301	Obs. Data Weighout Trip Logbook	.02, .03, .06, .07, .04	1, 1, 1, 5, 2	30, 31, 7, 59 , 41	.74, .93, .98, .49, .71	34 (0.33)
Northeast Bottom Trawl[c]	02-06	unk	Obs. Data Weighout	.03, .04, .05, .12, .06	1, 12, 16, 47, 4	170, 216, 200, 213, 164	.32, .27, .30, .28, .34	193 (0.13)
Northeast Mid-water Trawl - Including Pair Trawl	02-06	27, 28, 22, 25, 25	Obs. Data Weighout Trip Logbook	.0, .031, .126, .199, .031	0,1,0,3, 0	unk, 24, 19, 15, 19	unk, .56, .58, .31, .44	19 (0.27)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl[c]	02-06	20, 23, 25, 31, 23	Obs. Data Weighout Trip Logbook	003, .018, .064, .084, .089	0,0,1,5, 3	unk, 51, 105, 97, 54	unk, .46, .38, .36, .57	77 (0.30)
Mid-Atlantic Bottom Trawl[c]	02-06	unk	Obs. Data Weighout Trip Logbook	.01, .01, .03, .03, .02	0, 0, 0, 1, 0	25, 31, 26, 38, 26	.17, .25, .20, .29, .25	29 (.11)
Total								352(0.10)

a   Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Observer Program. NEFSC collects landings data (Weighout) that are used as a measure of total effort in the Northeast gillnet fishery. Mandatory Vessel Trip Report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the sink gillnet fishery and in the two mid-water trawl fisheries. In addition, the Trip Logbooks are the primary source of the measure of total effort (soak duration) in the mid-water and bottom trawl fisheries.
b   Observer coverages for the Northeast sink gillnet are ratios based on metric tons of fish landed. Observer coverages of the trawl fisheries are ratios based on trips.
c   A new method was used to develop preliminary estimates of mortality for the mid-Atlantic and Northeast trawl fisheries during 2000-2006. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2006. In addition, the fisheries listed in Table 2 reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The *Illex, Loligo* and Mackerel fisheries are now part of the mid-Atlantic and Northeast bottom trawl fisheries.
d   After 1998, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within the stratum where white-sided dolphins were observed taken. During the years 1997, 1999, 2001, 2002, and 2004, respectively, there were 2, 1, 1, 1, and 1 observed white-sided dolphins taken on pingered trips. No takes were observed on pinger trips during 1995, 1996, 1998, 2000, 2005, and 2006.

CANADA
     There is little information available that quantifies fishery interactions involving white-sided dolphins in

Canadian waters. Two white-sided dolphins were reported caught in groundfish gillnet sets in the Bay of Fundy during 1985 to 1989, and 9 were reported taken in West Greenland between 1964 and 1966 in the now non-operational salmon drift nets (Gaskin 1992). Several (number not specified) were also taken during the 1960s in the now non-operational Newfoundland and Labrador groundfish gillnets. A few (number not specified) were taken in an experimental drift gillnet fishery for salmon off West Greenland which took place from 1965 to 1982 (Read 1994).

Hooker *et al.* (Hooker *et al.* 1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. Bycaught marine mammals were noted as weight in kilos rather than by the numbers of animals caught. Thus the number of individuals was estimated by dividing the total weight per species per trip by the maximum recorded weight of each species. During 1991 through 1996, an estimated 6 white-sided dolphins were observed taken. One animal was from a longline trip south of the Grand Banks (43° 10'N 53° 08'W) in November 1996 and the other 5 were taken in the bottom trawl fishery off Nova Scotia in the Atlantic Ocean; 1 in July 1991, 1 in April 1992, 1 in May 1992, 1 in April 1993, 1 in June 1993 and 0 in 1994 to 1996.

Estimation of small cetacean bycatch is currently underway for Newfoundland fisheries using data collected during 2001 to 2003 (pers. comm. J. Lawson, DFO). White-sided dolphins were reported to have been caught in the Newfoundland nearshore gillnet fishery and offshore monkfish/skate gillnet fisheries.

Herring Weirs

During the last several years, one white-sided dolphin was released alive and unharmed from a herring weir in the Bay of Fundy (A. Westgate, pers. comm.). Due to the formation of a cooperative program between Canadian fishermen and biologists, it is expected that most dolphins and whales will be able to be released alive. Fishery information is available in Appendix III.

Other Mortality

U.S.

During 2002-2006 there were 325 documented Atlantic white-sided dolphin strandings on the US Atlantic coast (Table 3). Twenty-four of these animals were released alive. Human interaction was indicated in 11 records during this period. Of these, 5 were classified as fishery interactions.

Mass strandings involving up to a hundred or more animals at one time are common for this species. 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 all of the marine mammals that die or are seriously injured may not 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.

CANADA

Small numbers of white-sided dolphins have been taken off southwestern Greenland and they have been taken deliberately by shooting elsewhere in Canada (Reeves *et al.* 1999). The Nova Scotia Stranding Network documented whales and dolphins stranded on the coast of Nova Scotia during 1991 to 1996 (Hooker *et al.* 1997). Researchers with Dept. of Fisheries and Oceans (DFO), Canada documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. White-sided dolphins stranded at nearly all times of the year on the mainland and on Sable Island. On the mainland of Nova Scotia, a total of 34 stranded white-sided dolphins was recorded between 1991 and 1996: 2 in 1991 (August and October), 26 in July 1992, 1 in Nov 1993, 2 in 1994 (February and November), 2 in 1995 (April and August) and 2 in 1996 (October and December). During July 1992, 26 white-sided dolphins stranded on the Atlantic side of Cape Breton. Of these, 11 were released alive and the rest were found dead. Among the rest of the Nova Scotia strandings, 1 was found in Minas Basin, 2 near Yarmouth and the rest near Halifax. On Sable Island, 10 stranded white-sided dolphins were documented between 1991 and 1998; all were males, 7 were young males (< 200cm), 1 in January 1993, 5 in March 1993, 1 in August 1995, 1 in December 1996, 1 in April 1997 and 1 in February 1998.

Whales and dolphins stranded between 1997 and 2005 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows (Table 3): 0 white-sided dolphins stranded in 1997 to 2000, 3 in September 2001 (released alive), 5 in November 2002 (4 were released

alive), 0 in 2003, 19-24 in 2004 (15-20 in October (some (unspecified) were released alive) and 4 in November were released alive), 0 in 2005, and 1 in 2006.

Area	2002	2003	2004	2005	2006	Total
Maine	4	2	10	3	3	22
New Hampshire				1		1
Massachusetts[a,b]	53	59	34	60	49	255
Rhode Island	2			2	4	8
Connecticut		1				1
New York	1	2	1		3	7
New Jersey	1	1	1	6	1	10
Delaware					1	1
Maryland				1	1	2
Virginia[b]	1		4	3	3	11
North Carolina		1	2	3	1	7
TOTAL US	**62**	**66**	**52**	**79**	**66**	**325**
Nova Scotia	6		2		1	9
GRAND TOTAL	68	66	54	79	67	334

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2002-2006.

[a] Records of mass strandings in Massachusetts are: March 1999 - 53 animals; April 2000 - 5 animals; August 2000 - 11 animals; April 2001 - 6 animals; March 2002 - 31 animals, of which 7 were released alive; August 2002 - 3 animals, of which 1 was released alive; January 2003 - 4 animals; April 2003 - 28 animals; November 2003 - 4 animals; February 2005 - 8 animals (3 released alive); April 2005 - 6 animals (all released alive); May 2005 strandings of 2 animals (both released alive but one died later); 3 animals (one released alive) and 5 animals; December 2005 - 2 animals; and January 2006 4 separate events involving 23 white-sided dolphins (5 released alive); February 2006 2 events involving 1 and 5 animals; and July 2006 - 9 animals (7 released alive).

[b] Strandings that appear to involve a human interaction are: 1 animal from Virginia in May 2002 had signs of fishery interaction; 2 animals from Massachusetts in March 2002 had signs of fishery interactions; 1 animal from Massachusetts in 2004 was a fishery interaction; and 1 other animal from Massachusetts in 2004 was found with twine obstructing its esophagus. In 2005, 5 animals had signs of human interaction but in no case was the human interaction able to be determined to be the cause of death. In 2006, 1 animal from Massachusetts was classified as having signs of fishery interaction.

STATUS OF STOCK

The status of white-sided dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. The total U.S. 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 non-strategic stock because the 2002-2006 estimated average annual human related mortality does not exceed PBR.

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ROUGH-TOOTHED DOLPHIN *(Steno bredanensis)*: Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the rough-toothed dolphin (*Steno bredanensis*) is poorly understood worldwide. These dolphins are thought to be a tropical to warm-temperate species, and historically have been reported in deep oceanic waters in the Atlantic, Pacific, and Indian oceans and the Mediterranean and Caribbean seas (Perrin and Walker 1975; Leatherwood and Reeves 1983; Reeves *et al.* 2003; Gannier and West 2005). Rough-toothed dolphins have, however, been observed in both shelf and oceanic waters in the northern Gulf of Mexico, and off Japan, Brazil, and Mauritania (Maigret *et al.* 1976; Miyazaki 1980; Lodi and Hetzel 1999; Addink and Smeenk 2001; Fulling *et al.* 2003; Mullin and Fulling 2003; Gannier and West 2005). In French Polynesia, rough-toothed dolphins were observed in deep waters, but were more commonly distributed inshore than offshore (Gannier and West 2005). Ritter (2002) observed rough-toothed dolphins in the Canary Islands in waters from 20 m to 2,500 m, with the average depth reported as 506 m and surface water temperatures ranging from 17° to 24°C. Rough-toothed dolphins have been reported feeding in waters off Brazil ranging from 5 m to 39 m in depth, with surface temperatures between 22°to 24°C (Lodi and Hetzel 1999). Sightings of rough-toothed dolphins along the East Coast of the U.S. are much less common than in the Gulf of Mexico (CETAP 1982; NMFS 1999; Mullin and Fulling 2003).

In the western North Atlantic, tracking of five rough-toothed dolphins which were rehabilitated and released following a mass stranding on the east coast of Florida in 2005, demonstrated a variety of ranging patterns (Wells *et al.* In review). All tagged rough-toothed dolphins moved through a large range of water depths averaging greater than 100 m, though each of the five tagged dolphins transited through very shallow waters at some point, with most of the collective movements recorded over a gently sloping sea floor. These five rough-toothed dolphins moved through waters ranging from 17° to 31°C, with temperatures averaging 21° to 30°C. Recorded dives were rarely deeper than 50 m, with the tagged dolphins staying fairly close to the surface. Three rehabilitated rough-toothed dolphins released with tags near Ft. Pierce, Florida in March 2005 were tracked in waters averaging 1,100 m in depth with sea surface temperatures averaging 24°C during the first week of tracking, moving to waters of 19°C (Wells and Gannon 2005). Rehabilitated rough-toothed dolphins released and tracked in the northeast Gulf of Mexico in 1998 were recorded in waters with an average depth of 195 m and an average sea surface temperature of 25°C, typically over or near an escarpment (Wells *et al.* 1999). It is not known how representative of normal species patterns any of these movements are.

Although Miyazaki and Perrin (1994) describe these dolphins as a "diving species," dives of more than 3 minutes duration were rare for the tagged dolphins (Wells *et al.* 1999; Wells and Gannon 2005; Wells *et al.* In review), similar to behavior reported for this species by Lodi and Hetzel (1999) and Ritter (2002).

These dolphins are typically seen in small groups of 10-20 animals (Wade and Gerrodette 1993; Jefferson 2002; Reeves *et al.* 2003; Waring *et al.* 2007) . Larger groups have been recorded, namely groups of 45 animals in the Atlantic (CETAP 1982), over 50 animals in the eastern tropical Pacific, 99 animals in the Caribbean (Swartz *et al.* 2001), 160 animals in the Mediterranean, and 300 animals off Hawaii (Miyazaki and Perrin 1994).

Tagging studies of rehabilitated and released rough-toothed dolphins, as well as field observations, indicate that social
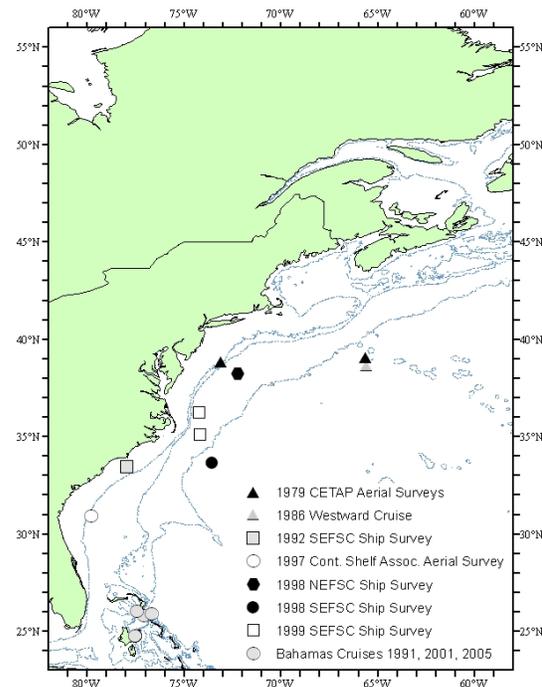
Figure 1. *Distribution of rough-toothed dolphin sightings from 1979 - 2005. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

bonds between members of a group may be strong. Two rough-toothed dolphins tagged and released in the Gulf of Mexico in 1998 were observed together 157 after release (Wells *et al.* 1999). Three rough-toothed dolphins released together near Ft. Pierce, Florida in 2005 exhibited frequent social interactions including food sharing, epimeletic care-giving behavior and whistle exchanges and were seen together throughout the tracking period of at least 20 days (Wells and Gannon 2005). Similar complex social behaviors have also been reported for this species off the Canary Islands (Ritter 2002; 2007), Brazil (Lodi 1992; de Moura *et al.* 2008), and Honduras (Kuczaj II and Yeater 2007). Photo-identification techniques suggest resident populations may exist off the coast of Utila, Honduras (Kuczaj II and Yeater 2007), in the Mediterranean Sea near Sicily (Reeves *et al.* 2003), and off the Canary Islands (Ritter 2001; 2007).

For management purposes, rough-toothed dolphins observed off the eastern U.S. coast are provisionally considered a separate stock from dolphins recorded in the northern Gulf of Mexico, although there is currently no information to differentiate these stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The number of rough-toothed dolphins off the eastern U.S. and Canadian Atlantic coast is unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen during surveys. With one exception, sightings were exclusively over or seaward of the continental slope north of the Bahamas (Figure 1). Though abundance estimates have been calculated in some cases, given the paucity of sightings as well as limited survey effort in deep, offshore areas, an accurate abundance estimate has not been made, and therefore the population size of rough-toothed dolphins in the western North Atlantic is presently considered unknown.

Rough-toothed dolphins were seen only twice during the Cetacean and Turtle Assessment Program (CETAP) surveys conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). Twenty probable rough-toothed dolphins were seen from the U.S. Coast Guard cutter *Cherokee* during the CETAP Platform of Opportunity Program (POP) in June 1979. In September 1979, 45 rough-toothed dolphins were observed from the Russian R/V *Belagorsk*. No abundance estimate was made based on these two sightings.

A sighting of 9 rough-toothed dolphins was made from the R/V *Westward* in June 1986 during an opportunistic cruise (Kenney pers. comm.). In January 1992, 6 rough-toothed dolphins were reported during a SEFSC aerial survey. Three rough-toothed dolphins were observed on 5 March 1997 during an aerial survey conducted by Continental Shelf Associates (Kenney pers. comm.).

Eight rough-toothed dolphins were seen on 28 July 1998 during a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Mullin and Fulling 2003). An abundance estimate of 274 (CV=1.03) was calculated based on this one sighting.

Three rough-toothed dolphins were observed from a ship in July 1998 during a line-transect sighting survey conducted from 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006). An abundance estimate of 30 (CV=0.86) was calculated based on this one sighting.

Two groups of rough-toothed dolphins were observed during a vessel survey of the western North Atlantic off Cape Hatteras, North Carolina in waters greater than 2,500 m deep (NMFS 1999). Four rough-toothed dolphins were seen in August 1999, and 20 rough-toothed dolphins were seen in September 1999. No abundance estimate was made based on these two sightings.

Recent surveys and abundance estimates

There have been no sightings of rough-toothed dolphins during shipboard or aerial surveys since 1999, except in the Caribbean, despite survey cruises conducted in areas where previous sightings of this species had been made. Survey effort in deep, offshore areas off the eastern U.S. coast and in the Caribbean, where this species may occur with more frequency, has, however, been limited.

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean

populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY
Fishery Information

Detailed fishery information is reported in Appendix III. No rough-toothed dolphins have been reported as bycatch in any of these fisheries (Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Palka, pers. com.; Fairfield Walsh and Garrison 2007). Total annual estimated average fishery-related mortality and serious injury to this stock during 2002-2006 was zero rough-toothed dolphins, as there were no reports of mortality or serious injury to this stock.

Rough-toothed dolphins have been taken incidentally in the tuna purse seine nets in the eastern tropical Pacific, and in gill-nets off Sri Lanka, Brazil and the offshore North Pacific (Jefferson 2002), though no incidental takes have been reported off the eastern U.S. coast. A small number of this species are taken in directed fisheries in the Caribbean countries of St. Vincent and the Lesser Antilles, as well as in countries in the Pacific and eastern north Atlantic Oceans (Northridge 1984; Argones 2001; Jefferson 2002; Reeves *et al.* 2003).

Other Mortality

From 2002 to 2006, 146 rough-toothed dolphins were reported stranded between Maine and Puerto Rico (Table 2). Human interaction was recorded for two dolphins that stranded in North Carolina in 2006, though specific details of the type of interaction were not recorded. Although rarely observed at sea in the southeastern U.S., this species accounts for 34% of the reported mass strandings involving 5 or more animals in the past 10 years. The majority of these occurred along the Atlantic coast of Florida and Georgia and the Gulf coast of Florida (NMFS 2008, Table 1).

Table 2. Rough-toothed dolphin (*Steno bredanensis*) strandings along the U.S. Atlantic coast (2002-2006).

STATE	2002	2003	2004	2005	2006	TOTALS
Virginia	14[1]	0	0	0	0	14
North Carolina	0	0	0	0	2	2
Georgia	0	17[2]	0	0	0	17
Florida	1	2	37[3]	70[4]	1	111
Puerto Rico	0	2	0	0	0	2
TOTALS	15	21	37	70	3	146

[1]Mass live stranding of 14 animals in Northampton, VA in July 2002.
[2]Mass live stranding of 17 animals in Glynn, GA in July 2003.
[3]Mass live stranding of 37 animals in St. Lucie, FL in August 2004.
[4]Mass live stranding of 69 animals in March 2005 in Marathon, FL.

At least thirty-six rough-toothed dolphins stranded on Hutchinson Island in St. Lucie County, Florida on 6 August 2004, and another one live-stranded on 8 August 2004. Due to severe weather, the animals were walked to chest-high water and released simultaneously. The dolphins restranded later the same evening 5.6 km to the north. Thirty dolphins were euthanized on site, and seven were taken to a rehabilitation facility. Four of the dolphins died in rehabilitation and three were released on 3 March 2005 with satellite transmitters 29 km east of Ft. Pierce, Florida. All three dolphins remained together and were last recorded off the Virginia/North Carolina coast. Two of the 37 dolphins showed signs of human interaction – one had a plastic bottle cap in its fore-stomach, while the second animal had black plastic in its fore-stomach.

On 2 March 2005, at least 69 rough-toothed dolphins mass-stranded alive on the Atlantic Ocean side of Marathon Island in the Florida Keys, though additional animals may have swam away or not been recovered. Fifty-six animals (41 females and 15 males) were evaluated for rehabilitation candidacy, 10 of which died naturally and 14 were euthanized on site. The remaining 32 dolphins were transferred to three rehabilitation facilities, though 12 of these dolphins died during rehabilitation. No evidence of human or fishery interaction was reported in any of the dolphins. A review of the potential causative factors for this mass stranding suggested that a transient environmental change, specifically a rapid change in near-shore water temperatures associated with a shift in wind direction, led an already nutritionally deficient group of dolphins into shallow water (NMFS 2008). Once in this habitat, the dolphins were presumably unable to navigate their way back out, resulting in the stranding. There was no indication of significant health effects due to toxins associated with harmful algal blooms, there was no evidence of acoustic trauma and only very limited potential exposure to Naval active acoustic activity, nor was there any evidence that an infectious agent such as a parasite, bacteria, or virus resulted in significant health effects and contributed to the stranding event

Eleven rehabilitated dolphins from this stranding were tagged and released back into the Atlantic Ocean in continental slope waters, two on 20 April 2005 off Key Biscayne, Florida; seven on 3 May 2005 and two on 12 September 2005 off Key Largo, Florida. Ten dolphins were tagged with VHF or satellite-linked transmitters and were tracked for 12-49 days (Wells *et al.* In review). For the two releases involving multiple tagged dolphins, the individuals appeared to remain together through much, if not all, of the tracks (Lodi 1992; Miyazaki and Perrin 1994; Lodi and Hetzel 1999; Wells and Gannon 2005). Detailed information on this mass stranding is available in National Marine Fisheries Service (2008) and in the companion report on follow-up tracking (Wells *et al.* In review).

A potential human-caused source that may contribute to mortality for this species is from persistent organic pollutants (POPs), which were analyzed in 15 stranded rough-toothed dolphins from the Gulf of Mexico (Struntz *et al.* 2004). Although these dolphins exhibited lower concentrations of polychlorinated biphenyls (PCBs) than those observed in other species of dolphins including Risso's, striped and bottlenose dolphins sampled in Japan, the Mediterranean and the Gulf coast of Texas, respectively, the concentrations were above the toxic threshold for marine mammal blubber suggested by Kannan *et al.* 2000. Struntz *et al.* (2004) concluded it was "likely that PCBs pose a health risk for the population represented by this limited sample group." Plastic debris may also pose a threat to this, and other, species, as evidenced by a plastic bag found in the stomach of two stranded rough-toothed dolphins – one which stranded in 2004 in St. Lucie County Florida (see above), and one in northeastern Brazil (de Meirelles and Barros 2007), and a plastic bottle cap found in one of the dolphins which stranded in St. Lucie County, Florida in 2004 (see above).

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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 rough-toothed 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 size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed; therefore, total fishery-related mortality and serious injury can be considered insignificant and approaching zero mortality. This is not a strategic stock.

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SHORT-BEAKED 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 occur over the continental shelf along the 200-2000 m isobaths and over prominent underwater topography from 50º N to 40º 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). In waters off the northeastern USA coast common dolphins are distributed along the continental slope (100 to 2,000 m) and are associated with Gulf Stream features (CETAP 1982; Selzer and Payne 1988; Waring *et al.* 1992; Hamazaki 2002). They occur from Cape Hatteras northeast to Georges Bank (35˚ to 42˚N) during mid-January to May (Hain *et al.* 1981; CETAP 1982; Payne *et al.* 1984). Common dolphins move 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 occasionally found in the Gulf of Maine (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11ºC (Sergeant *et al.* 1970; Gowans and Whitehead 1995).

Westgate (2005) tested the proposed one-population-stock model using a molecular analysis of mitochondrial DNA (mtDNA), as well as a morphometric analysis of cranial specimens. Both genetic analysis and skull morphometrics failed to provide evidence (p>0.05) of more then a single population in the western North Atlantic, supporting the proposed one stock model. However, when western and eastern North Atlantic common dolphin mtDNA and skull morphology were compared, both the cranial and mtDNA results showed evidence of restricted gene flow (p<0.05) indicating that these two areas are not panmictic. Cranial specimens from the two sides of the North Atlantic differed primarily in elements associated with the rostrum. These results suggest that common dolphins in the western North Atlantic are composed of a single panmictic group whereas gene flow between the western and eastern North Atlantic is limited (Westgate 2005; 2007).

Figure 1. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

There is also a peak in parturition during July and August with an average birth day of July 28th. Gestation lasts about 11.7 months and lactation lasts at least a year. Given these results western North Atlantic female common dolphins are likely on a 2-3 year calving interval. Females become sexually mature earlier (8.3 years and 200 cm) than males (9.5 years and 215 cm) as males continue to increase in size and mass. There is significant sexual dimorphism present with males being on average about 9% larger in body length (Westgate 2005; Westgate and Read 2007).

POPULATION SIZE

The total number of common dolphins off the U.S. or Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for selected time periods. The best abundance estimate for common dolphins is 120,743 animals (CV= 0.23). This is the sum of the estimates from two 2004 U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 90,547 (CV=0.24), and from the southern U.S. Atlantic is 30,196 (CV=0.54). This joint estimate is considered best because the two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 29,610 common dolphins (CV=0.39) was obtained from an aerial survey program conducted

from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 22,215 (CV=0.40) common dolphins was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). An abundance estimate of 1,645 (CV=0.47) common dolphins was obtained 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 (NMFS 1993). An abundance estimate of 6,741 (CV=0.69) common dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered 32,600 km in waters from Virginia to the mouth of the Gulf of St. Lawrence. An abundance estimate of 30,768 (CV=0.32) common dolphins was generated from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006). The SEFSC conducted a shipboard line-transect sighting survey between 8 July and 17 August 1998, surveying 4,163 km of track line in waters south of Maryland (38ºN) and sighted no common dolphins (Mullin and Fulling 2003). Although the 1991, 1993, 1995, and 1998 surveys did not sample the same areas or encompass the entire common dolphin habitat (e.g., little effort in Scotian shelf edge waters), they did focus on segments of known or suspected high-use habitats off the northeastern USA coast. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 6,460 (CV=0.74) common dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1: Palka 2006). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 90,547 (CV= 0.244) common dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of trackline in waters north of Maryland (38ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 30,196 (CV=0.537) common dolphins was derived from a shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50 m) between Florida and Maryland (27.5 and 38º N latitude) conducted during June-August, 2004 (Table 1). The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias (*g(0)*) and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001; Palka 2006).

An abundance estimate of 84,000 (CV=0.36) common dolphins was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

Table 1. Summary of abundance estimates for western North Atlantic short-beaked 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
Aug 2002	S. Gulf of Maine to Maine	6,460	0.74
Jun-Aug 2004	Maryland to Bay of Fundy	90,547	0.24
Jun-Aug 2004	Florida to Maryland	30,196	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	120,743	0.23
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	84,000	0.36

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 120,743 animals (CV=0.23) derived from the 2004 surveys. The minimum population estimate for the western North Atlantic common dolphin is 99,975.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 99,975 animals. 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 the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic stock of common dolphin is 1,000.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2002-2006 was 161 (CV=0.10) common dolphins (Table 2).

Fishery information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Fisheries Conservation and Management Act (FCMA), an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. During the period 1977-1986, observers recorded 123 mortalities in foreign *Loligo* squid-fishing activities. No mortalities were reported in foreign *Illex* squid fishing operations.

From 1977 to 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. A U.S. joint venture (JV) mackerel fishery was conducted in the mid-Atlantic region from February-May 1998. Seventeen incidental takes of common dolphin were observed in this fishery.

In the Atlantic pelagic longline fishery between 1990 and 2006, 20 common dolphins were observed hooked and released alive. No takes have been observed within the last five years.

Eight hundred and sixty-one common dolphin mortalities were observed between 1989 and 1998 in the pelagic drift gillnet fishery, resulting in an estimated annual mortality and serious injury attributable to this fishery of (CV in parentheses) 540 in 1989 (0.19), 893 in 1990 (0.18), 223 in 1991 (0.12), 227 in 1992 (0.09), 238 in 1993 (0.08), 163 in 1994 (0.02), 83 in 1995 (0), 106 in 1996 (0.07) and 255 in 1998 (0). The fishery was closed in 1997.

Twelve mortalities were observed in the pelagic pair trawl 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 and 5.6 in 1995 (0.35).

The estimated fishery-related mortality of common dolphins attributable to the *Loligo* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries was 0 between 1997-1998 and 49 in 1999 (CV=0.97). After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

In the Atlantic mackerel portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries, the estimated fishery-related mortality was 161 (CV=0.49) animals in 1997 and 0 in 1998 and 1999. However, the

estimates in both the mackerel and *Loligo* fisheries should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl and mid-Atlantic mid-water trawl fisheries.

There was one observed take in the Southern New England/Mid-Atlantic Bottom Trawl fishery reported in 1997. The estimated fishery-related mortality for common dolphins attributable to this fishery was 93 (CV=1.06) in 1997 and 0 in 1998 and 1999. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

For more details on the earlier fishery interactions see Waring *et al.* (2007).

Northeast Sink Gillnet

Four common dolphins were observed taken in Northeast sink gillnet fisheries in 2005 and one in 2006. The estimated annual fishery-related mortality and serious injury attributable to the northeast sink gillnet fishery (CV in parentheses) was 0 in 1995, 63 in 1996 (1.39), 0 in 1997, 0 in 1998, 146 in 1999 (0.97), 0 in 2000-2004, 26 (0.80) in 2005, and 20 (1.05) in 2006. The 2002-2006 average mortality attributed to the northeast sink gillnet was 9 animals (CV=0.64).

Mid-Atlantic Gillnet

One common dolphin was taken in an observed trip during 2006. Two common dolphins were observed taken in 1995, 1996 and 1997, and no takes were observed from 1998 to 2005. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7.4 in 1995 (0.69), 43 in 1996 (0.79), 16 in 1997 (0.53), 0 in 1998-2005, and 11 (1.03) in 2006. Average annual estimated fishery-related mortality attributable to this fishery during 2002-2006 was 2 (CV=1.03) common dolphins (Table 2).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. One common dolphin was observed taken in 2002, three in 2004, five in 2005, and 1 in 2006. (Table2). The estimated annual fishery-related mortality and serious injury attributable to the northeast bottom trawl fishery (CV in parentheses) was 27 in 2000 (0.29), 30 (0.30) in 2001, 26 (0.29) in 2002, 26 (0.29) in 2003, 26 (0.29) in 2004, 32 (0.28) in 2005, and 25 (0.28) in 2006. The 2002-2006 average mortality attributed to the northeast bottom trawl was 27 animals (CV=0.13).

Mid-Atlantic Bottom Trawl

Three common dolphins were observed taken in mid-Atlantic bottom trawl fisheries in 2000, two in 2001, nine in 2004, 15 in 2005, and 14 in 2006 (Table 2). The estimated annual fishery-related mortality and serious injury attributable to the northeast bottom trawl fishery (CV in parentheses) was 93 in 2000 (0.26), 103 (0.27) in 2001, 87 (0.27) in 2002, 99 (0.28) in 2003, 159 (0.30) in 2004, 141 (0.29) in 2005, and 131 (0.28) in 2006. The 2002-2006 average mortality attributed to the mid-Atlantic bottom trawl was 123 animals (CV=0.12).

Table 2. Summary of the incidental mortality of short-beaked 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 [a]	Years	Vessels	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	02-06	unk	Obs. Data Weighout, Logbooks	.02, .03, .06, .07, .04	0, 0, 0, 0, 0	0, 0, 0, 4, 1	0, 0, 0, 0, 0	0, 0, 0, 26, 20	0, 0, 0, 26, 20	0, 0, 0, .8, 1.05	9 (0.64)
Mid-Atlantic Gillnet	02-06	unk	Obs. Data, Weighout	.01, .01, .02, .03, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 11	0, 0, 0, 0, 11	0, 0, 0, 0, 1.03	2 (1.03)

Northeast Bottom Trawl[d]	02-06	unk	Obs. Data Dealer Data VTR Data	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	1, 0, 3, 5, 1	0, 0, 0, 0, 0	26, 26, 26, 32, 25	26, 26, 26, 32, 25	.29, .29, .29, .28, .28	27 (.13)
Mid-Atlantic Bottom Trawl[d]	02-06	unk	Obs. Data Dealer	.01, .01, .03 , .03, .02	0, 0, 0, 0, 0	0, 0, 9, 15, 14	0, 0, 0, 0, 0	87, 99, 159, 141, 131	87, 99, 159, 141, 131	.27, .28, .30, .20, .28	123 (.12)
TOTAL											161 (.10)

a. The fisheries listed in Table 2. reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The *Illex, Loligo* and Mackerel fisheries are now part of the 'mid-Atlantic bottom trawl' and 'mid-Atlantic midwater trawl' fisheries.

b. Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Dealer reported data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) that are used to determine the spatial distribution of landings and fishing effort.

c. The observer coverages for the Northeast sink gillnet fishery are ratios based on tons of fish landed. North Atlantic bottom trawl and mid-Atlantic bottom trawl fishery coverages are ratios based on trips.

d. A new method was used to develop estimates of mortality for the mid-Atlantic and Northeast bottom trawl fisheries during 2000-2006. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2006. NE and MA bottom trawl mortality estimates reported for 2006 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2006 effort. This assumes that fishing practices during 2006 were consistent with fishing practices during the 2000-2005 time period. Complete documentation of methods used to estimate cetacean bycatch mortality are described in 'Estimated Bycatch of Cetaceans in Northeast U.S. Bottom Trawl Fishing Gear' but is not available for distribution. The manuscript is expected to be published in 2009.

CANADA

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

Other Mortality

From 2002 to 2006, 352 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass stranded common dolphins in Massachusetts during 2002 (12 animals), 2004 (one event of 6 animals and one of 3 animals), a total of 43 in 2005 in 4 separate events, and a total of 65 in 2006 in 10 events. Five of the 2005 Massachusetts stranded animals and 18 animals in 2006 were released alive. In 2002, one stranding in New York and another animal in Virginia were designated as human interactions/fishery interactions. Common dolphins were included in the UME (unusual mortality event) declared for Virginia in 2004 (MMC 2005). The strandings were primarily bottlenose dolphins, but common dolphins were also involved. Human interactions were indicated on one of the 2004 Virginia common dolphin mortality records, one of the 2005 New York mortality records and one of the 2006 Virginia mortality records.

Four common dolphin strandings (6 individuals) were reported on Sable Island, Nova Scotia from 1996 to 1998 (Lucas and Hooker 1997; 2000). One common dolphin was reported stranded in Halifax County, Nova Scotia in 2005 (Tonya Wimmer, pers. comm.).

Table 3. Short-beaked common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2002-2006.

STATE	2002	2003	2004	2005	2006	TOTALS
Maine	0	0	0	0	0	0
Massachusetts[a]	34	22	26	64	100	236
Rhode Island	1	2	1	0	2	6
Connecticut	0	0	0	0	0	0
New York [b, c]	5	11	3	4	3	26
New Jersey	1	6	17	4	2	30
Delaware	1	1	2	1	0	5
Maryland	0	0	5	0	0	5
Virginia[b, c]	3	4	8	2	1	18
North Carolina	0	7	4	1	2	14
Georgia	0	0	0	0	0	0
Florida	1	0	0	0	0	1
EZ	0	0	1	0	0	1
TOTALS	46	53	67	76	110	352

a. Massachusetts mass strandings (2002 - 9 animals; 2004 - 6 and 3; 2005 - 7,5,25, and 4; 2006 - 2,2,3,4,4,3,9,10,14, and 14).
b. Virginia reports 1 common dolphin found in a pound net in 2004. One common dolphin was released alive from a pound net in 2006 in New York.
c. One fisheries interaction mortality was reported in New York and one in Virginia in 2002. One 2005 mortality in New York reported as having human interaction and one in Virginia in 2006.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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 short-beaked 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. There are insufficient data to determine the population trends for this species. The total U.S. 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 2002-2006 average annual human-related mortality does not exceed PBR; therefore, this 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 morphologically and genetically distinct bottlenose dolphin morphotypes (Duffield *et al.* 1983; Duffield 1986) described as the coastal and offshore forms. Both inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997) along the U.S. Atlantic coast. The two morphotypes are genetically distinct based upon both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean; however the offshore morphotype has been documented to occur relatively close to shore over the continental shelf south of Cape Hatteras, NC.

Bottlenose dolphins which stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles that matched that of the offshore morphotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between offshore morphotype dolphins and dolphins with hematological profiles matching the coastal morphotype which had stranded in the Indian/Banana River in Florida. North of Cape Hatteras, there is separation of the two morphotypes across bathymetry during summer months. Aerial surveys flown during 1979-1981 indicated a concentration of bottlenose dolphins in waters < 25 m deep corresponding to the coastal morphotype, and an area of high abundance along the shelf break corresponding to the offshore stock (CETAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that bottlenose dolphins concentrated close to shore were of the coastal morphotype, while those in waters > 40 m depth were from the offshore morphotype (Garrison *et al.* 2003). However, during winter months and south of Cape Hatteras, NC the range of the coastal and

Figure 1. Distribution of bottlenose dolphin sightings from NEFSC and SEFSC aerial surveys during summer in 1998, 1999, 2002, 2004, and 2006. Isobaths are at 100 m, 1,000 m, and 4,000 m.

offshore morphotypes overlap to some degree. Torres *et al.* (2003) found a statistically significant break in the distribution of the morphotypes at 34 km from shore based upon the genetic analysis of tissue samples collected in nearshore and offshore waters. The offshore morphotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore in water depths of 13 m (Garrison *et al.* 2003). Systematic biopsy collection surveys were conducted coastwide during the summer and winter between 2001and 2005 to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, North Carolina the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth based upon a logistic regression analysis (Garrison *et al.* 2003).

Seasonally, bottlenose dolphins occur over the outer continental shelf and inner slope as far north as Georges

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Bank (Figure 1; CETAP 1982; Kenney 1990). Sightings occurred along the continental shelf break from Georges Bank to Cape Hatteras during spring and summer (CETAP 1982; Kenney 1990). In Canadian waters, bottlenose dolphins have occasionally been sighted on the Scotian Shelf, particularly in the Gully (Gowans and Whitehead 1995; NMFS unpublished data). The range of the offshore bottlenose dolphin includes waters beyond the continental slope (Kenney 1990), and offshore bottlenose dolphins may move between the Gulf of Mexico and the Atlantic (Wells *et al.* 1999). Dolphins with characteristics of the offshore type have stranded as far south as the Florida Keys.

POPULATION SIZE

The best available estimate for offshore morphotype bottlenose dolphins is the sum of the estimates from the June-July 2002 aerial survey covering the continental shelf, the summer 2004 vessel survey south of Maryland, and the summer 2004 vessel and aircraft surveys north of Maryland. This joint estimate provides complete coverage of the offshore habitat from central Florida to Canada during summer months. The combined abundance estimate from these surveys is 81,588 (CV=0.17).

Earlier abundance estimates

An abundance of 16,689 (CV=0.32) bottlenose dolphins was estimated from a line-transect sighting survey conducted during July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of trackline in waters north of Maryland (38˚N) (Figure 1; Palka, unpublished). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*. An abundance of 13,085 (CV=0.40) for bottlenose dolphins was obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38˚N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001; Thomas *et al.* 1998) where school size bias and ship attraction were accounted for.

Recent surveys and abundance estimates

During the summer (June - July) of 2002, aerial surveys covering a total of 6,734 km of trackline were conducted along the U.S. Atlantic coast between Ft. Pierce, Florida and Sandy Hook, New Jersey. The abundance of bottlenose dolphins in survey strata was obtained using line-transect methods and distance analysis, and the direct duplicate estimator was used to account for visibility bias (Buckland *et al.* 2001; Palka 1995). These estimates were further partitioned between the coastal and offshore morphotypes based upon the results of the logistic regression models and spatial analyses described above. A parametric bootstrap approach was used to incorporate the uncertainty in the logistic regression models into the overall uncertainty in the abundance estimate for offshore bottlenose dolphins (Garrison *et al.* 2003). The resulting coastwide abundance estimate for the offshore morphotype in waters < 40 m depth was 26,849 (CV=0.193).

An abundance of 9,786 (CV=0.56) for offshore morphotype bottlenose dolphins was estimated from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of 38˚N (Table 1; Palka 2005). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An estimate of abundance obtained from an aerial survey conducted in August 2002 was 5,100 (CV=0.41) offshore morphotype bottlenose dolphins and an abundance estimate of 2,989 (CV=1.11) was obtained from a survey conducted in August 2006. The 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of *g(0)* (Palka 2005). The estimate of *g(0)* was derived from the pooled data from the three aerial surveys, while the density estimates were year-specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000-m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000-m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100-m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths > 50 m) between 27.5

and 38ºN latitude was conducted during June-August 2004. The survey employed two independent visual teams searching with "bigeye" binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias ($g(0)$) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for offshore morphotype bottlenose dolphins between Florida and Maryland was 44,953 (CV=0.26).

Table 1. Summary of abundance estimates for western North Atlantic offshore stock of bottlenose 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
Jun-Jul 2002	New Jersey to Florida	26,849	0.19
Aug 2002	S. Gulf of Maine to Maine	5,100	0.41
Jun-Aug 2004	Maryland to Bay of Fundy	9,786	0.56
Jun-Aug 2004	Florida to Maryland	44,953	0.26
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,989	1.11

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 minimum population estimate for western North Atlantic offshore bottlenose dolphin is 70,775.

Current Population Trend

The data are insufficient to determine population trends. Previous estimates cannot be utlized to assess trends because previous survey coverage of the species' habitat was incomplete.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for offshore bottlenose dolphins is 70,775. 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 0.4 because this stock is of unknown status and due to the high degree of uncertainty in bycatch estimates (CV can not be calculated). PBR for the western North Atlantic offshore bottlenose dolphin is therefore 566.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual human-caused mortality and serious injury of offshore bottlenose dolphins is unknown.

Fisheries Information

Total estimated mean annual fishery-related mortality for this stock during 2001-2006 is unknown, however mortalities of offshore bottlenose dolphins were observed during this period in the Northeast Sink Gillnet and mid-Atlantic Gillnet commercial fisheries. Detailed fishery information is reported in Appendix III.

Earlier Interactions
Prior to 1977, there was no documentation of marine mammal bycatch 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 bycatch of marine mammals, was established in 1977 with the implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA).

Bottlenose dolphin mortalities were observed in the pelagic drift gillnet fishery in 1989-1998. Bycatch mortality estimates extrapolated for each year (CV in parentheses) were 72 in 1989 (0.18), 115 in 1990 (0.18), 26 in 1991 (0.15), 28 in 1992 (0.10), 22 in 1993 (0.13), 14 in 1994 (0.04), 5 in 1995 (0), 0 in 1996, and 3 in 1998 (0).

Thirty-two bottlenose dolphin mortalities were observed in the pelagic pair trawl fishery 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).

Although there were reports of bottlenose dolphin mortalities in the foreign squid mackerel butterfish 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 during 1990-1992.

One bottlenose dolphin mortality was documented in the North Atlantic bottom trawl in 1991 and the total estimated mortality in this fishery in 1991 was 91 (CV=0.97). Since 1992 there were no bottlenose dolphin mortalities observed in this fishery.

Pelagic Longline
The pelagic longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Between 1992 and 2006 in Atlantic waters, one bottlenose dolphin was observed caught and released alive during 1993, and one was caught and released alive during 1998. In addition, one bottlenose dolphin was observed taken and released alive in 2005 near the continental shelf break south of Cape Hatteras, NC. No bottlenose dolphin mortalities or serious injuries were observed between 2002 and 2006 (Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield-Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Northeast Sink Gillnet
The first observed mortality of bottlenose dolphins was recorded in 2000. This was genetically identified as an offshore morphotype animal. The estimated annual fishery-related serious injury and mortality attributable to this fishery (CV in parentheses) was 0 from 1996-1999, and 132 (CV=1.16) in 2000. There was one additional observed mortality of a bottlenose dolphin presumed to be from the offshore morphotype in this fishery during 2004. Total mortality estimates for 2002-2006 have not been calculated (Table 2).

Mid-Atlantic Gillnet
Bottlenose dolphin mortalities were observed in this fishery during 1998, 2001, and 2005. In each case, the dolphin was presumed to be of the offshore morphotype based upon its location in deep water over the outer continental shelf. The only prior estimate of total mortality in the fishery was 4 (CV=0.7) for 1998. Extrapolated estimates of total mortality from 2002 to 2006 have not been calculated (Table 2).

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	02-06	unk[c]	Obs. Data Dealer Reports, Logbooks	.02, .03, .06, .07, .04	0, 0, 1, 0, 0	0, 0, unk[d], 0, 0	0, 0, unk[d], 0, 0	unk[d]
Mid-Atlantic Gillnet	02-06	unk[c]	Obs. Data Dealer Reports	.01, .01, .02, .03, .04	0, 0, 0, 1, 0	0, 0, 0 unk[d], 0	0, 0, 0, unk[d], 0	unk[d]

Table 2. Summary of the incidental mortality of offshore morphotype 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).

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected by the Northeast Fisheries Observer Program. The NEFSC collects landings data (Dealer Reports), and total landings are used as a measure of total effort for the gillnet fisheries. Mandatory vessel trip reports (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.

b. Observer coverage of the Northeast sink gillnet and mid-Atlantic coastal gillnet fisheries are ratios based on the percentage of tons of fish landed.

c. Number of vessels is not known.

d. Estimates of bycatch mortality attributed to the Northeast sink gillnet and mid-Atlantic gillnet fisheries have not been generated

Other Mortality

Bottlenose dolphins are among the most frequently stranded small cetaceans along the Atlantic coast. Many of the animals show signs of human interaction (*i.e.*, net marks, mutilation, etc.); however, it is unclear what proportion of these stranded animals is from the offshore morphotype.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. The western North Atlantic offshore bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Average 2002-2006 annual U.S. fishery-related mortality and serious injury has not been estimated, and it is therefore unknown whether or not total mortality and serious injury can be considered insignificant.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Geographic Range and Coastal Morphotype Habitat

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York around the Florida peninsula and along the Gulf of Mexico coast. Based on differences in mitochondrial DNA haplotype frequencies, nearshore animals in the northern Gulf of Mexico and the western North Atlantic represent separate stocks (Curry 1997; Duffield and Wells 2002). On the Atlantic coast, Scott *et al.* (1988) hypothesized a single coastal migratory stock ranging seasonally from as far north as Long Island, to as far south as central Florida, citing stranding patterns during a high mortality event in 1987-88 and observed density patterns. More recent studies demonstrate that the single coastal migratory stock hypothesis is incorrect, and there is instead a complex mosaic of stocks (NMFS 2001; McLellan *et al.* 2003).

The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype primarily occupying habitats further offshore (Hoelzel *et al.* 1998; Mead & Potter 1995). Aerial surveys conducted between 1978 and 1982 (CETAP 1982) north of Cape Hatteras, North Carolina identified two concentrations of bottlenose dolphins, one inshore of the 25 m isobath and the other offshore of the 50 m isobath. The lowest density of bottlenose dolphins was observed over the continental shelf, with higher densities along the coast and near the continental shelf edge. It was suggested, therefore, that north of Cape Hatteras, North Carolina the coastal morphotype is restricted to waters < 25 m deep (Kenney 1990). Similar patterns were observed during summer months in more recent aerial surveys (Garrison and Yeung 2001; Garrison *et al*. 2003). However, south of Cape Hatteras during both winter and summer months, there was no clear longitudinal discontinuity in bottlenose dolphin sightings (Garrison and Yeung 2001; Garrison *et al.* 2003).

A combined spatial and genetic analysis of tissue samples from large vessel surveys during the summers of 1998 and 1999 indicated that bottlenose dolphins within 7.5 km from shore were most likely of the coastal morphotype, and there was a region of overlap between the coastal and offshore morphotypes between 7.5 and 34 km from shore south of Cape Hatteras (Torres *et al.* 2003). However, relatively few samples were available from the region of overlap, and therefore the longitudinal boundaries based on these initial analyses were uncertain (Torres *et al*. 2003). Extensive systematic biopsy sampling efforts were conducted in the summers of 2001 and 2002 to supplement collections from large vessel surveys. During the winters of 2002 and 2003, additional biopsy collection efforts were conducted in nearshore continental shelf waters of North Carolina and Georgia. Additional biopsy samples were collected in deeper continental shelf waters south of Cape Hatteras during winter 2002. Genetic analyses using mitochondrial DNA sequences of these biopsies identified individual animals to the coastal or offshore morphotype. Using the genetic results from all surveys combined, a logistic regression was used to model the probability that a particular bottlenose dolphin group was of the coastal morphotype as a function of environmental variables including depth, sea surface temperature, and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the two morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the two morphotypes in coastal Atlantic waters. During summer months, all biopsy samples collected from nearshore waters north of Cape Lookout, North Carolina (< 20 m deep) were of the coastal morphotype, and all samples collected in deeper waters (> 40 m deep) were of the offshore morphotype. South of Cape Lookout, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth. In intermediate depth waters, there was spatial overlap between the two morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13 m, and coastal morphotype dolphins were observed at depths of 31 m and 75 km from shore (Garrison *et al*. 2003).

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, one offshore morphotype group was sampled during November just south of Cape Lookout only 7.3 km from shore. Coastal morphotype samples were also collected farther away from shore at 33 m depth and 39 km distance from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions were highly uncertain due to

limited sample sizes and spatial overlap between the two morphotypes. Samples collected in Georgia waters also indicated significant overlap between the two morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected 112 km from shore and a depth of 38 m. An offshore sample was collected in 22 m depth at 40 km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the two morphotypes (Garrison *et al.* 2003).

In summary, the primary habitat of the coastal morphotype of bottlenose dolphin extends from Florida to New Jersey during summer months and in waters less than 20 m deep, including estuarine and inshore waters. South of Cape Lookout, the coastal morphotype occurs in lower densities over the continental shelf (waters between 20 m and 100 m depth) and overlaps spatially with the offshore morphotype.

Distinction Between Coastal and Estuarine Bottlenose Dolphins

There are multiple lines of evidence supporting demographic separation between bottlenose dolphins residing within estuaries along the Atlantic coast. For example, long-term photo-identification studies in waters around Charleston, South Carolina have identified communities of resident dolphins that are seen within relatively restricted home ranges year-round (Zolman 2002; Gubbins 2002; Speakman *et al.* 2006). In Biscayne Bay, Florida there is a similar community of bottlenose dolphins with evidence of year-round residents that are genetically distinct from animals residing in a nearby estuary in Florida Bay (Litz 2007). The Indian River Lagoon system in central Florida also has a long photo-identification study, and this study identified year-round resident dolphins repeatedly observed across multiple years (Stolen *et al.* 2007; Mazzoil 2008)). There are relatively few published studies demonstrating that these resident animals are genetically distinct from animals in nearby coastal waters; however, a study conducted near Jacksonville, Florida demonstrated significant genetic differences between animals in nearshore coastal waters and estuarine waters (Caldwell 2001). In addition, stable isotope analysis of animals sampled along the Outer Banks of North Carolina between Cape Hatteras and Bogue Inlet during February and March shows very low stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen, Cortese 2000). One explanation for the depleted oxygen signature is a resident group of dolphins in Pamlico Sound that move into nearby nearshore areas in the winter. The possibility of a resident group of bottlenose dolphins in Pamlico Sound is also supported by results from satellite telemetry and photo-identification (NMFS 2001). Long-term, year-round, multi-generational resident communities of dolphins have been recognized in embayments and coastal areas of the Gulf of Mexico (Wells *et al.* 1987; Wells *et al.* 1996; Scott *et al.* 1990; Weller 1998; Wells 2003), and it is not surprising to find similar patterns along the Atlantic coast.

Given the observed patterns of residency across multiple estuaries along the Atlantic coast and the evidence of demographically distinct estuarine stocks in the Gulf of Mexico (e.g., Wells 2003), it is highly likely that there is demographic separation between bottlenose dolphins residing within estuaries and those in nearshore coastal waters. However, the degree of spatial overlap between these populations remains unclear. Photo-identification studies within estuaries demonstrate seasonal immigration and emigration and the presence of transient animals (e.g., Speakman *et al.* 2006). In addition, the degree of movement of resident estuarine animals into coastal waters on seasonal or shorter time scales is poorly understood. However, for the purposes of this analysis, bottlenose dolphins inhabiting primarily estuarine habitats are considered distinct from those inhabiting coastal habitats. Bottlenose dolphin stocks inhabiting coastal waters are the focus of this report.

Definition of Coastal Stocks

Initially, a single stock of coastal morphotype bottlenose dolphins was thought to migrate seasonally between New Jersey (summer months) and central Florida based on seasonal patterns in strandings during a large scale mortality event occurring during 1987-1988 (Scott *et al.* 1988). However, re-analysis of stranding data (McLellan *et al.* 2003) and extensive analysis of genetic, photo-identification, satellite telemetry, and stable isotope studies demonstrate a complex mosaic of coastal bottlenose dolphin stocks (NMFS 2001). In the northern part of the range, the patterns reported include seasonal residency, year-round residency with large home ranges, and migratory or transient movements (Barco and Swingle 1996). There are strong seasonal differences in the spatial distribution of bottlenose dolphins in coastal waters. North of Cape Lookout, North Carolina, bottlenose dolphins were observed along the North Carolina coast and as far north as Long Island, New York during summer months (CETAP 1982, Kenney 1990, Garrison *et al.* 2003). During winter months, bottlenose dolphins are rarely observed north of the North Carolina-Virginia border, and their northern distribution appears to be limited by water temperatures < 9.5 ºC

(Garrison *et al.* 2003; Kenney 1990). Bottlenose dolphin densities are highest during winter months along the North Carolina coast south of Cape Hatteras (Garrison *et al*. 2003; Torres *et al.* 2005). Seasonal variation in the densities of animals observed off Virginia Beach, Virginia also indicates the seasonal migration of dolphins northward during summer months and then south during winter (Barco and Swingle 1996). Four dolphins tagged during 2003 and 2004 off the coast of New Jersey in late summer moved south to North Carolina and inhabited waters near and just south of Cape Hatteras during winter months. These animals then moved north to New Jersey again during the following summer (NMFS, Southeast Fisheries Science Center, unpublished data). Similarly, dolphins tagged off Virginia Beach, Virginia during the late summer occupied the area between Cape Hatteras and Cape Lookout during winter months (NMFS 2001). There is no evidence suggesting that these animals moved farther south than Cape Lookout during winter months, and there are genetic differences between animals sampled in North Carolina and areas further south (NMFS 2001). In addition, there are no matches in long term photo-identification studies between sites in New Jersey and those south of Cape Hatteras (Urian *et al.* 1999; NMFS 2001). These studies are the basis for the definition of the Northern Migratory stock in this and previous stock assessment reports.

Satellite tag telemetry studies also provide evidence for a stock of dolphins migrating seasonally along the coast between North Carolina and northern Florida. Two dolphins were tagged during November just south of Cape Fear, North Carolina. One of these animals remained along the South Carolina and southern North Carolina coasts throughout the winter while the other migrated south to northern Florida through February. In the spring, these animals moved farther north of the tagging site to Cape Hatteras. The tags did not last beyond June, and therefore the distribution of these animals during summer months is unknown (NMFS, Southeast Fisheries Science Center, unpublished data). However, there are no available genetic data to test conclusively whether or not this migrating group represents a distinct stock. Available data do demonstrate significant genetic differences between animals sampled off southern North Carolina during summer months and groups both farther north (i.e., Northern Migratory animals) and farther south. Given the observed migration patterns, a prospective Southern Migratory stock of coastal bottlenose dolphins moving between North Carolina in the summer and along the south Atlantic coast during the winter is defined.

In addition to these two migrating coastal stocks, there is evidence for coastal resident stocks. In North Carolina, additional satellite telemetry studies and movements of tracked freeze-branded animals demonstrate that some animals occurring in coastal waters do not migrate and instead reside along the North Carolina coast or in Pamlico Sound year-round (NMFS 2001). Photo-identification studies at multiple sites in North Carolina indicate frequent exchange of animals between Beaufort, North Carolina (Cape Lookout) and Wilmington, North Carolina (Cape Fear, Urian *et al.* 1999). However, there was little exchange of animals between southern North Carolina (i.e., south of Cape Lookout) and northern North Carolina or points further north (Urian *et al.* 1999, NMFS 2001). In addition, genetic analyses of samples from northern Florida, Georgia, central South Carolina (primarily the estuaries around Charleston), and southern North Carolina using both mitochondrial DNA and nuclear microsatellite markers indicate significant genetic differences between these areas (NMFS 2001). As a result, the previously defined Southern North Carolina stock is retained in this revised stock structure. There is also evidence for genetic differences between animals occupying the northern and central Florida coast (NMFS 2001). The spatial extent of these stocks, their potential seasonal movements, and their relationships with estuarine stocks are poorly understood. However, based upon the available genetic and photo-identification data, prospective stocks of coastal residents are defined.

In summary, this stock assessment report identifies seven prospective stocks of coastal morphotype bottlenose dolphins inhabiting nearshore coastal waters along the Atlantic coast (Figure 1). This prospective stock structure differs from that described in previous stock assessment reports in that 1) the Southern Migratory stock is a new identified group, 2) the previously defined summer Northern North Carolina stock is presumed to correspond primarily to the Southern Migratory stock and is redefined to exclude estuarine residents, and 3) the seasonal management unit framework of using half-year PBR values for some stocks and designating a winter mixed North Carolina management unit has been discarded. In addition, whereas the previous stock structure included estuarine residents, and incorporated available estuarine abundance estimates into N_{min} and PBR, the revised structure does not include estuarine resident stocks. For the Central Florida, Northern Florida, Georgia, South Carolina, and Southern North Carolina stocks, the latitudinal boundaries remain the same as those in previous stock assessments and do not change seasonally (Table 1). The summertime boundaries between the Southern Migratory and Northern Migratory stocks are redefined based upon a spatial analysis described below. During winter months, the Northern

Migratory stock migrates south and occupies waters along the North Carolina coast north of Cape Lookout. Available tagging and photo-identification data suggest that animals inhabiting North Carolina estuaries also move onto the coast during winter and overlap with these Northern Migratory animals. Similarly, the Southern Migratory stock overlaps with the Northern Florida, Georgia, South Carolina, and Southern North Carolina stocks during winter months. The assignment of mortality to the appropriate stocks along the North Carolina coast during winter months remains problematic. This revised structure is provisional while additional analysis of available genetic data is conducted to confirm the separations amongst coastal resident stocks and verify distinctions between coastal and estuarine stocks. Additional field sampling will be required to adequately describe the Southern Migratory stock.
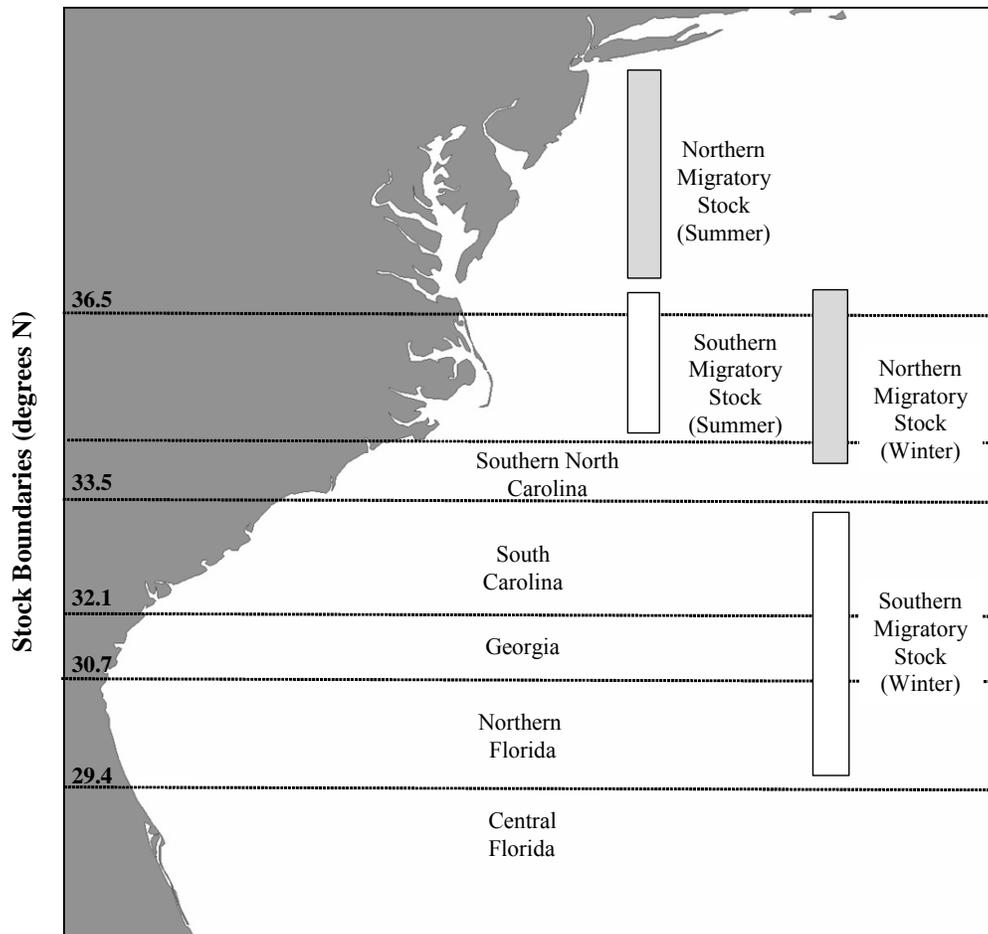
Figure 1. Seasonal distribution and spatial boundaries for prospective stocks of the coastal morphotype of bottlenose dolphin along the Atlantic coast.

POPULATION SIZE

Aerial surveys to estimate the abundance of coastal bottlenose dolphins were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20 m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal

management units. The surveys employed two observer teams operating independently on the same aircraft to estimate visibility bias.

The winter survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411 km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay corresponding to water temperatures < 9.5 ºC. During the summer survey, 6,734 km of trackline were completed between Sandy Hook, New Jersey and Ft. Pierce, Florida. All tracklines in the 0-20 m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia-Florida state line. A total of 185 bottlenose dolphin groups was sighted during summer including 2,544 individual animals.

In summer 2004, an additional aerial survey between central Florida and New Jersey was conducted. As with the 2002 surveys, effort was stratified into 0-20 m and 20-40 m strata with the majority of effort in the shallow depth stratum. The survey was conducted between 16 July and 31 August and covered 7,189 km of trackline. There was a total of 140 sightings of bottlenose dolphins including 3,093 individual animals. A winter survey was conducted between 30 January and 9 March, 2005 covering waters from the mouth of Chesapeake Bay through central Florida. The survey covered 5,457 km of trackline and observed 135 bottlenose dolphin groups accounting for 957 individual animals.

Abundance estimates for bottlenose dolphins in each stock were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included two teams of observers to derive a correction for visibility bias. The independent and joint estimates from the two survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka 1995). The resulting estimate of the probability of seeing animals on the trackline was applied to abundance estimates for the summer 2004 and winter 2005 surveys. Observed bottlenose dolphin groups were also partitioned between the coastal and offshore morphotypes based upon analysis of available biopsy samples (Garrison *et al.* 2003).

For the Central Florida, Northern Florida, Georgia, South Carolina, and Southern North Carolina stocks, the mean of the summer 2002 and 2004 abundance estimates provided the best estimate of abundance (Table 1). During winter months, these stocks overlap spatially with either the Southern Migratory or Northern Migratory stocks. There is apparent inter-annual variation in the abundance estimates and observed spatial distribution of bottlenose dolphins in this region that may indicate movements of animals in response to environmental variability. However, at this time there is no tag telemetry or genetic evidence supporting the presence of additional migratory stocks along the southern portion of the survey range. The survey abundance estimates for these stocks were stratified based upon the fixed boundaries shown in Figure 1.

The summer surveys are also the best for estimating the abundance for both the Northern and Southern Migratory stocks since they overlap least with other stocks during summer months. The Southern Migratory stock most likely occupies waters along the coast of North Carolina north of Cape Lookout during summer months. There is a resident population of animals within Pamlico Sound (e.g., Read *et al.* 2003), and some of these animals may also occur along the coast and overlap with the Southern Migratory group. However, for the purposes of this assessment, we are assuming that the majority of the animals in this area belong to the Southern Migratory stock.

An analysis of summer survey data from 1995, 2002, and 2004 demonstrated strong inter-annual variation in the spatial distribution of presumed Southern Migratory and Northern Migratory stock animals. Two groups of dolphins in each survey year were identified using a multivariate cluster analysis of sightings based on water temperature, depth, and latitude. One group ranged from Cape Lookout, North Carolina to just north of the Chesapeake Bay mouth, and one ranged farther north along the eastern shore of Virginia to New Jersey. The southern group (i.e., the Southern Migratory stock) was found in water temperatures between 26.5 and 28.0 °C, and the northern group (i.e., the Northern Migratory stock) occurred in cooler waters between 24.5 and 26.0 °C. The spatial distribution of these groups was strongly correlated with water temperatures and varied between years. During the summer of 2004, water temperatures were significantly cooler than those during 2002, and animals from both groups were distributed farther south and overlapped spatially. The best abundance estimate for these two groups is therefore from the summer 2002 survey when there was little overlap and an apparent separation between the two stocks at approximately 37.5°N latitude. This boundary is based upon the distribution of the two identified clusters of animals, and it will vary between years as a function of varying water temperatures. Abundance estimates from the summer 2002 survey were derived for these stocks by post-stratifying survey effort and sightings into the

identified spatial range of the two clusters of animals (Table 1).

Table 1. Estimates of abundance and the associated CV, n_{min}, and PBR for each stock of WNA coastal bottlenose dolphins . All estimates are derived from summer aerial surveys conducted in 2002 and/or 2004 as noted in the table. The recovery factor (Fr) used to calculate PBR for each stock is based upon the CV of the mortality estimate based on the guidelines in Wade and Angliss (1997).

Stock	Abundance Summer 2002 (CV)	Abundance Summer 2004 (CV)	Best Estimate (CV)	Nmin	Recovery Factor (Fr)	PBR
Northern Migratory	7,489 (0.36)	NA[a]	7,489 (0.36)	5,582	0.5	56
Southern Migratory	10,341 (0.33)	NA[a]	10,341 (0.33)	7,889	0.5	79
Southern North Carolina	3,654 (1.11)	5,983 (0.43)	4,818 (0.50)	3,241	0.5	32
South Carolina	2,284 (0.27)	1,620 (0.56)	1,952 (0.28)	1,548	0.5	15
Georgia	6,234 (0.50)	5,759 (0.55)	5,996 (0.37)	4,434	0.5	44
Northern Florida	737 (0.47)	5,391 (0.27)	3,064 (0.24)	2,502	0.5	25
Central Florida	718 (0.51)	11,918 (0.27)	6,317 (0.26)	5,109	0.5	51

[a] During the summer 2004 survey, a cluster analysis indicated a high degree of spatial overlap between these two stocks, preventing a reliable abundance estimate.

Minimum Population Estimate
   The minimum population size (Nmin) for each stock was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). Minimum population sizes for each stock are shown in Table 1.

Current Population Trend
   There are insufficient data to determine the population trend for these stocks.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES
   Current and maximum net productivity rates are not known for the WNA coastal morphotype. 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). This group of prospective stocks incorporates the range of the former WNA coastal migratory stock that was defined as depleted under MMPA guidelines. At least some of these stocks are likely depleted relative to their optimum sustainable population (OSP) size due both to mortality during the 1987-1988 die-off and high incidental mortality in fisheries. Given the known population structure within the coastal morphotype bottlenose dolphins, it is appropriate to apply PBR separately to each stock so as to achieve the goals of the MMPA (Table 1; Wade and Angliss 1997).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The primary known source of fishery mortality is the mid-Atlantic coastal gillnet fishery, which affects the Northern Migratory, Southern Migratory, and Southern North Carolina stocks. The five-year average mortality due to this fishery is currently unknown. In addition, an estimated 1 (CV=0.36) mortalities occurred annually in the shark gillnet fisheries off the coast of Florida during 2002-2006, affecting the Central Florida management unit. Only limited observer data are available for other fisheries that may interact with WNA coastal bottlenose dolphins. Therefore, the total average annual mortality estimate is a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch 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 bycatch of marine mammals, was established in 1977 with the implementation of the Magnuson Fisheries Conservation and Management Act (MFCMA).

Stranding data for 1993-1997 document interactions between WNA coastal bottlenose dolphins and pound nets in Virginia. Two bottlenose dolphin carcasses were found entangled in the leads of pound nets in Virginia during 1993-1997, an average of 0.4 bottlenose dolphin mortalities per year. A third record of an entangled bottlenose dolphin in Virginia in 1997 may have been associated with this fishery. This entanglement involved a bottlenose dolphin carcass found near a pound net with twisted line marks consistent with the twine in the nearby pound net lead rather than with monofilament gillnet gear.

One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast Region Marine Mammal Stranding Network, unpublished data), and another was taken in 1996 near the mouth of Winyah Bay, South Carolina, during a research survey. In August 2002 in Beaufort County, South Carolina, a fisherman self-reported a dolphin entanglement in a commercial shrimp trawl. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.

The Atlantic menhaden purse seine fishery historically reported an annual incidental take of 1 to 5 bottlenose dolphins (NMFS 1991, pp. 5-73). However, no observer data are available, and this information has not been updated for some time.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of WNA coastal morphotype bottlenose dolphins, and the North Carolina sink gillnet fishery is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish, 1 was in a set targeting "shark" species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish, or finfish generically (Rossman and Palka 2001). Only two bottlenose dolphin mortalities were observed in 2001-2002, and both occurred in the winter just north of the North Carolina/Virginia border. Based on the prospective stock structure described here, these mortalities are most likely from the Northern Migratory stock. Four additional mortalities were observed during summer along the North Carolina coast near Cape Hatteras: one in 2003, one in 2004, and two in 2006. These mortalities are most likely to have impacted the prospective Southern Migratory stock. The methodology for estimating total mortality is currently

being revised to account for the prospective stock structure and improved understanding of the seasonal spatial distribution of these stocks. In addition, the Bottlenose Dolphin Take Reduction Plan was implemented in May 2006, and there has been insufficient time to collect data to support mortality analyses and assess the effectiveness of the plan. Therefore, it is currently not possible to estimate total mortality from the gillnet fisheries for these prospective stocks. The mortality estimates will be updated in the 2009 stock assessment report.

Table 2. Summary of the 2002-2006 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by management unit in the commercial mid-Atlantic coastal gillnet fisheries. Data include the years sampled (Years), the number of vessels active within the fishery (Vessels), type of data used (Data Type), observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Stock	Years	Vessels	Data Type[a]	Observer Coverage[b]	Observed Serious Injury	Observed Mortality	Estimated Mortality[d]	Estimated CVs[c]	Mean Annual Mortality
Northern Migratory	2002-2006	unk	Obs. Data, NER Dealer Data	.01, .03, .03, .05, .06	0, 0, 0, 0, 0	2, 0, 0, 0, 0	unk[e]	unk[e]	unk[e]
Southern Migratory	2002-2006	unk	Obs. Data, NCDMF Dealer Data	.0, .01, .02, .02, .03	0, 0, 0, 0, 0	0, 1, 0, 1, 2	unk[e]	unk[e]	unk[e]
Southern North Carolina	2002-2006	unk	Obs. Data, NCDMF Dealer Data	0,.01, .03, .01, .04	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk[e]	unk[e]	unk[e]
Total	2002-2006								unk[e]

NA=Not applicable, unk = unknown or unobserved

a   Observer data (Obs. data) are used to measure bycatch rates; the data are collected within the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program. The NEFSC collects weighout landings data that are used as a measure of total effort for the sink gillnet fisheries.

b   The observer coverage for the mid-Atlantic coastal sink gillnet fishery is measured as a proportion of the tons of fish landed.

c   The annual estimates of mortality are computed by summing mortality estimates over six strata for each management unit. Stratified bycatch rates are estimated by a generalized linear model (Palka and Rossman 2001). An aggregate weighted CV is then calculated by weighting the stratified bycatch rates and variances by the proportion of observed metric tons sampled within each stratum. The CV does not account for variability that may exist in the unit of total landings (mt) from each year that are used to expand the bycatch rate.

d   From November 2000 through April 2006 only 4 coastal bottlenose dolphins mortalities have been observed in the coastal habitat ranging from New Jersey to southern North Carolina. As a result, the data were too sparse to apply to the previously defined model used to estimate bycatch rates during the 1996 - 2000 time period (Palka and Rossman 2001). A traditional stratified ratio-estimator was used to estimate bycatch mortality for the seasonal management units from winter 2001 through the winter of 2006. A NEFSC Laboratory Reference Document documenting the methods and results is expected to be available for distribution in January 2008.

e   It is currently not possible to estimate total mortality due to the revisions to the stock structure and implementation of the bottlenose dolphin take reduction plan. Mortality estimates will be updated in the 2009 SAR.

South Atlantic Shark Drift Gillnet

Observed takes of bottlenose dolphins occurred primarily during winter months when the fishery operates in waters off southern Florida. Fishery observer coverage outside of this time and area has increased significantly in the last several years, and there was one observed mortality during summer months in fishing operations off Cape Canaveral, Florida. There have been no observed interactions with bottlenose dolphins since 2003 (Carlson and Betha 2006; Garrison 2007). All observed fishery takes are restricted to the Central Florida management unit of coastal bottlenose dolphin. Total bycatch mortality has been estimated for 2002-2006 following methods described in (Garrison 2007, Table 3).

Table 3. Summary of the 2002-2006 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by stock in the shark gillnet fishery in federal waters off the coast of Florida. Data include years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), annual observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Seasonal Management Unit	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northern Florida	2002-2006	6	Obs. Data, SEFSC FVL	0.46, 0.73, 0.22, 0, 0	0, 0, 0, NA, NA	0, 0,0, NA, NA	0, 0, 0, 0, 0	NA	0
Central Florida	2002-2006	6	Obs. Data, SEFSC FVL	1[c], .34, .43, 1[c], 1[c]	0, 0, 0, 0,0	1, 2 ,0, 0, 0	1[c], 2 , 1, 0[c], 0[c]	0, .64, .64, 0, 0	0.8 (.36)

unk = unknown, NA = cannot be calculated

a   Observer data are used to estimate bycatch rates. The SEFSC Fishing Vessel Logbook (FVL) is used to estimate effort as total number of reported sets per bottlenose dolphin stock.

b   Observer coverage targets 100% of sets during winter months in the Central Florida stock area. There is apparent under-reporting of effort as the number of observed drift net sets routinely exceeds the number of reported drift sets for this fishery. Coverage of the drift net fishery is much lower outside of these months and in the Northern Florida stock area. In addition, the total amount of fishing effort using drift nets targeting sharks is unknown as fishermen do not report the type of gillnet set and boats fish using drift, strike, and sink nets during the same seasons (Garrison 2007)

c   The number of observed drift sets exceeded the number of reported sets, therefore the observed mortality is presumed to be the total mortality.

Beach Haul Seine

Two coastal bottlenose dolphin takes were observed in the mid-Atlantic beach haul seine fishery: 1 in May 1998 and 1 in December 2000.

Crab Pots

Between 1994 and 1998, 22 bottlenose dolphin carcasses (4.4 dolphins per year on average) recovered by the Stranding Network between North Carolina and Florida's Atlantic coast displayed evidence of possible interaction with a trap/pot fishery (i.e., rope and/or pots attached, or rope marks). Additionally, at least 5 dolphins were reported to be released alive (condition unknown) from blue crab traps/pots during this time period. During 2003, 2 bottlenose dolphins were observed entangled in crab pot lines in South Carolina, including 1 confirmed mortality, and 2 bottlenose dolphins were disentangled alive from crab pots in Virginia. In 2004, the SER stranding network reported observing 3 bottlenose dolphins (including one mortality) entangled in crab pot lines in Florida, one in Georgia, and three in South Carolina. In 2005, one entanglement was observed in Florida, one in Georgia, and one in Virginia. With the exception of the mortality in Florida during 2004, all animals were released from entangling gear and were not described to be seriously injured (SER Stranding Network). Three bottlenose dolphins were observed entangled in crab pot gear during 2006. Two occurred in South Carolina and were released alive, while one mortality occurred near Cape Canaveral, Florida. A review of stranding network data from South Carolina between

1992 and 2003 indicated that 24% of known bottlenose dolphin entanglements could be confirmed as involving crab pots, and an additional 19% of known entanglements were probable interactions with crab pots (Burdett and McFee 2004). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that this interaction is a common occurrence and does result in mortalities of coastal morphotype bottlenose dolphins.

In addition to blue crab pots, there have been four documented interactions with pot fisheries in southern Florida. These include two interactions (one in 2003, one in 2006) with stone crab pots near Miami, FL and two interactions (one in 2003 and one in 2006) with spiny lobster traps also off Miami and the Florida Keys. One of these interactions (with a stone crab pot) resulted in a mortality.

Virginia Pound Nets

 Stranding data for 2002-2006 indicate interactions between coastal bottlenose dolphins and pound nets in Virginia. Twenty dolphins were removed dead from pound nets and 5 were disentangled and released alive. This includes three mortalities observed during 2006. Additionally, 17 animals stranded with twisted twine line marks consistent with nearby pound net leaders (SER Stranding Network)

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies and fisheries surveys. In March 2002, a dolphin was entangled in the lazy line of a turtle relocation trawl off Bogue Banks, North Carolina. In August 2002, a dolphin died during a fisheries research project using a trammel net in South Carolina (NMFS Protected Resources Division). Similarly, in March and November 2004, three dolphin mortalities occurred, including a mother-calf pair, during a fisheries research project using a trammel net in Georgia (SER Stranding Network). During 2004, one female bottlenose dolphin died during a health assessment capture study in Charleston, South Carolina (NMFS Protected Resources Division). In July and October 2006, two mortalities occurred during a fisheries research project using trawl gear in South Carolina and North Carolina (SER Stranding Network). Two bottlenose dolphins tagged with an experimental transmitter package deployed during a NMFS research program in North Carolina died within several weeks of tagging during spring 2006 (NMFS Protected Resources Division). Finally, two bottlenose dolphins were killed in research trawls conducted by the South Carolina Department of Natural resources during 2006: one in July near Beaufort County, South Carolina and one in October off Brunswick City, North Carolina. All mortalities from known sources including commercial fisheries and research related mortalities for each provisional stock are summarized in Table 4.

The nearshore and estuarine habitats occupied by the coastal morphotype are adjacent to areas of high human population and some are highly industrialized. The blubber of stranded dolphins examined during the 1987-88 mortality event contained very high concentrations of organic pollutants (Kuehl *et al*. 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Charleston, South Carolina and Beaufort, North Carolina (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002; Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Table 4. Total estimated mortalities from known sources for each prospective stock. The annual mean of estimated mortalities from commercial fisheries with observer programs (mid-Atlantic gillnet [Table 2] and shark gillnet [Table 3]) are shown. For other mortalities with known sources (Crab Pot, Virginia Pound Net, and Research Takes) the mortalities are direct observations, and hence underestimate the true total mortality from these sources. Dashes indicate that the fishery or mortality source does not occur within the region of the effected stock.

Stock	Years	Mid-Atlantic Gillnet[a]	Shark Gillnet	Va. Pound Net	Crab Pot	Marine Mammal Research[b]	Other Research[b]	Annual Totals	5-year Annual Average
Northern Migratory		unk	-	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk	unk
Southern Migratory		unk	-	1, 3, 5, 4, 3	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk	unk
Southern North Carolina		unk	-	-	0, 0, 0, 0, 0	0, 0, 0, 0, 2	1, 0, 0, 0, 1	unk	unk
South Carolina	2002-2006	-	-	-	0, 1, 0, 0, 0	0, 0, 1, 0, 0	1, 0, 0, 0, 1	1, 1, 1, 0, 1	0.8
Georgia		-	0	-	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 3, 0, 0	0, 0, 3, 0, 0	0.6
Northern Florida		-	0	-	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0
Central Florida		-	1, 2, 0, 1, 0	-	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, 0	1, 2, 1, 0, 1	0.8

[a] As noted in Table 2, the mid-Atlantic gillnet mortality cannot be estimated at this time due to changes in the stock structure and the implementation of the BDTRP. Mortality estimates will be updated in the 2009 SAR.

[b] Marine mammal research includes both live capture and tagging studies permitted under an MMPA research permit. Other research includes fisheries research trammel netting and trawls and turtle relocation trawling operations.

Strandings

From 2002 to 2006, 1,570 bottlenose dolphins stranded along the Atlantic coast from New York to Florida (Table 5, Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network). Of these, it was possible to determine whether or not a human interaction had occurred for 715 (46%). For the remainder, it was not possible to make that determination. Of those cases where an evaluation was possible, 32% of the carcasses had evidence of fisheries interaction; however, it should be noted that this was not necessarily the cause of death. The highest numbers of stranded animals with evidence of fisheries interactions were observed in Virginia, North Carolina, and Florida. Stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, and it is therefore possible that some of the reported strandings were of the offshore form.

Table 5. Summary of bottlenose dolphins stranded along the Atlantic Coast . Total Stranded is separated into cases with line or nets marks (Fishery Interaction), other indications of human interactions, no apparent human interaction, or where a determination could not be made (CBD).

	2002	2003	2004	2005	2006
New York – Total Stranded	**1**	**2**	**0**	**0**	**6**
--Fishery Interaction	0	0	0	0	0
--Other Human Interaction	0	0	0	0	0
--No Human Interaction	0	1	0	0	3
--CBD	1	1	0	0	3
New Jersey – Total Stranded	**11**	**7**	**15**	**13**	**14**
--Fishery Interaction	1	1	1	0	1
--Other Human Interaction	1	0	1	0	2
--No Human Interaction	4	5	11	7	9
--CBD	5	1	2	6	2
Delaware – Total Stranded	**13**	**18**	**16**	**9**	**10**
--Fishery Interaction	1	1	1	1	1
--Other Human Interaction	0	0	0	0	1
--No Human Interaction	8	13	11	1	0
--CBD	4	4	4	7	8
Maryland – Total Stranded	**5**	**10**	**10**	**4**	**11**
--Fishery Interaction	0	1	1	1	2
--Other Human Interaction	0	0	0	0	0
--No Human Interaction	2	8	6	0	3
--CBD	3	1	3	3	6
Virginia – Total Stranded	**67**	**60**	**75**	**60**	**63**
--Fishery Interaction	15	25	22	13	17
--Other Human Interaction	6	0	2	0	0
--No Human Interaction	7	12	13	20	4
--CBD	39	23	38	27	42
North Carolina – Total Stranded	**92**	**69**	**89**	**78**	**66**
--Fishery Interaction	13	11	15	9	6
--Other Human Interaction	2	0	1	3	1
--No Human Interaction	15	16	22	14	15
--CBD	62	42	51	52	44
South Carolina – Total Stranded	**28**	**35**	**46**	**38**	**39**
--Fishery Interaction	4	3	3	5	5
--Other Human Interaction	0	0	3	0	1
--No Human Interaction	13	17	22	17	12
--CBD	11	15	18	16	21
Georgia – Total Stranded	**11**	**17**	**27**	**14**	**23**
--Fishery Interaction	0	0	3	2	2
--Other Human Interaction	0	0	1	0	0
--No Human Interaction	0	2	9	2	4
--CBD	11	15	14	10	17
Florida – Total Stranded	**82**	**74**	**81**	**68**	**93**
--Fishery Interaction	8	11	7	6	8
--Other Human Interaction	2	0	2	2	6
--No Human Interaction	50	21	27	14	11
--CBD	22	42	45	46	68
TOTAL	**310**	**292**	**359**	**284**	**325**

STATUS OF STOCKS

The coastal migratory stock was designated as depleted under the MMPA. From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the WNA, and the entire stock was listed as depleted. This stock structure was revised in 2002 to recognize both multiple stocks and seasonal management units. The prospective stocks described here replace these management units. This prospective stock structure continues to be evaluated using available data and will be finalized when these analyses are complete. It should be noted that the impacts of entanglements with crab pots in Georgia and South Carolina and the total mortality associated with pound nets in Virginia are unknown. Likewise, the total mortality in the mid-Atlantic gillnet fishery is currently unknown pending collection of additional data and analysis. Thus, evaluation of mortality for these stocks will not be available until the next stock assessment report. The total U.S. fishery-related mortality and serious injury for the Northern Migratory and Southern Migratory stocks likely is not less than 10% of the calculated PBR, and thus cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Since one or more of the stocks may be depleted, all stocks retain the depleted designation. The species is not listed as threatened or endangered under the Endangered Species Act, but these are strategic stocks due to the depleted listing under the MMPA.

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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. The distribution of harbor porpoises has been documented by sighting surveys, strandings and takes reported by NMFS observers in the Sea Sampling Program. During summer (July to September), harbor porpoises are concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m deep (Gaskin 1977; Kraus *et al.* 1983; Palka 1995a; Palka 1995b), with a few sightings in the upper Bay of Fundy and on the northern edge of Georges Bank (Palka 2000). During fall (October-December) and spring (April-June), harbor porpoises are widely dispersed from New Jersey to Maine, with lower densities farther north and south. They are seen from the coastline to deep waters (>1800 m; Westgate *et al.* 1998), although the majority of the population is found over the continental shelf. During winter (January to March), intermediate densities of harbor porpoises can be found in waters off New Jersey to North Carolina, and lower densities are found in waters off New York to New Brunswick, Canada. There does not appear to be a temporally coordinated migration or a specific migratory route to and from the Bay of Fundy region. However, during the fall, several satellite tagged harbor porpoises did favor the waters around the 92-m isobath, which is consistent with observations of high rates of incidental catches in this depth range (Read and Westgate 1997). There were two stranding records from Florida during the 1980s (Smithsonian strandings database) and one in 2003 (NE Regional Office/NMFS strandings and entanglement database).

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 analyses involving mtDNA (Wang *et al.* 1996; Rosel *et al.* 1999a; Rosel *et al.* 1999b), organochlorine contaminants (Westgate

Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, and 2006. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

et al. 1997; Westgate and Tolley 1999), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. Genetic studies using mitochondrial DNA (Rosel *et al.* 1999a) and contaminant studies using total PCBs (Westgate and Tolley 1999) indicate that the Gulf of Maine/Bay of Fundy females were distinct from females from the other populations in the Northwest Atlantic. Gulf of Maine/Bay of Fundy males were distinct from Newfoundland and Greenland males, but not from Gulf of St. Lawrence males according to studies comparing mtDNA (Palka *et al.* 1996; Rosel *et al.* 1999a) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Analyses of stranded animals from the mid-Atlantic states suggest that this aggregation of harbor porpoises consists of animals from more than just the Gulf of Maine/Bay of Fundy stock (Rosel *et al.* 1999a). However, the majority of the samples used in the Rosel *et al.* (1999a) study were from stranded juvenile animals. Further work is needed to examine adult animals from this region. Nuclear microsatellite markers have also been applied to samples from these four populations, but this analysis failed to detect significant population sub-division in either sex (Rosel *et al.* 1999a). These patterns may be indicative of female philopatry coupled with dispersal of

males. This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic, where the 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 population size of harbor porpoises in the Gulf of Maine/Bay of Fundy region, seven line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, 1999, 2002, 2004, and 2006. The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,054 (CV=0.47), based on the 2006 survey results (Table 1). This is because the 2006 estimate is the most current, and this survey covered the largest portion of the harbor porpoise range.

Earlier abundance estimates

Earlier abundance calculations include estimates of 37,500 harbor porpoises in 1991 (CV=0.29, 95% confidence interval (CI)=26,700-86,400) (Palka 1995b), 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) of the 1991 to 1995 estimates 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, inter-annual changes in water temperature and availability of primary prey species (Palka 1995b), and movement among population units (e.g., between the Gulf of Maine and Gulf of St. Lawrence).

Kingsley and Reeves (1998) estimated there were 12,100 (CV=0.26) harbor porpoises in the entire Gulf of St. Lawrence during 1995, and 21,700 (CV=0.38) in the northern Gulf of St. Lawrence during 1996. These estimates are presumed to be of the Gulf of St. Lawrence stock of harbor porpoises. The highest densities were north of Anticosti Island, with lower densities in the central and southern Gulf. During the 1995 survey, 8,427 km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993 km of track lines were flown in an area of 94,665 km^2 during July and August. Data were analyzed using Quenouille's jackknife bias reduction procedure on line transect methods that modeled the left truncated sighting curve. These estimates were not corrected for visibility biases such as *g(0)*.

An abundance estimate of 89,700 (CV=0.22, 95% CI=53,400-150,900) harbor porpoises was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Palka 2000). Total trackline length was 8,212 km. One of the reasons the 1999 estimate is larger than previous estimates is that, for the first time, the upper Bay of Fundy and northern Georges Bank were surveyed and harbor porpoises were seen in both areas. This indicates the harbor porpoise summer habitat is larger than previously thought (Palka 2000). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 64,047 (CV=0.48) harbor porpoises was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1). The value of *g(0)* used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 51,520 (CV=0.65) harbor porpoises was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed (Table 1). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct-duplicate method (Palka 1995b) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 89,054 (CV=0.47) harbor porpoises was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.).

Table 1. Summary of recent abundance estimates for the Gulf of Maine/Bay of Fundy harbor porpoise. Month, year, and area covered during each abundance survey and the resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	**N_{best}**	**CV**
Aug 2002	S. Gulf of Maine to Maine	64,047	0.48
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	51,520	0.65
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	89,054	0.47

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 89,054 (CV=0.47). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 60,970.

Current Population Trend

A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Although current population growth rates of Gulf of Maine/Bay of Fundy harbor porpoises have not been estimated due to lack of data, several attempts have been made to estimate potential population growth rates. Barlow and Boveng (1991), who used a re-scaled human life table, estimated the upper bound of the annual potential growth rate to be 9.4%. Woodley and Read (1991) used a re-scaled Himalayan tahr life table to estimate a likely annual growth rate of 4%. In an attempt to estimate a potential population growth rate that incorporates many of the uncertainties in survivorship and reproduction, Caswell *et al.* (1998) used a Monte Carlo method to calculate a probability distribution of growth rates. The median potential annual rate of increase was approximately 10%, with a 90% confidence interval of 3-15%. This analysis underscored the considerable uncertainty that exists regarding the potential rate of increase in this population. Consequently, for the purposes of this assessment, the maximum net productivity rate was assumed to be 4%, consistent with values used for other cetaceans for which direct observations of maximum rate of increase are not available, and following a recommendation from the Atlantic Scientific Review Group. The 4% value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 60,970. 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 the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 610.

ANNUAL HUMAN-CAUSED MORTALITY

Data to estimate the mortality and serious injury of harbor porpoise come from U.S. and Canadian Sea Sampling Programs, from records of strandings in U.S. and Canadian waters, and from records in the Marine Mammal Authorization Program (MMAP). See Appendix III for details on U.S. fisheries and data sources. Estimates using Sea Sampling Program and MMAP data are discussed by fishery under the Fishery Information section (Table 2). Strandings records are discussed under the Unknown Fishery in the Fishery Information section (Table 3) and under the Other Mortality section (Table 4).

The total annual estimated average human-caused mortality is 874 (CV=0.13) harbor porpoises per year. This is derived from four components: 866 harbor porpoise per year (CV=0.13) from U.S. fisheries using observer and MMAP data, 2 per year (unknown CV) from Canadian herring weir fisheries using observer data, and 5.7 per year from unknown U.S. fisheries using strandings data.

Fishery Information

Recently, Gulf of Maine/Bay of Fundy harbor porpoise takes have been documented in the U.S. Northeast sink gillnet, mid-Atlantic gillnet, Northeast bottom trawl and in the Canadian Bay of Fundy groundfish sink gillnet and herring weir fisheries (Table 2). Detailed U.S. fishery information is reported in Appendix III.

Earlier Interactions

One harbor porpoise was observed taken from the Atlantic pelagic drift gillnet fishery during 1991-1998; the fishery ended in 1998. This observed bycatch was notable because it occurred in continental shelf edge waters adjacent to Cape Hatteras (Read *et al.* 1996). Estimated annual fishery-related mortality (CV in parentheses) attributable to this fishery was 0.7 in 1989 (7.00), 1.7 in 1990 (2.65), 0.7 in 1991 (1.00), 0.4 in 1992 (1.00), 1.5 in 1993 (0.34), 0 during 1994-1996 and 0 in 1998. The fishery was closed during 1997.

U.S.

Northeast Sink Gillnet

In 1984 the Northeast sink gillnet fishery was investigated by a sampling program that collected information concerning marine mammal bycatch. Approximately 10% of the vessels fishing in Maine, New Hampshire, and Massachusetts were sampled. Among the 11 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; Gilbert 1987).

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). There have been 578 harbor porpoise mortalities related to this fishery observed between 1990 and 2006. Bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Estimated annual bycatch (CV in parentheses) from this fishery during 1990-2006 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) (CUD 1994; Bravington and Bisack 1996), 2,100 in 1994 (0.18), 1,400 in 1995 (0.27) (Bisack 1997), 1,200 in 1996 (0.25), 782 in 1997 (0.22), 332 in 1998 (0.46), 270 in 1999 (0.28) (Rossman and Merrick 1999), 507 in 2000 (0.37), 53 (0.97) in 2001, 444 (0.37) in 2002, 592 (0.33) in 2003, 654 (0.36) in 2004, 630 (0.23) in 2005, and 514 in 2006. There appeared to be no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the bycatch (Read and Hohn 1995). Using observer data collected during 1990-1998 and a logit regression model, females were 11 times more likely to be caught in the offshore southern Gulf of Maine region, males were more likely to be caught in the south Cape Cod region, and the overall proportion of males and females caught in a gillnet and brought back to land were not significantly different from 1:1 (Lamb 2000).

Scientific experiments that demonstrated the effectiveness of pingers in the Gulf of Maine were conducted during 1992 and 1993 (Kraus *et al.* 1997). After the scientific experiments, experimental fisheries were allowed in the general fishery during 1994 to 1997 in various parts of the Gulf of Maine and south of Cape Cod areas. During these experimental fisheries, harbor porpoise takes in pingered nets were less than in non-pingered nets.

Average estimated harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery during 1994-1998, before the Take Reduction Plan, was 1,163 (0.11). The average annual harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery from 2002 to 2006 was 567 (0.14) (Table 2).

Mid-Atlantic Gillnet

Before an observer program was in place for this fishery, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the mid-Atlantic gillnet fishery by the NEFSC Sea Sampling program (Appendix III). Documented bycatch after 1995 were from December to May. Bycatch estimates were calculated using methods similar to that used for bycatch estimates in the Northeast sink gillnet fishery (Bravington and Bisack 1996; Bisack 1997). After 1998, a separate bycatch estimate was made for the drift gillnet and set gillnet sub-fisheries. The number presented here is the sum of these two sub-fisheries. The estimated annual mortality (CV in parentheses) attributed to this fishery was 103 (0.57) for 1995, 311 (0.31) for 1996, 572 (0.35) for 1997, 446 (0.36) for 1998, 53 (0.49) for 1999, 21 (0.76) for 2000, 26 (0.95) for 2001, unknown in 2002, 76 (1.13) in 2003, 137 (0.91) in 2004, 470 (0.51) in 2005, and 511 (0.32) in 2006. During 2002, the overall observer coverage was lower than usual, 1%, where 65% of that coverage was off Virginia, and most of the rest of the area was not sampled at all. Thus, due to this non-representative and low

observer coverage, a bycatch estimate for harbor porpoises cannot be confidently estimated. Annual average estimated harbor porpoise mortality and serious injury from the mid-Atlantic gillnet fishery during 1995 to 1998, before the Take Reduction Plan, was 358 (CV=0.20). The average annual harbor porpoise mortality and serious injury in the mid-Atlantic gillnet fishery from 2002 to 2006 was 299 (0.27), which is the 4-year average estimate from 2003, 2004, 2005, and 2006.

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. Eight harbor porpoise mortalities were observed in the Northeast bottom trawl fishery between 1989 and 2006. The first take occurred in February 1992 east of Barnegat Inlet, New Jersey 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. The second take occurred in January 2001 off New Hampshire in a haul trawling for flounder. This animal was clearly dead prior to being taken by the trawl, because it was severely decomposed (the skull broke off while the net was emptying) and the tow duration was 3.1 hours. This take was observed in the same time and area stratum that had documented gillnet takes. One fresh dead take was observed in the Northeast bottom trawl fishery in 2003, 4 in 2005, and 1 in 2006. Estimates have not been generated for this fishery.

Unknown Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 228, 27, 113, 79, 122, 118, 174, and 73 stranded harbor porpoises on U.S. beaches during 1999 to 2006, respectively (see Other Mortality section for more details). Of these, it was determined that the cause of death of 19, 1, 3, 2, 9, and 6 stranded harbor porpoises in 1999 to 2004, respectively, were due to unknown fisheries and these animals were in areas and times that were not included in the above mortality estimate derived from observer program data (Table 3). As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. The three-year average harbor porpoise mortality and serious injury in this unknown fishery category from 2002 to 2004 is 5.7 (CV is unknown).

CANADA

Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on 25-40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. No harbor porpoises were observed taken.

Bay of Fundy Sink Gillnet

During the early 1980s, Canadian harbor porpoise bycatch in the Bay of Fundy sink gillnet fishery, based on casual observations and discussions with fishermen, was thought to be low. The estimated harbor porpoise bycatch in 1986 was 94-116 and in 1989 it was 130 (Trippel *et al.* 1996). The Canadian gillnet fishery occurs mostly in the western portion of the Bay of Fundy during the summer and early autumn months, when the density of harbor porpoises is highest. Polacheck (1989) reported there were 19 gillnetters active in 1986, 28 active in 1987, and 21 in 1988.

More recently, an observer program implemented in the summer of 1993 provided a total bycatch estimate of 424 harbor porpoises (± 1 SE: 200-648) from 62 observed trips, (approximately 11.3% coverage of the Bay of Fundy trips) (Trippel *et al.* 1996). During 1994, the observer program was expanded to cover 49% of the gillnet trips (171 observed trips). The bycatch was estimated to be 101 harbor porpoises (95% confidence limit: 80-122), and the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996). During 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed from July 21 to August 31. During the open fishing period of 1995, 89% of the trips were observed, all in the Swallowtail region. Approximately 30% of these observed trips used pingered nets. The estimated bycatch was 87 harbor porpoises (Trippel *et al.* 1996). No confidence interval was computed due to lack of coverage in the Wolves fishing grounds. During 1996, the Canadian gillnet fishery was closed during 20-31 July and 16-31 August due to groundfish quotas. From the 107 monitored trips, the bycatch in 1996 was estimated to be 20 harbor porpoises (DFO 1998; Trippel *et al.* 1999). Trippel *et al.* (1999) estimated that during 1996, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 68% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. During 1997, the fishery was closed to the majority of the gillnet fleet during 18-31 July and 16-31 August, due to groundfish quotas. In addition a time-area closure to reduce porpoise bycatch in the Swallowtail area occurred during September 1-7. From the 75 monitored trips, 19 harbor porpoises

were observed taken. After accounting for total fishing effort, the estimated bycatch in 1997 was 43 animals (DFO 1998). Trippel *et al.* (1999) estimated that during 1997, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 85% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. The number of monitored trips (and observed harbor porpoise mortalities were 111 (5) for 1998, 93 (3) for 1999, 194 (5) for 2000, and 285 (39) for 2001. The estimated annual mortality estimates were 38 for 1998, 32 for 1999, 28 for 2000, and 73 for 2001 (Trippel and Shepherd 2004). Estimates of variance are not available.

There has been no observer program during the summer since 2002 in the Bay of Fundy region, but the fishery was active. Thus, it is not known what the bycatch for these years is. The estimated harbor porpoise mortality in the Canadian groundfish sink gillnet fishery during 2001 was 73. An estimate of variance is not possible.

Herring Weirs

Harbor porpoises are taken in Canadian herring weirs, but there have been no recent efforts to observe takes in the U.S. component of this fishery. Smith *et al.* (1983) estimated that in the 1980s approximately 70 harbor porpoises became trapped annually and, on average, 27 died annually. In 1990, at least 43 harbor porpoises were trapped in Bay of Fundy weirs (Read *et al.* 1994). In 1993, after a cooperative program between fishermen and Canadian biologists was initiated, over 100 harbor porpoises were released alive (Read *et al.* 1994). Between 1992 and 1994, this cooperative program resulted in the live release of 206 of 263 harbor porpoises caught in herring weirs. Mortalities (and releases) were 11 (50) in 1992, 33 (113) in 1993, and 13 (43) in 1994 (Neimanis *et al.* 1995). Since that time, an additional 623 harbor porpoises have been documented in Canadian herring weirs, of which 637 were released or escaped, 36 died, and 9 had an unknown status. Mortalities (and releases, unknowns) were 5 (60, 0) in 1995; 2 (4, 0) in 1996; 2 (24, 0) in 1997; 2 (26, 0) in 1998; 3 (89, 0) in 1999; 0 (13, 0) in 2000 (A. Read, pers. comm), 14 (296, 0) in 2001, 3 (46, 4) in 2002, 1 (26, 3) in 2003, 4 (53, 2) in 2004; 0 (19, 5) in 2005; and 2 (14, 0) in 2006 (Neimanis *et al.* 2004; H. Koopman and A. Westgate, pers. comm.).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 2002-2006 was 2.0 (Table 2). An estimate of variance is not possible.

Gulf of St. Lawrence gillnet

This fishery interacts with the Gulf of St. Lawrence harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Using questionnaires to fishermen, Lesage *et al.* (2006) determined a total of 2215 (95% CI 1151-3662) and 2394 (95% CI 1440-3348) harbor porpoises were taken in 2000 and 2001, respectively. The largest takes were in July and August around Miscou and the North Shore of the Gulf of St. Lawrence. According to the returned questionnaires, the fish species most usually associated with incidental takes of harbor porpoises include Atlantic cod, herring and mackerel. An at-sea observer program was also conducted during 2001 and 2002. However, due to low observer coverage that was not representative of the fishing effort, Lesage *et al.* (2006) concluded that resulting bycatch estimates were unreliable.

Newfoundland gillnet

This fishery interacts with the Newfoundland harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Estimates of incidental catch of small cetaceans, where the vast majority are likely harbor porpoises was 862 in 2001, 1,428 in 2002, and 2,228 in 2003 for the Newfoundland nearshore cod and Greenland halibut fisheries, and the Newfoundland offshore fisheries in lumpfish, herring, white hake, monkfish and skate (Benjamins *et al.* 2007) .

Table 2. From observer program data, 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 [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
				U.S.				
Northeast Sink Gillnet	02-06	unk	Obs. Data, Weighout, Trip Logbook	.02 .03, .06, .07, .04	10[c], 12[c], 27[c], 51[c], 26	444[c], 592, 654[c], 630[c], 514	.37, .33, .36, .23, .31	567 (0.14)
Mid-Atlantic Gillnet	02-06	unk	Obs. Data Weighout	.01, .01, .02, .03, .04	unk[f], 1, 2, 15, 20	unk[f], 76, 137, 470, 511	unk[f], 1.13, .91, .51, .32	299[f] (0.27)
Northeast bottom trawl	02-06	unk	Obs. Data Weighout	.03, .04, .05, .12, .06	0,1,0,4,1	0,unk[h],0,unk[h], unk	0, unk, 0, unk, 0	Unk[h]
U.S. TOTAL	2002-2006							866 (0.13)
				CANADA				
Groundfish Sink Gillnet	02-06	unk	Can. Trips	0[g],0[g],0[g],0[g],0[g]	unk[g],unk[g], unk[g], unk[g], unk[g] unk[g]	unk[g],unk[g], unk[g], unk[g] unk[g]	unk	unk
Herring Weir	02-06	1998=255 licenses[d] 2002=22[e]	Coop. Data	unk	3, 1, 4, 0, 2	3, 1, 4, 0, 2	NA	2.0 (unk)
CANADIAN TOTAL	2002-2006							2 (unk)
GRAND TOTAL								868 (unk)

NA = Not available.

a.   Observer data (Obs. Data) are used to measure bycatch rates; the U.S. data are collected by the Northeast Fisheries Science Center (NEFSC) Sea Sampling Program, the Canadian data are collected by DFO. NEFSC collects Weighout (Weighout) landings data that are used as a measure of total effort for the U.S. gillnet fisheries. The Canadian DFO catch and effort statistical system collected the total number of trips fished by the Canadians (Can. Trips), which was the measure of total effort for the Canadian groundfish gillnet fishery. Mandatory vessel trip report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery. Observed mortalities from herring weirs are collected by a cooperative program between fishermen and Canadian biologists (Coop. Data).

b.   The observer coverages for the U.S. and Canadian sink gillnet fisheries are ratios based on trips, and for the mid-Atlantic coastal gillnet fishery, the unit of effort is tons of fish landed.

c.   During 2002-2006, harbor porpoises were taken on pingered strings within strata that required pingers but that stratum also had observed strings without pingers. For estimates made during 1998 and after, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within a stratum. The weighted bycatch rate was:

$$\sum_{i}^{ping, non-ping} \frac{\# porpoise_i}{sslandings_i} \cdot \frac{\# hauls_i}{total \# hauls}$$

There were 10, 33, 44, 0, 11, 0, 2, 8, 6, 2, 26, 2, 4, 12, and 2 observed harbor porpoise takes on pinger trips from 1992 to 2006, respectively, that were included in the observed mortality column. In addition, there were

Table 3. From strandings and entanglement data, summary of confirmed incidental mortality of harbor porpoises (*Phocoena phocoena*) by fishery: includes years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), mortalities assigned to this fishery (Assigned Mortality), and mean annual mortality.

Fishery	Years	Vessels	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	02-06	NA	Entanglement & Strandings	2, 9, 6, unk[b], unk[b]	5.7
TOTAL					5.7

NA=Not Available.
a Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).
b. As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Thus, the annual mortality is an average from the years 2002-2004.

Other Mortality
U.S.

There is evidence that harbor porpoises were harvested by natives in Maine and Canada before the 1960s, and the meat was used for human consumption, oil, and fish bait (NMFS 1992). The extent of these past harvests is unknown, though it is believed to have been small. Up until the early 1980s, small kills by native hunters (Passamaquoddy Indians) were reported. In recent years it was believed to have nearly stopped (Polacheck 1989) until media reports in September 1997 depicted a Passamaquoddy tribe member dressing out a harbor porpoise. Further articles describing use of porpoise products for food and other purposes were timed to coincide with ongoing legal action in state court.

During 2002, 82 harbor porpoises were reported stranded on Atlantic US beaches (Table 4). Eleven animals displayed signs of emaciation and two showed signs of fishery interactions (Table 4). Both of the strandings with fishery interactions were in the mid-Atlantic (Maryland and Virginia) during March and were not in a time and area that was part of a bycatch estimate derived from observer data (Table 3).

During 2003, 122 harbor porpoises were reported stranded (Table 4). The number of reported fishery interactions by state are: 1 in Massachusetts (October), 1 in Maryland (March), 6 in Virginia (3 in March, 2 in April, and 1 in May), and 1 in North Carolina (February). Three harbor porpoises were reported mutilated in North Carolina. All of these strandings reported with fishery interactions were in areas and times that were not part of a bycatch estimate derived from the observer data (Table 3).

During 2004, 117 harbor porpoises were reported stranded on Atlantic US beaches. There were 8 reported fishery interactions by state: 1 in Massachusetts (May), 1 in New York (May), and 3 in Virginia (February, March, and April), and 3 in North Carolina (April). In addition, there was 1 mutilation in Delaware during March. Of these

8 fishery interactions, six were in areas and times that were not part of a bycatch estimated derived from the observer data (Table 3).

During 2005, 175 harbor porpoises were reported stranded on Atlantic US beaches. Although 24 animals were classified as having signs of human interaction, and of those 24, 7 showed signs of fishery interaction, in no case was cause of death directly attributable to these interactions. An Unusual Mortality Event was declared for harbor porpoise in North Carolina, as 38 stranded in that state between 1 January and 28 March 2005. Most of these were young of the year, and histopathological examinations of 6 of these animals showed no common symptoms other than emaciation or any systemic disease (MMC 2006).

During 2006, 73 harbor porpoises were reported stranded on Atlantic US beaches. Eight of these were reported as having signs of human interaction, but in no case was cause of death directly attributable to these interactions. In fact, in three cases the human interaction was post-mortem. One of the human interaction mortalities was classified as a fishery-interaction (with no further detail), one as a boat collision, and one was involved in an oil spill.

As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Averaging 2002 to 2004, there were 0.8 animals per year that were stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality.

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

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2002-2006.

Area	Year					Total
	2002	2003	2004	2005	2006	
Maine[a]	10	5	15	9	9	**48**
New Hampshire	2	2	2	0	1	**7**
Massachusetts[b]	43	35	49	55	23	**205**
Rhode Island[c]	1	2	3	6	3	**15**
Connecticut	1	0	0	1	0	**2**
New York	6	8	8	15	11	**48**
New Jersey	6	5	14	17	6	**48**
Pennsylvania	0	0	0	1	0	**1**
Delaware	3	1	1	3	3	**11**
Maryland	1	5	2	4	2	**14**
Virginia	6	19	8	22	9	**64**
North Carolina[d]	3	39	15	42	6	**105**
Florida	0	1	0	0	0	**1**
TOTAL U.S.	**82**	**122**	**117**	**175**	**73**	**569**
Nova Scotia	5	3	4	6	4	**22**
GRAND TOTAL	**87**	**125**	**121**	**181**	**77**	**591**

a. In Maine, one animal stranded alive in March 2002, brought to Mystic Aquarium but died 2 days later.
b. In Massachusetts, during 2002, three animals stranded alive and were rehabilitated at Mystic Aquarium (1 in February, March and May). In 2005, 2 animals were relocated and released. In 2006 one stranding record was of an emaciated calf swimming in shallow water, but capture attempts were unsucessful.

c. In Rhode Island, one animal stranded alive in 2006, and was taken to rehab.

d. In North Carolina, one animal was relocated and released in 2005.

CANADA

The Nova Scotia Stranding Network documented whales and dolphins stranded between 1991 and 1996 on the coast of Nova Scotia (Hooker *et al.* 1997). Researchers with the Canadian Dept. of Fisheries and Oceans documented strandings on the beaches of Sable Island during 1970 to 1998 (Lucas and Hooker 2000). Sable Island is approximately 170 km southeast of mainland Nova Scotia. On the mainland of Nova Scotia, a total of 8 stranded harbor porpoises were recorded between 1991 and 1996: 1 in May 1991, 2 in 1993 (July and September), 1 in August 1994 (released alive), 1 in August 1994, and 3 in 1996 (March, April, and July (released alive)). On Sable Island, 8 stranded dead harbor porpoises were documented, most in January and February; 1 in May 1991, 1 in January 1992, 1 in January 1993, 3 in February 1997, 1 in May 1997, and 1 in June 1997. Two strandings during May-June 1997 were neonates (> 80 cm). The harbor porpoises that stranded in the winter (January-February) were on Sable Island, those in the spring (March to June) were in the Bay of Fundy (2 in Minas Basin and 1 near Yarmouth) and on Sable Island (2), and those in the summer (July to September) were scattered along the coast from the Bay of Fundy to Halifax.

Whales and dolphins stranded between 1997 and 2006 on the coast of Nova Scotia as recorded by the Marine Animal Response Society and the Nova Scotia Stranding Network are as follows (Table 4): 3 harbor porpoises stranded in 1997 (1 in April, 1 in June and 1 in July), 2 stranded in June 1998, 1 in March 1999, 3 in 2000 (1 in February, 1 in June, and 1 in August); 2 in 2001 (1 in July and 1 in December), 5 in 2002 (3 in July (1 released alive), 1 in August, and 1 in September (released alive)), 3 in 2003 (2 in May (1 was released alive) and 1 in June (disentangled and released alive)), 4 in 2004 (1 in April, 1 in May, 1 in July (released alive) and 1 in November), 6 in 2005 (1 in April (released alive), 1 in May, 3 in June and 1 in July), and 4 in 2006 (1 in June, 1 in August, 1 in September, and 1 in December).

USA Management measures taken to reduce bycatch

A ruling to reduce harbor porpoise bycatch in USA Atlantic gillnets was published in the Federal Register (63 FR 66464) on 02 December 1998 and became effective 01 January 1999. The Gulf of Maine portion of the plan pertains to all fishing with sink gillnets and other gillnets capable of catching regulated groundfish in New England waters, from Maine through Rhode Island. This portion of the rule includes time and areas closures, some of which are complete closures; others are closed to gillnet fishing unless pingers are used in the prescribed manner. Also, the rule requires those who intend to fish to attend training and certification sessions on the use of the technology. The mid-Atlantic portion of the plan pertains to waters west of 72°30'W longitude to the mid-Atlantic shoreline from New York to North Carolina. This portion of the rule includes time and area closures, some of which are complete closures; others are closed to gillnet fishing unless the gear meets certain restrictions. The MMPA mandates that the take reduction teams that developed the above take reduction measures periodically meet to evaluate the effectiveness of the plan and modify it as necessary.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. On 7 January 1993, the National Marine Fisheries Service (NMFS) proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). On 5 January 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On 2 August 2001, NMFS made available a review of the biological status of the Gulf of Maine/Bay of Fundy harbor porpoise population. The determination was made that listing under the Endangered Species Act (ESA) was not warranted and this stock was removed from the ESA candidate species list (NMFS 2001). Population trends for this species have not been investigated. The total U.S. 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 human-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 all nearshore waters of the Atlantic Ocean and adjoining seas above about 30ºN (Katona *et al.* 1993). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren 1979; Katona *et al.* 1993; Gilbert and Guldager 1998; Baird 2001). Stanley *et al.* (1996) examined worldwide patterns in harbor seal mitochondrial DNA, which indicate that western and eastern North Atlantic harbor seal populations are highly differentiated. Further, they suggested that harbor seal females are only regionally philopatric, thus population or management units are on the scale of a few hundred kilometers. 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 (Temte *et al.* 1991). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.* 1991; Katona *et al.* 1993).

Harbor seals are year-round inhabitants of the coastal waters of eastern Canada and Maine (Katona et al. 1993), and occur seasonally along the southern New England, to New Jersey coasts from September through late May (Schneider and Payne 1983; Barlas 1999; Schroeder 2000; deHart 2002). Scattered sightings and strandings have been recorded as far south as Florida (NMFS unpublished data). A general southward movement from the Bay of Fundy to southern New England waters occurs in autumn and early winter (Rosenfeld *et al.* 1988; Whitman and Payne 1990; Barlas 1999; Jacobs and Terhune 2000). A northward movement from southern New England to Maine and eastern Canada occurs prior to the pupping season, which takes place from mid-May through June along the Maine Coast (Richardson 1976; Wilson 1978; Whitman and Payne 1990; Kenney 1994; deHart 2002). While earlier research identified no pupping areas southern New England (Payne and Schneider 1984; Barlas 1999), more recent information suggests that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts (B. Rubinstein, pers. comm., New England Aquarium). The overall geographic range throughout coastal New England has not changed significantly during the last century (Payne and Selzer 1989).

Prior to the spring 2001 live-capture and radio-tagging of adult harbor seals, it was believed that the majority of seals moving into southern New England and mid-Atlantic waters were subadults and juveniles (Whitman and Payne 1990; Katona *et al.* 1993). The 2001 study established that adult animals also made this migration. Seventy-five percent (9/12) of the seals tagged in March in Chatham Harbor seals were detected at least once during the May/June 2001 abundance survey along the Maine coast (Gilbert *et al.* 2005; Waring *et al.* 2006).

POPULATION SIZE

Since passage of the MMPA in 1972, the observed count of seals along the New England coast has been increasing. Coast-wide aerial surveys along the Maine coast were conducted in May/June 1981, 1986, 1993, 1997, and 2001 during pupping (Gilbert and Stein 1981; Gilbert and Wynne 1983; 1984; Kenney 1994; Gilbert and Guldager 1998; Gilbert *et al.* 2005). However, estimates older than eight years are deemed unreliable (Wade and Angliss 1997), and should not be used for PBR determinations. Therefore, only the 2001 estimate is useful for population assessment. The 2001 survey, conducted in May/June, included replicate surveys and radio tagged seals to obtain a correction factor for animals not hauled out. The corrected estimate for 2001 is 99,340 (23,722). The 2001 observed count of 38,014 is 28.7% greater than the 1997 count. Increased abundance of seals in the Northeast region has also been documented during aerial and boat surveys of overwintering haul-out sites from the Maine/New Hampshire border to eastern Long Island and New Jersey (Payne and Selzer 1989; Rough 1995; Barlas 1999; Schroeder 2000; deHart 2002) .

Canadian scientists counted 3,500 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. The Sable Island population was the largest in eastern Canada in the late 1980s, however recently the number has drastically declined (Baird 2001). Similarly, pup production declined on Sable Island from 600 in 1989 to around a dozen pups or fewer by 2002 (Baird 2001; Bowen *et al.* 2003). A decline in the number of juveniles and adults did not occur immediately, but a decline was observed in these age classes as a result of the reduced number of pups moving into the older age classes (Bowen *et al.* 2003). Possible reasons for this decline may be increased use of the island by

gray seals and increased predation by sharks (Stobo and Lucas 2000; Bowen *et al*. 2003). Helicopter surveys have also been flown to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St Lawrence estuary. In the estuary, surveys were flown in June 1995, 1996, and 1997, and in August 1994, 1995, 1996 and 1997; different portions of the Gulf were surveyed in June 1996 and 2001 (Robillard *et al.* 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Although all slopes were positive, only one was significant, indicating numbers are likely stable or increasing slowly. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which is lower than a count of 621 (SD=41, N=3) hauled-out animals flown under similar conditions in August. Aerial surveys in the Gulf of St. Lawrence resulted in counts of 467 animals in 1996 and 423 animals in 2001 for a different area (Robillard et al. 2005).

Table 1. Summary of abundance estimates for the western Atlantic harbor seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	N_{best} [a]	**CV**
May/June 2001	Maine coast	99,340 (23,722) [b]	CV=.097
[a] Pup counts are in brackets [b] Corrected estimate based on uncorrected count of 38,011 (9,278)			

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 seals is 99,340 (CV=.097). The minimum population estimate is 91,546 based on corrected total counts along the Maine coast in 2001.

Current Population Trend

Between 1981 and 2001, the uncorrected counts of seals increased from 10,543 to 38,014, an annual rate of 6.6 percent (Gilbert et al. 2005).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on uncorrected haulout counts over the 1981 to 2001 survey period, the harbor seal population is growing at approximately 6.6% (Gilbert et al. 2005). However, a population grows at the maximum growth rate (R_{max}) only when it is at a very low level; thus the 6.6% growth rate is not considered to be a reliable estimate of (R_{max}). 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 (½ of 12%), and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 91,546. The recovery factor (F_R) for this stock is 0.5, the value for stocks of unknown status. PBR for U.S. waters is 2,746.

ANNUAL HUMAN-CAUSED MORTALITY

For the period 2002-2006 the total human caused mortality and serious injury to harbor seals is estimated to be 621 per year. The average was derived from two components: 1) 611 (CV=0.15); Table 2) from the 2002-2006 observed fishery; and 2) 10 from average 2002-2006 non-fishery related, human interaction stranding mortalities (NMFS unpublished data).

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 occurred in the mariculture industry (i.e., salmon farming), and by deliberate shooting (NMFS unpublished data). However, no data are available to determine

whether shooting still takes place.

Fishery Information

Detailed Fishery information is given in Appendix III.

U.S.

Northeast Sink Gillnet:

Annual estimates of harbor seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. The fishery has been observed in the Gulf of Maine and in southern New England (Williams 1999; NMFS unpublished data). There were 545 harbor seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2006, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data). Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (e.g. less than four years old). Estimated annual mortalities (CV in parentheses) from this fishery were 332 (0.33) in 1998, 1,446 (0.34) in 1999, 917 (0.43) in 2000, 1,471 (0.38) in 2001, 787 (0.32) in 2002, 542 (0.28) in 2003, 792 (0.34) in 2004, 719 (0.20) in 2005, and 87 (.58) in 2006 (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). There were 2, 2, 9, 14, and 8 unidentified seals observed during 2002-2006, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2002-2006 was 585 harbor seals (CV=0.15) (Table 2).

Mid-Atlantic Gillnet

No harbor seals were taken in observed trips during 1993-1997, or 1999-2003. Two harbor seals were observed taken in 1998, one in 2004, two in 2005, and one in 2006. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997 and 1999-2003, 11 in 1998 (0.77), 15 (0.86) in 2004, 63 (0.67) in 2005, and 26 (.98) in 2006. In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality attributable to this fishery during 2002-2006 was 26 (CV=0.49) harbor seals (Table 2).

Northeast Bottom Trawl

Two harbor seal mortalities were observed between 2001 and 2006, one in 2002 and one in 2005. (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery has not been generated.

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003. No mortalities have been observed, but 11 harbor seals were captured and released alive in 2004 and 4 in 2005. In addition, 5 seals of unknown species were captured and released alive in 2004 and 2 in 2005. This fishery was not observed in 2006.

CANADA

Currently, scant data are available on bycatch in Atlantic Canada fisheries due to a lack of observer programs (Baird 2001). An unknown number of harbor seals have been taken in Newfoundland, 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; Cairns *et al.* 2000). Furthermore, some of these mortalities (e.g., seals trapped in herring weirs) are the result of direct shooting.

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet [c]	02-06	unk [d]	Obs. Data, Weighout, Logbooks	.02, .03, .06, .07, .04	12, 21, 45, 70, 3	787, 542, 792, 719, 87	.32, .28, .34, .20, .58	585 (0.15)
Mid-Atlantic Gillnet	02-06	unk [d]	Obs. Data, Weighout	.01, .01, .02, .03, .04	unk [e], 0, 1, 2, 1	unk [e], 0, 15, 63, 26	unk [e], 0, .86, .67, .98	26 (0.49) [e]
Northeast Bottom Trawl	02-06	unk [d]	Obs. Data, Weighout	.03, .04 .05, .12, .06	1, 0, 0, 1, 0	unk [f], 0, 0, unk [f], 0	unk [f], 0, 0, unk [f], 0	unk [f]
TOTAL								611 (0.15)

[a] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. NEFSC collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.

[b] The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed and coverages for the northease bottom trawl are ratios based on trips.

[c] Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2002 - 2006, respectively, 3, 0, 8, 3, and 3 takes were observed in nets with pingers. In 2002 – 2006, respectively, 9, 21, 37, 67, and 0 takes were observed in nets without pingers.

[d] Number of vessels is not known.

[e] Sixty-five percent of sampling in the mid-Atlantic coastal gillnet by the NEFSC fisheries observer program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionately throughout the mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (2003- 2006) estimated mortality was applied as the best representative estimate.

[f] Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery for the years 2002-2006 has not been generated.

Other Mortality

Historically, harbor seals were bounty hunted in New England waters, which may have caused a severe decline of this stock in U.S. waters (Katona *et al.* 1993). Bounty hunting ended in the mid-1960s.

Currently, aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Baird 2001). Other sources of harbor seal mortality include human interactions, storms, abandonment by the mother, disease, and predation (Katona *et al.* 1993; NMFS unpublished data; Jacobs and Terhune 2000). Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting.

Small numbers of harbor seals strand each year throughout their migratory range. Stranding data provide insight into some of these sources of mortality. From 2002 to 2006, 2162 harbor seal stranding mortalities were reported in all states between Maine and Florida (Table 3; NMFS unpublished data). Seventy-one (3.2%) of the seals stranded during this five year period showed signs of human interaction (18 in 2002, 2 in 2003, 15 in 2004, 24 in 2005, and 12 in 2006), with 21 having some sign of fishery interaction (9 in 2002, 0 in 2003, 3 in 2004, 4 in 2005, and 5 in 2006). An Unusual Mortality Event (UME) was declared for harbor seals in northern Gulf of Maine waters in 2003 and continued into 2004. No consistent cause of death could be determined. The UME was declared over in spring 2005 (MMC [Marine Mammal Commission] 2006). NMFS declared another UME in the Gulf of Maine in autumn

2006 based on infectious disease.

Stobo and Lucas (2000) have documented shark predation as an important source of natural mortality at Sable Island, Nova Scotia. They suggest that shark-inflicted mortality in pups, as a proportion of total production, was less than 10% in 1980-1993, approximately 25% in 1994-1995, and increased to 45% in 1996. Also, shark predation on adults was selective towards mature females. The decline in the Sable Island population appears to result from a combination of shark-inflicted mortality, on both pups and adult females and inter-specific competition with the much more abundant gray seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).

Table 3. Harbor seal (*Phoca vitulina*) stranding mortalities along the U.S. Atlantic coast (2002-2006)[a].						
State	2002	2003[b]	2004[b]	2005	2006[c]	Total
ME	149	212	358	148	448	1315
NH	2	15	21	31	31	100
MA	90	98	146	112	99	545
RI	4	12	11	4	8	39
CT		1	3	2	2	8
NY	8	10	14	23	15	70
NJ	6	15	5	4	10	40
DE		2		4	1	7
MD		1	1	3		5
VA	1	2	1	3	3	10
NC	2	8		7	4	21
FL		1			1	2
Total	262	377	560	341	622	2162
Unspecified seals (all states)	35	27	33	59	46	200
a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated						
b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2003-2004.						
c. Unusual Mortality Event (UME) declared for harbor seals in the Gulf of Maine in 2006.						

STATUS OF STOCK

The status of the western North Atlantic harbor seal stock, 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. Total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al.* 1993; R. DiGiovanni, pers. comm., The Riverhead Foundation, Riverhead, NY). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New England to Labrador (Davies 1957; Mansfield 1966; Katona *et al.* 1993; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial DNA variation from the northeastern Atlantic stock (Bonner 1981; Boskovic *et al.* 1996; Lesage and Hammill 2001). There are two breeding concentrations in eastern Canada; one at Sable Island, and one that breeds on the pack ice in the Gulf of St. Lawrence ((Laviguer and Hammill 1993)). Tagging studies indicate that there is little intermixing between the two breeding groups (Zwanenberg and Bowen 1990) and, for management purposes, they are treated by the Canadian DFO as separate stocks (Mohn and Bowen 1996). In the mid 1980s, small numbers of animals and pupping were observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona et al. 1993; J. R. Gilbert, pers. comm., University of Maine, Orono, ME; Rough 1995). In the late 1990s, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (D. Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and at the Monomoy National Wildlife Refuge. Gilbert (pers. comm.) has also documented resident colonies and pupping in Maine since 1994.

POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although estimates of portions of the stock are available for select time periods. The size of the Canadian population from 1993 to 2004 has been estimated from three surveys. A 1993 survey estimated the population at 144,000 animals (DFO 2003, Mohn and Bowen 1996), a 1997 survey estimated 195,000 (DFO [Dept. Of Fisheries and Oceans] 2003), and a 2004 survey obtained estimates ranging between 208,720 (SE=29,730) and 223,220 (SE=17,376) depending upon the model used (Trzcinski *et al.* 2005). The population at Sable Island had been increasing by approximately 13% per year for nearly 40 years (Bowen *et al.* 2003), but the most recent (2004) survey results indicate this population increase has declined to 7% (Trzcinski *et al.* 2005; Bowen *et al.* 2007). The non-Sable Island (Gulf of St Lawrence and Eastern Shore) abundance has increased from 20,900 (SE=200) in 1970 to 52,500 (SE=7,800) in 2004 (Hammill 2005).

The population in US waters is also increasing. Maine coast-wide surveys conducted during summer (all other surveys were conducted January-May) revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al.* 2005). In 2002, the maximum counts of two breeding colonies in Maine, with number of pups in parentheses, were 193 (9) on Seal Island and 74 (31) on Green Island (S. Wood, pers. comm.). Gray seal numbers are increasing in Massachusetts at Muskeget Island off the coast of Nantucket, and at Monomoy Island, off the coast of Chatham, Cape Cod. Pup counts on Muskeget have increased from 0 in 1989 to 1,023 in 2002 (Rough 1995, S. Wood, pers. comm.). Gray seal numbers increase in this region in the spring (April-May) when molting occurs. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, Maine and Woods Hole, Massachusetts) (Barlas 1999). No gray seals were recorded at haul out sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently small numbers of gray seals have been recorded in this region (deHart 2002; R. DiGiovanni, pers. comm., The Riverhead Foundation, Riverhead, NY). Recently, a small number of gray seals have maintained a winter presence in the Woods Hole region (Vineyard Sound) (deHart 2002).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal. Month, year, and area covered during each abundance survey, resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	**Nbest**	**CV**
May 2001[a]	Maine coast	1,731	NA
January 2004[b]	Gulf of St Lawrence + Nova Scotia Eastern Shore	52,500	0.15
January 2004[b]	Sable Island	208,720 216,490 223,220	0.14 0.11 0.08
[a] These counts pertain to animals seen in U.S. waters, and the stock relationship to animals in Canadian waters is unknown. [b] These are model based estimates derived from pup surveys.			

Minimum Population Estimate

Depending on the model used, the N_{min} for the Canadian gray seal population was estimated to range between 125,541 and 169,064 (Trzcinski et al. 2005) Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current Population Trend

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950s the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island population was less affected and has been increasing for several decades. Pup production on Sable Island, Nova Scotia, has increased exponentially at a rate of 12.8% annually for more than 40 years (Stobo and Zwanenburg 1990; Mohn and Bowen 1996; Bowen et al. 2003; Trzcinski et al. 2005; Bowen et al. 2007), but has declined to 7% in 2004 (Trzcinski et al. 2005; Bowen et al. 2007). The non Sable Island population increased from 6,900 in the mid-1980s to a peak of 11,100 (SE=1,300) animals in 1996 (Hammill and Gosselin 2005). Pup production declined to 6,100 (SE=900) in 2000, then increased to 15,900 (SE=1,200) in 2004 (Hammill and Gosselin 2005). Approximately 57% of the western North Atlantic population is from the Sable Island stock. In recent years pupping has been established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001).

Winter breeding colonies in Maine and on Muskeget Island may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 1980s as the gray seal population and range expanded in eastern Canada. Five pups were born at Muskeget in 1988. The number of pups increased to 12 in 1992, 30 in 1993, and 59 in 1994 (Rough 1995). In January 2002, between 900 and 1,000 pups were counted on Muskeget Island and surrounding shoals (S. Wood, pers. comm.). In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island and Nomans Land. These observations continue the increasing trend in pup production reported by Rough (1995). The change in gray seal counts at Muskeget and Monomoy from 2,010 in 1994 to 5,611 in 1999 represents an annual increase rate of 20.5%, however, it can not be determined what proportion of the increase represents growth or immigration.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. A recent study estimated the annual rate of increase at 7% on Sable Island (Trzcinski et al. 2005; Bowen et al. 2007), which represents a 45% decline from previous estimates (Mohn and Bowen 1996; Bowen et al. 2003). For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow et al. 1995).

POTENTIAL BIOLOGICAL REMOVAL

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

population size is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is 1.0, the value for stocks of unknown status, but is known to be increasing. PBR for the western North Atlantic gray seals in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2002-2006, the total estimated human caused mortality and serious injury to gray seals was 836 per year. The average was derived from three components: 1) 331 (CV=0.21) (Table 2) from the 2002-2006 U.S. observed fishery; 2) 2 from average 2002-2006 non-fishery related, human interaction stranding mortalities (NMFS unpublished data); and 3) 503 from average 2002-2006 kill in the Canadian hunt (DFO [Dept. Of Fisheries and Oceans] 2003; G. Stenson unpublished data; M. Hammill pers.comm., DFO, Mont-Joli, Quebec).

Fishery Information

Detailed fishery information is given in Appendix III.

U.S.
Northeast Sink Gillnet

Annual estimates of gray seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were 105 gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and 2006. Estimated annual mortalities (CV in parentheses) from this fishery were 0 in 1990-1992, 18 in 1993 (1.00), 19 in 1994 (0.95), 117 in 1995 (0.42), 49 in 1996 (0.49), 131 in 1997 (0.50),61 in 1998 (0.98), 155 in 1999 (0.51), 193 in 2000 (0.55), 117 in 2001 (0.59), 0 in 2002, 242 (0.47) in 2003, 504 (0.34) in 2004, 574 (0.44) in 2005, and 314 (0.22) in 2006 (Table 2). There were 2, 2, 9, 14, and 8 unidentified seals observed during 2002-2006, respectively. Since 1997 unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2002-2006 was 314 gray seals (CV=0.22) (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Coastal Gillnet

No gray seals were taken in observed trips during 1998-2000, 2003, and 2006. One gray seal was observed taken in both 2001and 2004 (Table 2). In 2001 the gray seal was taken in April off the coast of New Jersey near Hudson Canyon in 81 m of water. The 2004 take was off Virginia in April. Observed effort was scattered between New Jersey and North Carolina from 1 to 90 km off the beach. In 2002, 65% of sampling was concentrated in one area and not distributed proportionally across the fishery. Therefore, observed mortality is considered unknown in 2002. Average annual estimated fisher-related mortality and serious injury to this stock attributable to this fishery during 2002-2006 was 17 gray seals (CV=0.92) (Table 2).

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003, and was not observed in 2006. No mortalities have been observed, but 15 gray seals were captured and released alive in 2004 and 19 in 2005. In addition, 5 seals of unknown species were captured and released alive in 2004 and 2 in 2005.

Northeast Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management, rather than marine mammal management needs. No mortalities were observed prior to 2005, when four mortalities were attributed to this fishery. The estimated annual fishery-related mortality and serious injury attributable to this fishery was 0 between 2001 and 2004, and for 2006. Estimates have not been generated for 2005.

CANADA

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

1970s and early 1980s on Sable Island (Anonymous 1986).

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

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet [c]	02-06	unk	Obs. Data, Weighout, Logbooks	.02, .03, .06, .07, .04,	0, 5, 21, 33, 9	0, 242, 504, 574, 248	0, .47, .34, .44, .47	314 (0.22)
Mid-Atlantic Gillnet	02-06	unk	Obs. Data, Weighout	.01, .01, .02 , .03, .04	unk [e], 0, 1 , 0, 0	unk [d], 0, 69 , 0, 0	unk [d], 0, .92, 0, 0	17 [d] (0.92)
Northeast Bottom Trawl	02-06	unk	Obs. Data, Weighout	.03, .04, .05, .12, .06	0, 0, 0, 4, 0	0, 0, 0, unk [f], 0	0, 0, 0, unk [f], 0	unk [f]
TOTAL								331 (0.21)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout), and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast multispecies sink gillnet fishery.

b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic gillnet fisheries are ratios based on tons of fish landed.

c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 1998, 1 take was observed in a net without a pinger that was within a marine mammal closure that required pingers. In 2002 - 2006, respectively, 0, 1, 1, 1, and 1 takes were observed in nets with pingers. In 2002 – 2006, respectively, 2, 0, 4, 20, 32, and 8 takes were observed in nets without pingers.

d. Sixty-five percent of sampling in the mid-Atlantic coastal gillnet by the Northeast Fisheries Observer Program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionally throughout the mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (2003- 2006) estimated mortality was applied as the best representative estimate.
f. Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated.

Other Mortality

Canada: In Canada, gray seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Laviguer and Hammill 1993). Between 1999 and 2006 the annual kill of gray seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76) 2002 (126), 2003 (6), 2004 (0), 2005 (579), and 2006 (1804). (DFO [Dept. Of Fisheries and Oceans] 2003; M. Hammill pers. comm.). The traditional hunt of a few hundred animals is expected to continue off the Magdalen Islands and in other areas, except Sable Island where commercial hunting is not permitted (DFO [Dept. Of Fisheries and Oceans] 2003). DFO established an annual (2006-2010) TAC of 2,100 gray seals in the Gulf of St. Lawrence, and 8,300 on the Scotian Shelf. The hunting of grey seals will continue to be prohibited on Sable Island (http://www.dfo-mpo.gc.ca/seal-phoque/index_e.htm).

Canada also issues personal hunting licenses which allow the holder to take six gray seals annually (Lesage and Hammill 2001). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001).

U.S: Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960s. This hunt may have severely depleted this stock in U.S. waters (Rough 1995). Other sources of mortality include human interactions, storms, abandonment by the mother, disease, and predation. Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. The Cape Cod stranding network has documented gray seals entangled in netting or plastic debris around the Cape Cod/Nantucket area, and in recent years have made successful disentanglement attempts.

From 2002-2006, 213 gray seal stranding mortalities were recorded, extending from Maine to North Carolina (Table 3; NMFS unpublished data). Most stranding mortalities were in Massachusetts. Thirty-seven (17.4%) of the total stranding mortalities showed signs of human interaction (6 in 2002, 7 in 2003, 16 in 2004, 3 in 2005, and 5 in 2006), with 25 having some indication of fishery interaction (3 in 2002, 5 in 2003, 11 in 2004,1 in 2005, and 5 in 2006).

Table 3. Gray seal (*Halichoerus grypus*) stranding mortalities along the U.S. Atlantic coast (2002-2006)[a].

State	2002	2003	2004	2005	2006	Total
ME	2	2	3	4	3	14
NH		1				1
MA	32	58	33	26	29	178
RI	1	6	8	2	2	19
CT			2			2
NY	5	5	2	7	6	25
NJ		2		2	1	4
DE			1			1
MD			1	3		4
VA		1	2	1		4
NC	1				2	1
Total	41	75	52	45	43	213
Unspecified seals (all states)	35	27	33	59	46	200

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated. Mortalities include those which stranded dead, died at site, were euthanized, died during transport, or died soon after transfer to rehab.

STATUS OF STOCK

The status of the gray seal population relative to OSP in U.S. Atlantic EEZ waters is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is low relative to the stock size in Canadian and U.S. 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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HARP SEAL (*Pagophilus groenlandicus*):
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). The world's harp seal population is divided into three separate stocks, each identified with a specific pupping site on the pack ice (Lavigne and Kovacs 1988; Bonner 1990). The largest stock is located off eastern Canada and is divided into two breeding herds. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988), and the third stock breeds on the ice in the White Sea off the coast of Russia. The Front/Gulf stock is equivalent to western North Atlantic stock.

Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between mid-February and April. Adults then assemble north of their whelping patches to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western North Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. The southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring.

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; B. Rubinstein, pers. comm., New England Aquarium; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000). These extralimital appearances usually occur in January-May (Harris *et al.* 2002), when the western North Atlantic stock of harp seals is at its most southern point of migration. Concomitantly, a southward shift in winter distribution off Newfoundland was observed during the mid-1990s, which was attributed to abnormal environmental conditions (Lacoste and Stenson 2000).

POPULATION SIZE

Abundance estimates for the western North Atlantic stock are available which use a variety of methods including aerial surveys and mark-recapture (Table 1). These methods involve surveying the whelping concentrations and estimating total population adult numbers from pup production. Roff and Bowen (1983) developed an estimation model to provide a more precise estimate of total abundance. This technique incorporates recent pregnancy rates and estimates of age-specific hunting mortality (CAFSAC 1992). This model has subsequently been updated in Shelton *et al.* (1992), Stenson (1993), Shelton *et al.* (1996), and Warren *et al.* (1997). The revised 2000 population estimate was 5.5 million seals (95% CI= 4.5-6.4 million) harp seals. (Healey and Stenson 2000). The estimate based on the 2004 survey was calculated at 5.82 million (95% CI=4.1-7.6 million; Hammill and Stenson 2005) but has been subsequently revised to 5.5 million (95% CI=3.8 - 7.1 million; Table 1; DFO 2007).

Table 1. Summary of abundance estimates for western North Atlantic harp seals. Year and area covered during each abundance survey, resulting abundance estimate (N_{best}) and confidence interval (CI).			
Month/Year	Area	N_{best}	CI
2000	Front and Gulf	5.5 million	(95% CI 4.5-6.4 million)
2004	Front and Gulf	5.5 million	(95% CI 3.8-7.1 million)

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 harp seals is 5.5 million (SE = 856,645; DFO 2007). The minimum population estimate based on the 2004 pup survey results is 288,000 seals. Data are insufficient to calculate the minimum population estimate for U.S. waters.

Current population trend

Harp seal pup production in the 1950s was estimated at 645,000, but had decreased to 225,000 by 1970 (Sergeant 1975). Estimated number then began to increase and have continued to increase through the late 1990s, reaching 478,000 in 1979 (Bowen and Sergeant 1983; 1985), 577,900 (CV=0.07) in 1990 (Stenson *et al.* 1993), 708,400 (CV=0.10) in 1994 (Stenson *et al.* 2002), and 998,000 (CV=0.10) in 1999 (Stenson *et al.* 2003). The 2004 estimate of 991,000 pups (CV=0.06) suggests that the increase in pup production observed throughout the 1990s may have abated (Stenson *et al.* 2005).

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 2004 pup production estimate suggests that the increase in pup production observed throughout the 1990s has likely stopped (Stenson et al. 2005).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size in U.S. waters is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 because it was believed that harp seals are within OSP. PBR for the western North Atlantic harp seal in U.S. waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of 321,000 harp seals. However, Johnston *et al.* (2000) suggests that catch statistics from the Canadian hunt are negatively biased due to under reporting. Because of this, and because of biases in the current abundance estimate, a more conservative F_R of 0.5 may be appropriate. Using the lower F_R results in a "PBR" of 160,000 harp seals. The Canadian model predicts replacement yields between 522,000 and 541,000 (Healey and Stenson 2000). The Canadian model predicts replacement yields between 522,000 and 541,000 (Healey and Stenson 2000). However, the PBR for the stock in US waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2002-2006 the total estimated annual human caused mortality and serious injury to harp seals was 443,299. This is derived from three components: 1) an average catch of 443,216 seals from 2002-2006 by Canada (Table 2a); 2) 80 harp seals (CV=0.31) from the observed U.S. fisheries (Table 2b); and 3) three harp seals from average 2002-2006 non-fishery related, human interaction stranding mortalities (NMFS unpublished data). Harp seal harvests are summarized in the table below.

Table 2a. Summary of the Canadian directed catch and bycatch incidental mortality of harp seal (*Pagophilus groenlandicus*) by year.

Fishery	2002	2003	2004	2005	2006		Average
Commercial catches[a]	312,367	289,512	365,971	329,829	354,867		**330,509**
Commercial catch struck and lost[b]	30,275	24,084	31,026	23,071	26,674		**27,026**
Greenland subsistence catch[c]	69,895	68,499	70,585	91,361			**75,085**
Canadian Arctic[d]	715	715	715	715[d]			**715**
Greenland and Canadian Arctic struck and lost[e]	70,610	69,214	71,300	91,361			**75,621**
Newfoundland lumpfish[f]	9,329	5,367	12,290	11,597[f]			**8,995**
Total	**493,191**	**457,391**	**551,887**	**535,622**	**381,541**		**443,216**

a. (DFO 2003; Hammill and Stenson 2003; Stenson unpublished data; DFO 2005)

b. Struck and lost is calculated for the commercial harvest assuming that the rate is 5% for young of the year, and 50% for animals one year of age and older (DFO 2001; Stenson unpublished data).

c. (ICES 2003; Stenson unpublished data; 2002-2004 average used for 2005; DFO 2005).

d. (Hammill and Stenson 2003; Stenson unpublished data)

e. The Canadian Arctic and Greenland struck and lost rate is calculated assuming the rate is 50% for all age classes (DFO 2001; Stenson unpublished data; 2002-2004 average used for 2005).

f. (DFO 2005; Stenson unpublished data; 2002-2004 average used for 2005).

Fishery Information
U.S.
  Detailed fishery information is reported in the Appendix III.

Northeast Sink Gillnet:
  Annual estimates of harp seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were 143 harp seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2006. The bycatch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. One observed winter mortality was in waters south of Cape Cod. The stratification design used for this species is the same as that for harbor porpoise (Bravington and Bisack 1996). Estimated annual mortalities (CV in parentheses) from this fishery were: 81 (0.78) in 1999, 24 (1.57) in 2000, 26 (1.04) in 2001, 0 during 2002-2003, 303 (0.30) in 2004, 35 (0.68) in 2005, and 65 (0.66) in 2006 (Table 2b). There were also 2, 2, 9, 14, and 8 unidentified seals observed during 2002 through 2006 respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2002-2006 was 80 harp seals (CV=0.31) (Table 2b).

Mid-Atlantic Gillnet:
  No harp seals were taken in observed trips during 1993-1997, and 1999-2006. One harp seal was observed taken in 1998. Observed effort from 1993 to 2006 was scattered between New York and North Carolina from 1 to 9 km off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997, 17 in 1998 (1.02) and 0 in 1999-2006. In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality attributable to this fishery during 2002-2006 was zero harp seals.

Northeast Bottom Trawl
  Three mortalities were observed in the Northeast bottom trawl fishery between 2002 and 2006. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 between 1991 and 2000, 49 (CV=1.10) in 2001, and 0 between 2002 and 2004, and in 2006. Estimates have not been

generated for 2005.

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Table 2b. Summary of the incidental mortality of harp seal (*Pagophilus groenlandicus*) 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).								
Northeast Sink Gillnet	02-06	unk	Obs. Data Weighout, Logbooks	.02, .03, .06, .07, .04	0, 0, 15, 3, 3	0, 0, 303, 35, 65	0, 0, .30, .68, .66	80 (0.31)
Northeast Bottom Trawl	02-06	unk	Obs. Data Weighout	.03, .04 .05, .12, .06	0, 0, 0, 3, 0	0, 0, 0, unk, 0	0, 0, 0, unk, 0	unk
TOTAL								80 (0.31)

a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. The Northeast Fisheries Observer Program collects landings data (Weighout) and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of fishing effort in the Northeast sink gillnet fishery.
b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic coastal sink gillnet fisheries are ratios based on tons of fish landed. North Atlantic bottom trawl fishery coverages are ratios based on trips.
c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 2000 - 2006, respectively, 2, 1, 0, 0, 4, 0, and 3 takes were observed in nets with pingers. In 2000 - 2006, respectively, 1, 0, 0, 0, 11, 3, and 0 takes were observed in nets without pingers.
d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated.

Other Mortality

U.S.: From 2002 to 2006, 456 harp seal stranding mortalities were reported (Table 3; NMFS unpublished data). Thirteen (2.8%) of the mortalities during this five-year period showed signs of human interaction (2 in 2002, 2 in 2003, 2 in 2004, 5 in 2005, and 2 in 2006), with 1 having some sign of fishery interaction (1 in 2005). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of harp seal stranding in the Gulf of Maine is consistent with the species' seasonal migratory patterns in this region.

State	2002	2003	2004	2005	2006	Total
Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities along the U.S. Atlantic coast (2002-2006)[a].						
ME	11	7	30	10	14	72
NH				2		2
MA	50	23	85	44	24	226
RI	5	3	7	9	6	30
CT	5	0	2	3	4	14
NY	15	5	20	41	15	96
NJ	1		6	12	3	22
DE		1	0	2		3

MD				2		2
VA	1		1	4		6
NC					1	1
Total	**83**	**37**	**142**	**129**	**65**	**456**
Unspecified seals (all states)	35	27	33	59	46	200

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated. Mortalities include animals found dead and animals that were euthanized, died during handling, or died in the transfer to, or upon arrival at, rehab facilities.

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown, but the stock's abundance appears to have stabilized. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is very low relative to the stock size 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 also low relative to the total stock size; therefore, this is not a strategic stock.

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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 to the edge of the ice at both poles (Leatherwood and Reeves 1983; Rice 1989; Whitehead 2002). Sperm whales were commercially hunted in the Gulf of Mexico by American whalers from sailing vessels until the early 1900s (Townsend 1935). In the northern Gulf of Mexico systematic aerial and ship surveys indicate that sperm whales inhabit only waters greater than 200 m deep where they are widely distributed (Fulling *et al.* 2003, Mullin *et al.* 2004, Mullin and Fulling 2004, Mullin 2007). Seasonal aerial surveys confirm that sperm whales are present in the northern Gulf of Mexico in all seasons (Mullin *et al.* 1994; Hansen *et al.* 1996; Mullin and Hoggard 2000). The information for southern Gulf of Mexico waters is more limited, but there are sighting and stranding records from each season with sightings widely distributed in continental slope waters of the western Bay of Campeche (Ortega-Ortiz 2002).

Sperm whales throughout the world exhibit a geographic social structure where females and juveniles of both sexes occur in mixed groups and inhabit tropical and subtropical waters. Males, as they mature, initially form bachelor groups but eventually become more socially isolated and more wide-ranging, inhabiting temperate and polar waters as well (Whitehead 2003). While this pattern also applies to the Gulf of Mexico, results of multi-disciplinary research conducted in the Gulf since 2000 confirms speculation by Schmidly (1981) and indicates clearly that Gulf of Mexico sperm whales constitute a stock that is distinct from other Atlantic Ocean stocks(s) (Mullin *et al.* 2003, Jaquet 2006, Jochens *et al.* 2006). The following

Figure 1. *Distribution of sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

summarizes the most significant stock structure-related findings from Jochens *et al.* (2006). Measurements of the total length of Gulf of Mexico sperm whales indicate that they are 1.5-2.0 m smaller on average compared to whales measured in other areas. Female/juvenile group size in the Gulf (9-11 whales) is about one-half that found elsewhere. Tracks from 39 whales satellite tagged in the northern Gulf were monitored for up to 607 days. These tracks show that whales exhibited a range of movement patterns within the Gulf, including movement into the southern Gulf in a few cases, but that only 1 whale (a male) left the Gulf of Mexico. Additionally, no matches were found when 185 individual whales photo-identified from the Gulf and about 2500 from the North Atlantic and Mediterranean were compared. An analysis of matrilineally inherited mtDNA revealed that of the 5 haplotypes found in Gulf whales, 2 are known to occur only in the Gulf of Mexico and 65% of the whales were of these haplotypes. Analysis of biparentally inherited nuclear DNA showed no significant difference between whales sampled in the Gulf and those from other areas of the Atlantic, indicating that mature males move in and out of the Gulf. Sperm whales make vocalizations used in a social context called "codas" that have distinct patterns that are apparently culturally transmitted, and based on degree of social affiliation, mixed groups of sperm whales worldwide can be placed in recognizable acoustic clans. Recordings from mixed groups in the Gulf of Mexico compared to those from other areas of the Atlantic indicated that Gulf sperm whales constitute a distinct acoustic clan that is rarely encountered outside of the Gulf.

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities and/or where shipping activity is high. Results from very limited studies of
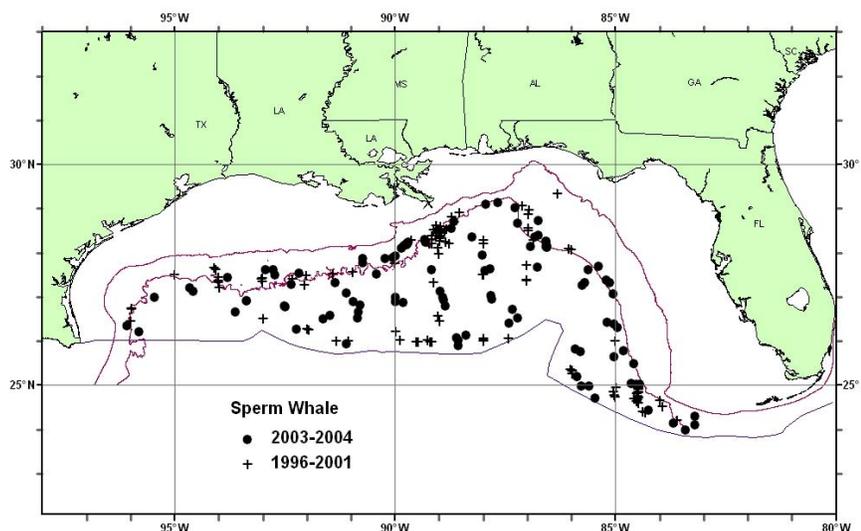
sperm whale responses to seismic exploration indicate that sperm whales do not exhibit horizontal avoidance of seismic survey activities, but results were not definitive for studies of fine-scale behavioral responses (Jochens *et al.* 2006).. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of sperm whales for all surveys combined was 530 (CV=0.31) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for sperm whales in oceanic waters, pooled from 1996 to 2001, is 1,349 (CV=0.23) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for sperm whales in oceanic waters, pooled from 2003 to 2004, was 1,665 (CV=0.20) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.
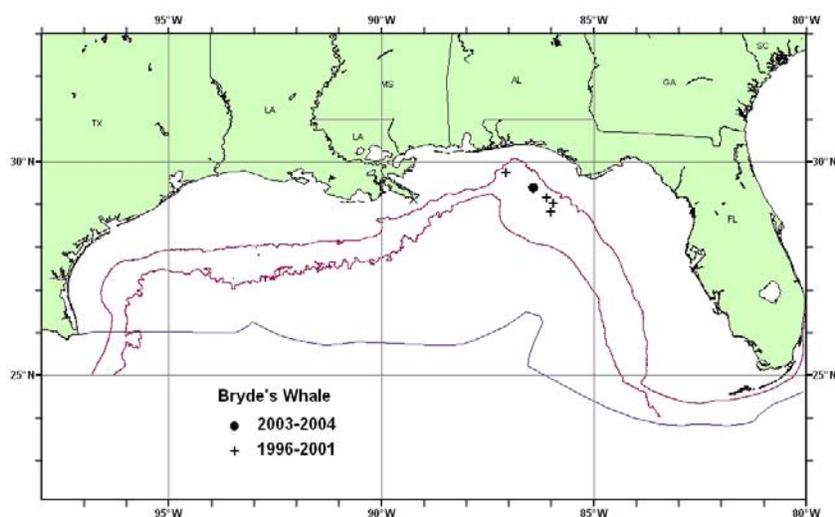
Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for sperm whales is 1,665 (CV=0.20). The minimum population estimate for the northern Gulf of Mexico is 1,409 sperm whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,665 (CV=0.20) and that for 1996-2001 of 1,349 (CV=0.29) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is relatively low. These estimates are 2-3 times larger than that for 1991-1994 of 530 (CV=0.31). The 2003-2004 estimates were based on less negatively biased estimates of sperm whale group size and may account for part of the difference. Nevertheless, these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of sperm whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,409. 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 0.1 because the sperm whale is an endangered species. PBR for the northern Gulf of

Mexico sperm whale is 2.8.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
There has been no reported fishing-related mortality of a sperm whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information
The level of past or current, direct, human-caused mortality of sperm whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to sperm whales by this fishery.

A commercial fishery for sperm whales operated in the Gulf of Mexico in deep waters between the Mississippi River delta and DeSoto Canyon during the late 1700s to the early 1900s (Mullin *et al.* 1991), but the exact number of whales taken is not known (Townsend 1935; Lowery 1974). Townsend (1935) reported many records of sperm whales from April through July in the north-central Gulf (Petersen and Hoggard 1996).

Other Mortality
No sperm whale strandings were documented during 2004-2006. A total of 9 sperm whale strandings were documented in the northern Gulf of Mexico during 1999-2003 (Table 1). There was no evidence of human interactions for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Seismic vessel operations in the Gulf of Mexico (commercial and academic) now operate with marine mammal observers as part of required mitigation measures. There have been no reported seismic-related or industry ship-related mortalities or injuries to sperm whales.

Table 1. Sperm whale (*Physeter macrocephalus*) strandings along the U.S. Gulf of Mexico coast, 1999-2003. No sperm whale strandings were documented during 2004-2006.

STATE	1999	2000	2001	2002	2003	TOTAL
Alabama	0	0	0	0	0	0
Florida	1	2	1	1	1	6
Louisiana	1	0	0	0	1	2
Mississippi	0	0	0	0	0	0
Texas	0	1	0	0	0	1
TOTAL	2	3	1	1	2	9

STATUS OF STOCK
The status of sperm whales in the northern Gulf of Mexico, relative to OSP, is unknown. This species is listed as endangered under the Endangered Species Act (ESA). There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be 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 distributed worldwide in tropical and sub-tropical waters. In the western Atlantic Ocean, Bryde's whales are reported from off the southeastern United States and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves 1983). Most of the sighting records of Bryde's whales in the Gulf of Mexico are from NMFS abundance surveys that were conducted during the spring (Figure 1; Hansen *et al.* 1995, 1996; Mullin and Hoggard 2000; Mullin and Fulling 2004). However, there are stranding records from throughout the year (Würsig *et al.* 2000).

It has been 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. The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data.

From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Bryde's whales for all surveys combined from 1991 through 1994 was 35 (CV=1.10) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001

Figure 1. *Distribution of Bryde's whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

(excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for Bryde's whales in oceanic waters, pooled from 1996 to 2001, was 40 (CV=0.61) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).
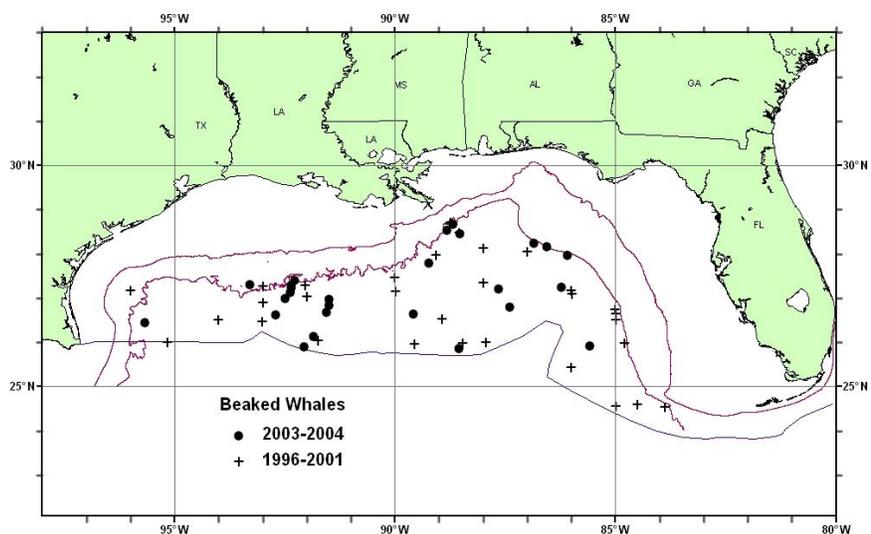
As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Bryde's whales in oceanic waters, pooled from 2003 to 2004, was 15 (CV=1.98) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Bryde's whales is 15 (CV=1.98). The minimum population estimate for the northern Gulf of Mexico is 5 Bryde's whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 15 (1.98) and that for 1996-2001 of 40 (CV=0.61) are not significantly different (P>0.05) from each other but due to the imprecision of the estimates, the power to detect a difference is low. The abundance estimate for 1991-1994 was 35 (CV=1.09). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Bryde's whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 5. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico Bryde's whale is 0.1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of Bryde's whales during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of Bryde's whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Bryde's whales by this fishery.

Other Mortality

There were no reported strandings of Bryde's whales in the Gulf of Mexico during 1999-2005. One Bryde's whale calf live-stranded in Sandestin, Florida, during November 2006. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of Bryde's whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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 east coast of the U.S. (Schmidly 1981) and throughout the year in the Gulf of Mexico (Würsig *et al.* 2000). Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000). Some of the aerial survey sightings may have included Cuvier's beaked whale, but identification of beaked whale species from aerial surveys is problematic.

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. In the absence of adequate information on stock structure, a species' range within an ocean should be divided into defensible management units, and such management units include distinct oceanographic regions (Wade and Angliss 1997). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Cuvier's beaked whales for all surveys combined was 30 (CV=0.50).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of beaked whale sightings from SEFSC shipboard spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for Cuvier's beaked whales in oceanic waters, pooled from 1996 to 2001, was 95 (CV=0.47) (Mullin and Fulling 2004). The estimated abundance of Cuvier's beaked whales was negatively biased because only sightings of beaked whales which could be positively identified to species were used. The estimate for the same time period for unidentified Ziphiidae was 146 (CV=0.46), which may also include an unknown number of *Mesoplodon* spp.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon*

Gunter (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Cuvier's beaked whales in oceanic waters, pooled from 2003 to 2004, was 65 (CV=0.67) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may also include an unknown number of *Mesoplodon* spp.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Cuvier's beaked whales is 65 (CV=0.67). The minimum population estimate for the northern Gulf of Mexico is 39 Cuvier's beaked whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 65 (CV=0.67) and that for 1996-2001 of 95 (CV=0.47) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Cuvier's beaked whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Cuvier's beaked whale is 39. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor for this stock is 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Cuvier's beaked whale is 0.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Cuvier's beaked whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of Cuvier's beaked whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Cuvier's beaked whales by this fishery.

Other Mortality

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). There was one reported stranding of Cuvier's beaked whale in the Gulf of Mexico during 1999-2006. One Cuvier's beaked whale stranded in Texas in October 2004. There was no indication of human interactions for this stranded animal. Two unidentified beaked whales mass stranded in Florida in December 1999. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whales and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado (1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Evans and England 2001; Balcomb and Claridge 2001; Cox *et al.* 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown. Necropsies were performed on 5 of the dead beaked whales and revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Evans and England 2001; Cox *et al.* 2006).

STATUS OF STOCK

The status of Cuvier's beaked whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping or naval activities are high. Limited studies are currently being conducted to address this issue and its impact, if any, on this and other marine species.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Three species of *Mesoplodon* are known to occur in the Gulf of Mexico, based on stranding or sighting data (Hansen *et al.* 1995; Würsig *et al.* 2000). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*) and Sowerby's beaked whale (*M. bidens*). Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only 1 known stranding of this species (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). Identification of *Mesoplodon* to species in the Gulf of Mexico is very difficult, and in many cases, *Mesoplodon* and Cuvier's beaked whale (*Ziphius cavirostris*) cannot be distinguished; therefore, sightings of beaked whales (Family Ziphiidae) are identified as *Mesoplodon* sp., Cuvier's beaked whale, or unidentified Ziphiidae.

Blainville's beaked whales appear to be widely but sparsely distributed in 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 4 documented strandings and 2 sightings of this species in the northern Gulf of Mexico (Hansen *et al.* 1995; Würsig *et al.* 2000). Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of undifferentiated beaked whales (*Mesoplodon* spp. and unidentified Ziphiidae) for all surveys combined was 117 (CV=0.38) (Hansen *et al.* 1995). Hansen *et al.* (1995) did not estimate the abundance of *Mesoplodon* spp.

Figure 1. *Distribution of beaked whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 1996 to 2001, was 106 (CV=0.41) (Mullin and Fulling 2004). This was a combined estimate for Gervais' beaked whale and

Blainville's beaked whale. The estimate for the same time period for unidentified Ziphiidae was 146 (CV=0.46) which may also include an unknown number of Cuvier's beaked whales.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).
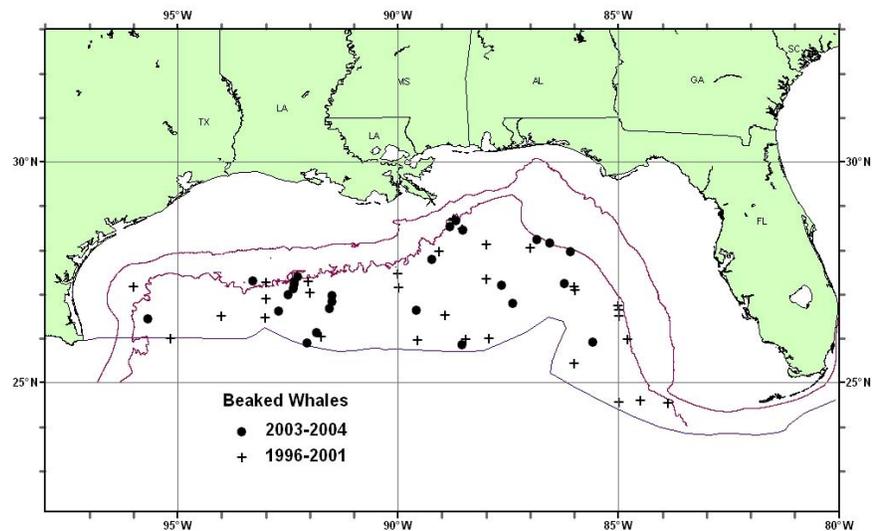
As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 2003 to 2004, was 57 (CV=1.40) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico. This is a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may also include an unknown number of Cuvier's beaked whales.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for *Mesoplodon* spp. is 57 (CV=1.40). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is 24.

Current Population Trend

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Mesoplodon* spp. for 2003-2004 of 57 (CV=1.40) and that for 1996-2001 of 106 (CV=0.41) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Mesoplodon* spp. is 24. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico *Mesoplodon* spp. is 0.2. It is not possible to determine the PBR for only Blainville's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a beaked whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of beaked whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Blainville's or other beaked whales by this fishery.

Other Mortality

There were no strandings of *Mesoplodon* spp. or unidentified beaked whales during 2004-2006. There were 2 reported stranding events of beaked whales in the Gulf of Mexico during 1999-2003. Two unidentified beaked whales

mass stranded in Florida in December 1999, and 1 unidentified *Mesoplodon* stranded in Florida in January 2003. There was no evidence of human interactions for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 UMEs have been declared in the Gulf of Mexico, and 1 of these included Blainville's beaked whales. Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. Additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, and 4 unidentified dolphins.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whales and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (NMFS 2001; Balcomb and Claridge 2001; Cox *et al.* 2006). Four Cuvier's, 2 Blainville's and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown. Necropsies were performed on 5 of the dead beaked whales and revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (NMFS 2001; Cox *et al.* 2006).

STATUS OF STOCK

The status of Blainville's beaked whales or other beaked whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping or naval activities are high. Limited studies are currently being conducted to address this issue and its impact, if any, on this and other marine species.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Three species of *Mesoplodon* are known to occur in the Gulf of Mexico, based on stranding or sighting data (Hansen *et al.* 1995; Würsig *et al.* 2000). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*) and Sowerby's beaked whale (*M. bidens*). Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only 1 known stranding of this species (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). Identification of *Mesoplodon* to species in the Gulf of Mexico is very difficult, and in many cases, *Mesoplodon* and Cuvier's beaked whale (*Ziphius cavirostris*) cannot be distinguished; therefore, sightings of beaked whales (Family Ziphiidae) are identified as *Mesoplodon* sp., Cuvier's beaked whale, or unidentified Ziphiidae.

Gervais' beaked whales appear to be widely but sparsely distributed in 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 16 documented strandings in the Gulf of Mexico (Würsig *et al.* 2000). Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of undifferentiated beaked whales (*Ziphius* and *Mesoplodon* spp.) for all surveys combined was 117 (CV=0.38) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from

Figure 1. *Distribution of beaked whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 1996 to 2001, was 106 (CV=0.41) (Mullin and Fulling 2004). This was a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate for the same time period for unidentified Ziphiidae was 146 (CV=0.46), which may also include an unknown number of Cuvier's beaked whales.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extend of the U.S. EEZ using NOAA Ship *Gordon*

Gunter (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 2003 to 2004, was 57 (CV=1.40) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico. This is a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may also include an unknown number of Cuvier's beaked whales.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for *Mesoplodon* spp. is 57 (CV=1.40). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is 24.

Current Population Trend

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Mesoplodon* spp. for 2003-2004 of 57 (CV=1.40) and that for 1996-2001 of 106 (CV=0.41) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Mesoplodon* spp. is 24. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico *Mesoplodon* spp. is 0.2. It is not possible to determine the PBR for only Gervais' beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a beaked whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of beaked whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Gervais' or other beaked whales by this fishery.

Other Mortality

There were no strandings of *Mesoplodon* spp. or unidentified beaked whales during 2004-2006. There were 2 reported stranding events of beaked whales in the Gulf of Mexico during 1999-2003. Two unidentified beaked whales mass stranded in Florida in December 1999, and 1 unidentified *Mesoplodon* stranded in Florida in January 2003. There was no evidence of human interactions for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 1980s multiple mass strandings of Cuvier's beaked whales (4 to about 20 per event) and small numbers of Gervais' beaked whales and Blainville's beaked whales occurred in the Canary Islands (Simmonds and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 were associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Evans and England 2001; Balcomb and Claridge 2001; Cox *et al.* 2006). Four Cuvier's, 2 Blainville's, and 2 unidentified beaked whales were returned to sea. The fate of the animals returned to sea is unknown. Necropsies were performed on 5 of the dead beaked whales and revealed evidence of tissue trauma associated with an acoustic or impulse injury that caused the animals to strand. Subsequently, the animals died due to extreme physiologic stress associated with the physical stranding (i.e., hyperthermia, high endogenous catecholamine release) (Evans and England 2001; Cox *et al.* 2006).

STATUS OF STOCK

The status of Gervais' beaked whales or other beaked whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

Disturbance by anthropogenic noise may prove to be an important habitat issue in some areas of this population's range, notably in areas of oil and gas activities or where shipping or naval activities are high. Limited studies are currently being conducted to address this issue and its impact, if any, on this and other marine species.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Gulf of Mexico continental shelf bottlenose dolphin stock inhabits waters from 20 to 200 m deep in the northern Gulf from the U.S.-Mexican border to the Florida Keys (Figure 1). Both "coastal" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998). The continental shelf stock probably consists of a mixture of both the coastal and offshore ecotypes. The offshore and nearshore ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34 km from shore. The offshore ecotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal ecotype. The continental shelf is much wider in the Gulf of Mexico so these results may not apply. The continental shelf stock range may extend into Mexican and Cuban territorial waters; however, there are no available estimates of either abundance or mortality from those countries. A stranded dolphin from the Florida Panhandle, genetically intermediate between coastal and offshore forms, was rehabilitated and released over the shelf off western Florida, and traveled into the Atlantic Ocean (Wells *et al.* 1999).

The bottlenose dolphins inhabiting waters <20 m deep in the U.S. Gulf are believed to constitute 36 inshore or coastal stocks. An oceanic stock is provisionally defined for bottlenose dolphins inhabiting waters >200 m. Both inshore and coastal stocks and the oceanic stock are separate from the continental shelf stock, but the continental shelf stock may overlap with coastal stocks and the oceanic stock in some areas and may be genetically indistinguishable from some of those stocks. However, studies have shown significant genetic differentiation between inshore stocks and coastal/continental shelf stocks along the central west coast of Florida (Sellas *et al.* 2005).

Based on research currently being conducted on bottlenose dolphins in the Gulf of Mexico, as well as the western North Atlantic Ocean, the structure of these stocks is uncertain, but appears to be complex. The multi-disciplinary research programs conducted over the last 37 years (e.g., Wells 1994) have begun to shed light on the structure of some of the stocks of bottlenose dolphins, though additional analyses are needed before stock structures can be elaborated on in the Gulf of Mexico. As research is completed, it may be necessary to revise stocks of bottlenose dolphins in the Gulf of Mexico.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. Data were collected from 1998 to 2001 during fall plankton surveys conducted from NOAA ships *Oregon II* (1998, 1999) and *Gordon Gunter* (2000, 2001). Tracklines, which were perpendicular to the bathymetry, covered shelf waters from the 20-m to the 200-m isobaths (Figure 1, Table 1; Fulling *et al.* 2003). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates using data older than 8 years are deemed unreliable, and therefore should
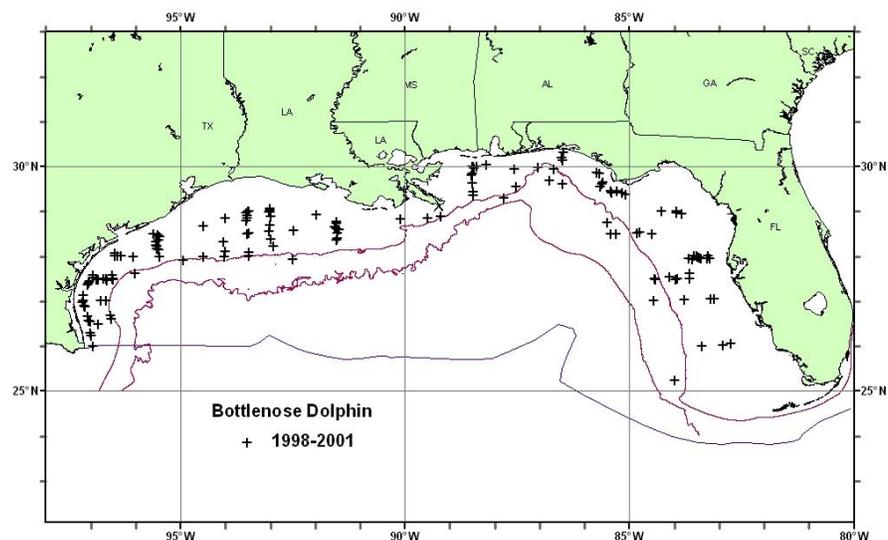
Figure 1. *Distribution of bottlenose dolphin sightings from SEFSC fall vessel surveys during 1998-2001. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

not be used for PBR determinations. Therefore, the best abundance estimate of bottlenose dolphins was based on data pooled from 2000 through 2001 for continental shelf vessel surveys and was 17,777 (CV=0.32) (see Fulling *et al.* 2003). This estimate is also considered the best because these surveys have the most complete coverage of the species' habitat.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for bottlenose dolphins is 17,777 (CV=0.32). The minimum population estimate for the northern Gulf of Mexico is 13,667 bottlenose dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate from the 2000-2001 ship survey of 17,777 (CV=0.32) and the previous abundance from a 1992-1994 aerial survey of 50,247 (CV=0.18) (Blaylock and Hoggard 1994) are significantly different (P<0.05). However, there are a number of reasons the 2 estimates are different other than from a change in abundance. Blaylock and Hoggard (1994) estimated from aerial surveys that about 31% of the bottlenose dolphins in shelf waters west of Mobile Bay were in a rather small area from the Mississippi River Delta west to about 90.5ºW. Vessel survey effort in this area was small and resulted in only 1 sighting of bottlenose dolphins. Therefore, vessel-based estimates may have underestimated the abundance of bottlenose dolphins in the western shelf. Aerial abundances were based on survey lines that extended from 9.3 km past the 18 m (10 fm) curve to 9.3 km past 183 m (100 fm) curve, so the area surveyed was somewhat different than from the study area (20-200 m) for vessel surveys. Also, Atlantic spotted dolphins are very common in shelf waters and are similar in length and shape to bottlenose dolphins. Atlantic spotted dolphins are born without spots and become progressively more spotted with age, but young animals look very similar to bottlenose dolphins. Therefore, depending on the composition of the group, from a distance Atlantic spotted are not always easily distinguished from bottlenose dolphins, so it is possible that some groups were misidentified during aerial surveys leading to bias in the relative abundance of each 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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a "recovery" factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 13,667. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico continental shelf bottlenose dolphin is 136.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of bottlenose dolphins in the pelagic longline fishery during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007). There were 3 interactions with the shark bottom longline fishery, including one mortality, during 1994-2003, and none during 2004-2007 (Burgess and Morgan 2003a,b; Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of bottlenose dolphins in the northern Gulf of Mexico is unknown; however, interactions between bottlenose dolphins and fisheries have been observed in the northern Gulf of Mexico. Fishery interactions have been reported to occur between bottlenose dolphins and the pelagic longline fishery in the Gulf of Mexico (SEFSC unpublished logbook data), and annual fishery-related mortality and serious injury to bottlenose dolphins was estimated to be 2.8 per year (CV=0.74) during 1992-1993. This could include bottlenose dolphins from the oceanic stock. The shark bottom longline fishery has been observed since 1994, and 3 interactions with bottlenose dolphins have been recorded. The incidents include 1 mortality (2003) and 2 hooked animals that escaped at the vessels (1999, 2002; Burgess and Morgan 2003a,b; Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007). Based on the water depths of the interactions (~12-60 m), they likely involved animals from the eastern coastal and continental shelf stocks. For the shark bottom longline fishery in the Gulf of Mexico, Richards (2007) estimated bottlenose dolphin

mortalities of 58 (CV=0.99), 0 and 0 for 2003, 2004 and 2005, respectively. There have been no reports of incidental mortality or injury associated with the shrimp trawl fishery in this area. A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980s 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 2 bottlenose dolphins (Burn and Scott 1988). There are no other data available.

Other Mortality

A total of 1,491 bottlenose dolphins were found stranded in the northern Gulf of Mexico from 2002 through 2006 (NMFS unpublished data). Of these, 93 showed evidence of human interactions as the cause of death (e.g., gear entanglement, mutilation, gunshot wounds). Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Wells *et al.* 1998; Gorzelany 1998), and some are struck by vessels (Wells and Scott 1997). The vast majority of stranded bottlenose dolphins are assumed to belong to one of the coastal or bay, sound and estuarine stocks. Nevertheless, it is possible that some of the stranded bottlenose dolphins belonged to the continental shelf or oceanic stocks and that they were among those strandings with evidence of human interactions. (Strandings do occur for other cetacean species whose primary range in the Gulf of Mexico is outer continental shelf or oceanic waters.)

The use of explosives to remove oil rigs in portions of the continental shelf 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 Herczeg 1994). There have been no reports of either serious injury or mortality to bottlenose dolphins (NMFS unpublished data).

STATUS OF STOCK

The status of bottlenose dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (Mullin *et al.* 1990). Northern Gulf of Mexico coastal waters have been divided for management purposes into 3 bottlenose dolphin stocks: eastern, northern and western. 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. Coastal waters are defined as those from shore, barrier islands or presumed bay boundaries to the 20-m isobath (Figure 1). The eastern coastal bottlenose dolphin stock area extends from 84° W longitude to Key West, Florida; the northern coastal bottlenose dolphin stock area from 84° W longitude to the Mississippi River Delta; and the western coastal bottlenose dolphin stock area from the Mississippi River Delta to the Texas-Mexico border. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches,

Figure 1. Locations of bottlenose dolphin groups sighted in coastal waters during aerial surveys in 1992-1994. The 20 and 200-m isobaths are shown.

marsh and mangrove islands, and has an intermediate level of freshwater 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. The western coastal stock area is characterized by an arid to temperate climate, sand beaches in southern Texas, extensive coastal marshes in northern Texas and Louisiana, and low to high levels of fresh water input.

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico continental shelf stock and bay, sound and estuary stocks, and the western coastal stock is trans-boundary with Mexico. The seaward boundary for coastal stocks, the 20-m isobath, generally corresponds to survey strata (Scott 1990; Blaylock and Hoggard 1994; Fulling *et al.* 2003), and thus represents a management boundary rather than an ecological boundary. Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998), and both could potentially occur in coastal waters. The offshore and coastal ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34 km from shore. The offshore ecotype was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal ecotype. The distance of the 20-m isobath ranges from 4 to 90 km from shore in the northern Gulf. Because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply.

Research on coastal stocks is limited. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1-12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine stocks from those occurring in adjacent Gulf coastal waters. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay, and Charlotte Harbor/Pine Island Sound over 14 months. They found coastal waters were inhabited by both 'inshore' and 'Gulf' dolphins but that the 2 types used coastal waters differently. Dolphins from the inshore communities were observed occasionally in Gulf near-shore waters adjacent to their inshore range, whereas 'Gulf' dolphins were found primarily in open Gulf of Mexico waters with some displaying seasonal variations in their use of the study area. The 'Gulf' dolphins did not show a preference for waters near passes as was seen for 'inshore' dolphins, but moved throughout the study area and made greater use of waters offshore of waters used by 'inshore' dolphins. During winter months abundance of 'Gulf' groups decreased while abundance for 'inshore' groups increased. Seasonal movements of identified individuals and abundance indices suggest that part of the 'Gulf' dolphin community moves out of the study area during winter, but their
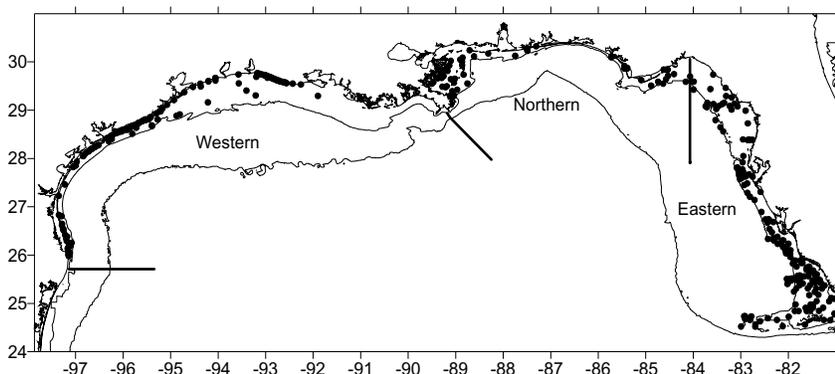
destination is unknown.

Off Galveston, Texas, Beier (2001) reported an open population of individual dolphins in coastal waters, but several individual dolphins had been sighted previously by other researchers over a 10-year period. Some coastal animals may move relatively long distances alongshore. 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 and Würsig 2002).

POPULATION SIZE

Population size has not been estimated for the 3 coastal stocks for more than 8 years and therefore the current population size is unknown for each (Wade and Angliss 1997). Previous 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 from 1992-1994 (Blaylock and Hoggard 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 18m isobath. Approximately 5% of the total survey area was visually searched. Previous bottlenose dolphin abundance estimates for each stock based on the 1991-1994 surveys are listed in Table 1.

Table 1. Previous bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV), and minimum population estimate (N_{MIN}) for northern Gulf of Mexico coastal bottlenose dolphin stocks. Because they are based on data collected more than 8 years ago, all estimates are currently considered unknown. PBR - Potential Biological Removal, UNK - unknown.					
Gulf of Mexico Stock Area	N_{BEST}	**CV**	N_{MIN}	**PBR**	**Year**
Eastern	9,912	0.12	UNK	UNK	1994
Northern	4,191	0.21	UNK	UNK	1993
Western	3,499	0.21	UNK	UNK	1992

Minimum Population Estimate

The current minimum population size for each stock is unknown. 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).

Current Population Trend

There are insufficient data to determine population trends for these stocks.

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 currently unknown for each stock. 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 the stocks are of unknown status.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There were 3 interactions with the shark bottom longline fishery, including one mortality, during 1994-2003, and none during 2004-2007 (Burgess and Morgan 2003a,b; Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007).

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. Five incidents have been documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. Four of the incidents were mortalities, and 1 occurred during each of the following years: 2003, 2005, 2006, and 2007. An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally.

STATE	2002	2003	2004	2005	2006	TOTAL
Table 2. Bottlenose dolphin strandings in the U.S. Gulf of Mexico (West Florida to Texas) from 2002 to 2006. Data are from the Southeast Marine Mammal Stranding Database (SESUS). Percent of animals with indications of human interactions were calculated based on animals which were determined as "yes" or "no" for human interactions. Animals that were "CBD" (could not be determined) were excluded from % with human interactions calculations. Please note human interaction does not necessarily mean the interaction caused the animal's death.						
Florida						
No. Stranded	82 [a]	64 [d]	162	135	166[h]	609
No. Human Interactions	6	7	4	4	18	39
No. CBD	44	34	63	84	112	337
% With Human Interactions	16%	23%	4%	8%	33%	14%
Alabama						
No. Stranded	12	7	18	19	20	76
No. Human Interactions	0	1	0	0	1	2
No. CBD	9	4	18	15	17	63
% With Human Interactions	0%	33%	CBD	0%	33%	15%
Mississippi						
No. Stranded	21[b]	37 [e]	27	11	8	104
No. Human Interactions	0	0	1	0	0	1
No. CBD	6	29	13	6	6	60
% With Human Interactions	0%	0%	7%	0%	0%	2%
Louisiana						
No. Stranded	2	33 [f]	26	22	13	96
No. Human Interactions	0	0	2	1	1	4
No. CBD	2	29	24	15	8	78
% With Human Interactions	CBD	0%	100%	14%	20%	22%
Texas						
No. Stranded	154 [c]	154 [g]	110	96	92	606
No. Human Interactions	15	10	12	3	7	47
No. CBD	57	101	41	17	42	258
% With Human Interactions	15%	19%	17%	4%	14%	14%
TOTAL						
No. Stranded	271	295	343	283	299	1491
No. Human Interactions	21	18	19	8	27	93
No. CBD	118	197	159	137	185	796
% With Human Interactions	14%	18%	10%	5%	24%	13%

a	Florida mass stranding of 2 animals in December 2002
b	Mississippi mass stranding of 2 animals in March 2002
c	Texas mass strandings (2 animals in January 2002, 2 animals in March 2002)
d	Florida mass stranding of 2 animals in May 2003
e	Mississippi mass stranding of 2 animals in April 2003
f	Louisiana mass stranding of 3 animals in July 2003
g	Texas mass stranding of 5 animals in March 2003
h	Florida mass strandings (2 animals in July 2006, 3 animals in November 2006)

Fisheries Information

The commercial fisheries which potentially could interact with coastal stocks in the northern Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden, gillnet, and shark bottom longline fisheries (Appendix I). Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. The blue crab fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery. There are no observer program data for the Gulf of Mexico menhaden fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). The menhaden fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken. No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. The shark bottom longline fishery has been observed since 1994, and 3 interactions with bottlenose dolphins have been recorded. The incidents include 1 mortality (2003) and 2 hooked animals that escaped at the vessels (1999, 2002; Burgess and Morgan 2003a,b; Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007). Based on the water depths of the interactions (~12-60 m), they likely involved animals from the eastern coastal and continental shelf stocks. For the shark bottom longline fishery in the Gulf of Mexico, Richards (2007) estimated bottlenose dolphin mortalities of 58 (CV=0.99), 0 and 0 for 2003, 2004 and 2005, respectively.

In 2007, a charter fishing boat captain was fined under the MMPA for shooting at a bottlenose dolphin that was attempting to remove a fish from his line in the Gulf of Mexico, off Orange Beach, Alabama. The problem of dolphin depredation of recreational and commercial fishing gear is increasing in the Gulf of Mexico.

Other Mortality

A total of 1,491 bottlenose dolphins were found stranded in the northern Gulf of Mexico from 2002 through 2006 (Table 2) (NMFS unpublished data). Of these, 93 showed evidence of human interactions as the cause of death (e.g., gear entanglement, mutilation, gunshot wounds). Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Wells *et al.* 1998; Gorzelany 1998), and some are struck by vessels (Wells and Scott 1997).

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 bay, sound and estuary stock; however, the proportion of stranded dolphins belonging to another stock cannot be determined because of the difficulty of determining from where the stranded carcass originated. Stranding data probably underestimate the extent of human-related mortality and serious injury because not all of the dolphins which die or are seriously injured due to human interactions wash ashore, nor will all of those that do wash ashore necessarily show signs of fishery-interaction or other human interactions. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

Since 1990, there have been 10 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). An unusual mortality event was declared for Sarasota Bay, Florida in 1991, but the cause was not determined. In March and April 1992, 111 bottlenose dolphins stranded in Texas; about 9 times the average number. The cause of this event was not determined, but carbamates were a suspected cause.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on

Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 7 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. 1) In 1993-1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). From February through April 1994, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 2) In 1996 a UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. 3) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesopolodon densirostris*, and 4 unidentified dolphins). 4) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 107 bottlenose dolphins stranded dead (NMFS 2004). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005). 5) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in December 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and a few unidentified dolphins). The investigation into this event is still ongoing, however, the evidence is highly suggestive of a relationship between the red tide bloom and the dolphin deaths. 6) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and September 2006 when the event was officially declared over, a total of 94 bottlenose dolphin strandings occurred (plus 1 stranding of a striped dolphin, *Stenella coeruleoalba*, and 4 unidentified dolphins). 7) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 66 bottlenose dolphins. Decomposition prevented conclusive analyses on most carcasses.

Feeding or provisioning, and swimming with wild bottlenose dolphins have been documented in Florida, particularly near Panama City Beach in the Panhandle, and near Sarasota Bay (Cunningham-Smith *et al.* 2006). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, Samuels and Bejder (2004) observed a high rate of uncontrolled provisioning near Panama City beach in 1998. The effects of swim-with activities on dolphins and their legality under the MMPA are less clear and are currently under review. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning.

The nearshore habitat occupied by these 3 stocks is adjacent to areas of high human population and in some areas, such as Tampa Bay, Florida; Galveston, Texas; and Mobile, Alabama, is highly industrialized. Concentrations of anthropogenic chemicals such PCB's and DDT and its metabolites vary from site to site, and can reach levels of concern for bottlenose dolphin health and reproduction in the southeastern U.S. (Schwacke *et al.* 2002). PCB concentrations in 3 stranded dolphins sampled from the eastern coastal stock area ranged from 16-46Φg/g wet weight. Two stranded dolphins from the northern coastal stock area had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with a 1990 mortality investigation conducted by NMFS (Varanasi *et al.* 1992). The significance of these findings is unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins (Lahvis *et al.* 1995), or impact reproduction through increased first-born calf mortality (Wells *et al.* 2005). 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).

The Mississippi River, which drains about two-thirds of the continental U.S., flows into the north-central Gulf of Mexico and deposits its nutrient load which is linked to the formation of one of the world's largest areas of seasonal hypoxia (Rabalais *et al.* 1999). This area is located in Louisiana coastal waters west of the Mississippi River delta. How it affects bottlenose dolphins is not known.

STATUS OF STOCK

The status of each 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 human-related mortality and serious injury for each stock cannot be assessed relative to PBR because the PBR is unknown for each stock, and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Each is a strategic stock because the known level of human-related mortality or serious injury relative to PBR is unknown.

Also, there is no systematic monitoring of all fisheries that may take these stocks. Insufficient information is available to determine whether the total fishery mortality and serious injury for coastal bottlenose dolphin stocks is insignificant and approaching zero mortality and serious injury rate. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Thirty-eight stocks have been provisionally identified for Gulf of Mexico bottlenose dolphins (Waring *et al.* 2001). Gulf of Mexico inshore habitat has been separated into 33 bay, sound and estuarine stocks. Three northern Gulf of Mexico coastal stocks include nearshore waters from the shore to the 20 m isobath. The continental shelf stock encompasses waters from 20 to 200 m deep. The Gulf of Mexico oceanic stock encompasses the waters from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ; Figure 1).

Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998) but the distribution of each is not known. The offshore and nearshore ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34 km from shore. The offshore ecotype was found exclusively seaward of 34 km and in waters deeper than 34m. The continental shelf is much wider in the Gulf of Mexico and these results may not apply. Ongoing research is aimed at defining these boundaries in the Gulf of Mexico.

Based on research currently being conducted on bottlenose dolphins in the Gulf of Mexico, as well as the western North Atlantic Ocean, the structure of these stocks is uncertain, but appears to be complex. The multi-disciplinary research programs conducted over the last 37 years (e.g., Wells 1994) are beginning to shed light on stock structures of bottlenose dolphins, though additional analyses are needed before stock structures can be elaborated on in the Gulf of Mexico. As research is completed, it may be necessary to revise stocks of bottlenose dolphins in the Gulf of Mexico.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. Surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Tracklines, which were perpendicular to the bathymetry, covered the waters from 200 m to the offshore extent of the U.S. EEZ. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for bottlenose dolphins in oceanic waters, pooled from 1996 to 2001, was 2,239 (CV=0.41) (Mullin and Fulling 2004)

Figure 1. *Distribution of bottlenose dolphin sightings from SEFSC shipboard surveys during spring 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004

surveys were considered most reliable. The estimate of abundance for bottlenose dolphins in oceanic waters, pooled from 2003 to 2004, was 3,708 (CV=0.42) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

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Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for bottlenose dolphins is 3,708 (CV=0.42) taken from Mullin and Fulling (2004). The minimum population estimate for the northern Gulf of Mexico oceanic stock is 2,641 bottlenose dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003 to 2004 of 3,708 (CV=0.42) and that for 1996-2001 of 2,239 (CV=0.41) are not significantly different (P>0.05), but due to the imprecision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of bottlenose dolphin abundance and stock structure. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum productivity rates are unknown for this stock. For purposes of this assessment, the maximum 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 level (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 2,641. 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 the stock is of unknown status. PBR for the Gulf of Mexico oceanic bottlenose dolphin is 26.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Annual human-caused mortality and serious injury is unknown for this stock.

Fisheries Information

The level of past or current, direct, human-caused mortality of bottlenose dolphins in the Gulf of Mexico is unknown; however, interactions between bottlenose dolphins and fisheries have been observed in the Gulf of Mexico. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to bottlenose dolphins in the Gulf of Mexico during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007). However, fishery interactions have previously been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico (SEFSC unpublished logbook data), with annual fishery-related mortality and serious injury to bottlenose dolphins estimated to be 2.8 per year (CV=0.74) during 1992-1993. This could include bottlenose dolphins from the continental shelf and oceanic stocks. One animal was hooked in the mouth and released by the pelagic longline fishery in 1998 (Yeung 1999). There have been no reports of incidental mortality or injury associated with the shrimp trawl fishery in this area. A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980s 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 2 bottlenose dolphins (Burn and Scott 1988). There are no other data available with regard to this fishery.

Other Mortality

A total of 1,491 bottlenose dolphins were found stranded in the northern Gulf of Mexico from 2002 through 2006 (NMFS unpublished data). Of these, 93 showed evidence of human interactions as the cause of death (e.g., gear entanglement, mutilation, gunshot wounds). Bottlenose dolphins are known to become entangled in, or ingest recreational

and commercial fishing gear (Wells and Scott 1994; Wells *et al.* 1998; Gorzelany 1998), and some are struck by vessels (Wells and Scott 1997). The vast majority of stranded bottlenose dolphins are assumed to belong to one of the coastal or bay, sound and estuarine stocks. Nevertheless, it is possible that some of the stranded bottlenose dolphins belonged to the continental shelf or oceanic stocks and that they were among those strandings with evidence of human interactions. (Strandings do occur for other cetacean species whose primary range in the Gulf of Mexico is outer continental shelf or oceanic waters.)

The use of explosives to remove oil rigs in portions of the continental shelf 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 Herczeg 1994). There have been no reports of either serious injury or mortality to bottlenose dolphins in the oceanic Gulf of Mexico (NMFS unpublished data).

STATUS OF STOCK

The status of bottlenose dolphins, relative to OSP, in the U.S. Gulf of Mexico oceanic waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because annual human-related mortality and 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

Bottlenose dolphins are distributed throughout the bays, sounds and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are provisionally identified in each of 33 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the Gulf of Mexico (Table 1, based on descriptions of relatively discrete dolphin "communities" in some of these areas). A "community" includes resident dolphins that regularly share large portions of their ranges, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent than with dolphins in adjacent waters. The term, as adapted from Wells *et al.* (1987), emphasizes geographic, genetic and social relationships of dolphins. Bottlenose dolphin communities do not constitute closed demographic populations, as individuals from adjacent communities are known to interbreed. Nevertheless, the geographic nature of these areas and long-term, multi-generational stability of residency patterns suggest that many of these communities exist as functioning units of their ecosystems, and under the Marine Mammal Protection Act must be maintained as such. Also, the stable patterns of residency observed within communities suggest that long periods would be required to repopulate the home range of a community were it eradicated or severely depleted. Thus, in the absence of information supporting management on a larger scale, it is appropriate to adopt a risk-averse approach and focus management efforts at the level of the community rather than at some larger demographic scale. Biological support for this risk-averse approach derives from several sources. Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification or tagging studies have been conducted in the Gulf of Mexico. In Texas, some of the dolphins in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994) have been reported as long-term residents. Hubard *et al.* (2004) reported sightings of dolphins tagged 12-15 years previously in Mississippi Sound. In Florida, long-term residency has been reported from Choctawhatchee Bay (1989-1993), Tampa Bay (Wells 1986a; Wells *et al.* 1996a), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986a, 1991; Scott *et al.* 1990; Wells *et al.* 1987; Wells 2003), Lemon Bay (Wells *et al.* 1996b) and Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996b, 1997; Shane 2004). In Louisiana, Miller (2003) concluded the bottlenose dolphin population in the Barataria Basin was relatively closed. In many cases, residents emphasize use of the bay, sound or estuary waters, with limited movements through passes to the Gulf of Mexico (Shane 1977, 1990; Gruber 1981; Irvine *et al.* 1981; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). These habitat use patterns are reflected in the ecology of the dolphins in some areas; for example, residents of Sarasota Bay, Florida, lacked squid in their diet, unlike non-resident dolphins stranded on nearby Gulf beaches (Barros and Wells 1998).

Genetic data also support the concept of relatively discrete bay, sound and estuary stocks. Analyses of mitochondrial DNA haplotype distributions indicate the existence of clinal variations along the Gulf of Mexico coastline (Duffield and Wells 2002). Differences in reproductive seasonality from site to site also suggest genetic-based distinctions between communities (Urian *et al.* 1996). Mitochondrial DNA analyses suggest finer-scale structural levels as well. For example, Matagorda Bay, Texas, dolphins appear to be a localized population, and differences in haplotype frequencies distinguish between adjacent communities in Tampa Bay, Sarasota Bay and Charlotte Harbor/Pine Island Sound, along the central west coast of Florida (Duffield and Wells 1991, 2002). Examination of protein electrophoretic data resulted in similar conclusions for the Florida dolphins (Duffield and Wells 1986). Additionally, Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, and the coastal Gulf of Mexico (1-12 km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and found evidence of significant population structure among all areas on the basis of both mitochondrial DNA control region sequence data and 9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine communities from those occurring in adjacent Gulf coastal waters.

The long-term structure and stability of at least some of these communities is exemplified by the residents of Sarasota Bay, Florida. This community has been observed since 1970 (Irvine and Wells 1972; Scott *et al.* 1990; Wells 1991). At least 5 generations of identifiable residents currently inhabit the region, including one-third of those first identified in 1970. Maximum immigration and emigration rates of about 2-3% have been estimated (Wells and Scott 1990).

Genetic exchange occurs between resident communities; hence the application of the demographically and behaviorally-based term "community" rather than "population" (Wells 1986a; Sellas *et al.* 2005). Some of the calves in

Sarasota Bay apparently have been sired by non-residents (Duffield and Wells 2002). A variety of potential exchange mechanisms occur in the Gulf. Small numbers of inshore dolphins traveling between regions have been reported, with patterns ranging from traveling through adjacent communities (Wells 1986b; Wells *et al.* 1996a,b) to movements over distances of several hundred km in Texas waters (Gruber 1981; Lynn and Würsig 2002). In many areas year-round residents co-occur with non-resident dolphins, providing potential opportunities for genetic exchange. About 17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987). Similar mixing of inshore residents and non-residents is seen off San Luis Pass, Texas (Maze and Würsig 1999), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of patterns, ranging from apparent nomadism recorded as transience in a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, several communities mix at the mouth of Tampa Bay, Florida (Wells 1986a), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries provide additional opportunities for genetic exchange with residents, and complicate the identification of stocks in coastal and inshore waters. In small bay systems such as Sarasota Bay, Florida, and San Luis Pass, Texas, residents move into Gulf coastal waters in fall/winter, and return inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). In larger bay systems, seasonal changes in abundance suggest possible migrations, with increases in more northerly bay systems in summer, and in more southerly systems in winter. Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and Charlotte Harbor/Pine Island Sound (Thompson 1981; Scott *et al.* 1989), and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and Würsig 2002) and Aransas Pass (Shane 1977; Weller 1998). Spring/summer increases in abundance occur in Mississippi Sound (Hubard *et al.* 2004) and are thought to occur in Galveston Bay (Henningsen 1991; Bräger 1993; Fertl 1994).

Spring and fall increases in abundance have been reported for St. Joseph Bay, Florida, where recent mark-recapture photo-identification surveys and 2 NOAA-sponsored health assessments were conducted during 2005-2006. Mark-recapture abundance estimates were highest in spring and fall and lowest in summer and winter (Table 1; Balmer 2007). Individuals with low site-fidelity indices were sighted more often in spring and fall, whereas individuals sighted during summer and winter displayed higher site-fidelity indices. In conjunction with health assessments, 23 dolphins were radio tagged during April 2005 and July 2006. Dolphins tagged in spring 2005 displayed variable utilization areas and variable site fidelity patterns. In contrast, during summer 2006 the majority of radio tagged individuals displayed similar utilization areas and moderate to high site-fidelity patterns. The results of the studies suggest that during summer and winter St. Joseph Bay hosts dolphins that spend most of their time within this region, and these may represent a resident community. In spring and fall, St. Joseph Bay is visited by dolphins that range outside of this area (Balmer 2007).

Much uncertainty remains regarding the structure of bottlenose dolphin stocks in many of the Gulf of Mexico bays, sounds and estuaries. Given the apparent co-occurrence of resident and non-resident dolphins in these areas, and the demonstrated variations in abundance, it appears that consideration should be given to the existence of a complex of stocks, and to the roles of bays, sounds and estuaries for stocks emphasizing Gulf of Mexico coastal waters. A starting point for management strategy should be the protection of the long-term resident communities, with their multi-generational geographic, genetic, demographic and social stability. These localized units would be at greatest risk from geographically-localized impacts. Complete characterization of many of these basic units would benefit from additional photo-identification, telemetry and genetic research (Wells 1994).

The current provisional stocks follow the designations in Table 1, with a few revisions. Available information suggests that Block B35, Little Sarasota Bay, can be subsumed under Sarasota Bay, and B36, Caloosahatchee River, can be considered a part of Pine Island Sound. As more information becomes available, additional combination or division may be warranted. For example, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remain undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a,b, 1997; Lynn and Würsig 2002; Urian 2002).

Understanding the full complement of the stock complex using the bay, sound and estuarine waters of the Gulf of Mexico will require much additional information. The development of biologically-based criteria to better define and manage stocks in this region should integrate multiple approaches, including studies of ranging patterns, genetics, morphology, social patterns, distribution, life history, stomach contents, isozyme analyses and contaminant concentrations. Spatially-explicit population modeling could aid in evaluating the implications of community-based stock definition. As these studies provide new information on what constitutes a bottlenose dolphin "biological stock," current provisional definitions will likely need to be revised. As stocks are more clearly identified, it will be possible to conduct abundance estimates using standardized methodology across sites (thereby avoiding some of the previous problems of mixing results of aerial and boat-based surveys), identify fisheries and other human impacts relative to specific stocks and perform individual stock assessments. As recommended by the Atlantic Scientific Review Group (November 1998, Portland, Maine), an expert panel reviewed the stock structure for bottlenose dolphins in the Gulf of Mexico during a workshop in

March 2000 (Hubard and Swartz 2002). The panel sought to describe the scope of risks faced by bottlenose dolphins in the Gulf of Mexico, and outline an approach by which the stock structure could most efficiently be investigated and integrated with data from previous and ongoing studies. The panel agreed that it was appropriate to use the precautionary approach and retain the stocks currently named until further studies are conducted, and made a variety of recommendations for future research (Hubard and Swartz 2002). As a result of this, efforts are being made to conduct research in new locations, such as the central Gulf, in addition to the ongoing studies in Texas and Florida.

Table 1. Most recent bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV) and minimum population estimate (N_{MIN}) in U.S. Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, most estimates are considered unknown for management purposes. Blocks refer to 33 aerial survey blocks illustrated in Figure 1. PBR - Potential Biological Removal; UNK - unknown.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	UNK	UNK	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	UNK	UNK	1992	A
B50	Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	UNK	UNK	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	UNK	UNK	1992	A
B55	West Bay	32	0.15	28	0.3	2000	E
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	UNK	UNK	1992	A
B57	Sabine Lake	0[a]	-		UNK	1992	A
B58	Calcasieu Lake	0[a]	-		UNK	1992	A
B59	Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[a]	-		UNK	1992	A
B60	Terrebonne Bay, Timbalier Bay	100	0.53	UNK	UNK	1993	A
B61	Barataria Bay	138	0.08	129	1.3	2001	D
B30	Mississippi River Delta	0[a]	-		UNK	1993	A
B02-05, 29,31	Bay Boudreau, Mississippi Sound	1,401	0.13	UNK	UNK	1993	A
B06	Mobile Bay, Bonsecour Bay	122	0.34	UNK	UNK	1993	A
B07	Perdido Bay	0[a]	-		UNK	1993	A
B08	Pensacola Bay, East Bay	33	0.80	UNK	UNK	1993	A
B09	Choctawhatchee Bay	242	0.31	UNK	UNK	1993	A
B10	St. Andrew Bay	124	0.57	UNK	UNK	1993	A
B11	St. Joseph Bay	81	0.14	72	0.7	2005-06	F
B12-13	St. Vincent Sound, Apalachicola Bay, St. Georges Sound	387	0.34	UNK	UNK	1993	A
B14-15	Apalachee Bay	491	0.39	UNK	UNK	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	UNK	UNK	1994	A
B17	St. Joseph Sound, Clearwater Harbor	37	1.06	UNK	UNK	1994	A
B32-34	Tampa Bay	559	0.24	UNK	UNK	1994	A
B20	Sarasota Bay	97	na[c]	UNK	UNK	1992	B
B35	Little Sarasota Bay	2[b]	0.24	UNK	UNK	1985	C
B21	Lemon Bay	0[a]	-		UNK	1994	A
B22-23	Pine Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	UNK	UNK	1994	A
B36	Caloosahatchee River	0[a,b]	-		UNK	1985	C
B24	Estero Bay	104	0.67	UNK	UNK	1994	A
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	UNK	UNK	1994	A
B27	Whitewater Bay	242	0.37	UNK	UNK	1994	A
B28	Florida Keys (Bahia Honda to Key West)	29	1.00	UNK	UNK	1994	A

References: A- Blaylock and Hoggard 1994; B- Wells 1992; C- Scott *et al.* 1989; D- Miller 2003; E- Irwin and Würsig 2004; F- Balmer 2007

Notes:

a   During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0-2 (CV= 0.38); B58, 0-6 (0.34); B59, 0-0; B30, 0-182(0.14); B07, 0-0; B21, 0-15(0.43); and B36, 0-0.

b   Block not surveyed during surveys reported in Blaylock and Hoggard 1994.

c   No CV because NBEST was a direct count of known individuals.
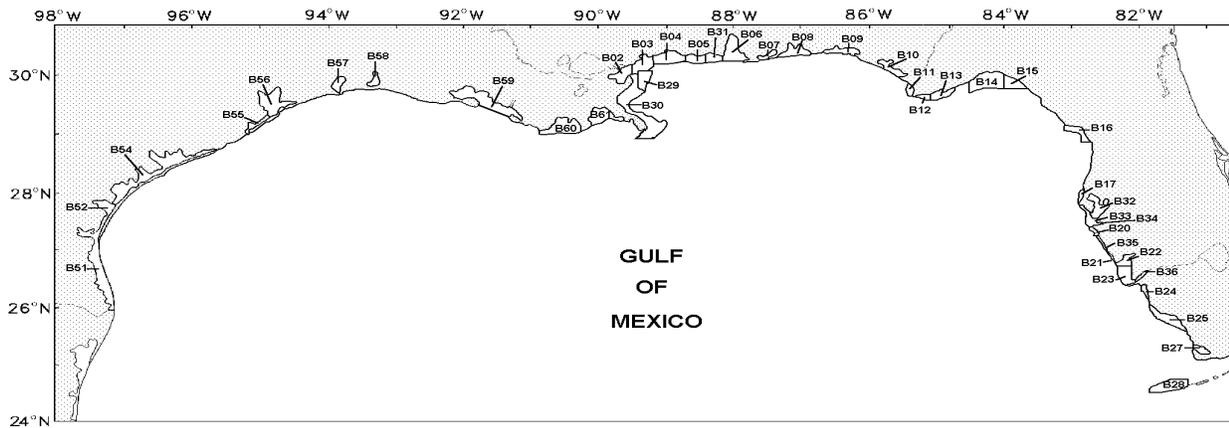
Figure 1. *U.S.A Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to 1 of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique stock for purposes of this assessment.*

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population size for each stock is considered unknown (Wade and Angliss 1997). Recent mark-recapture population size estimates are available for West Bay, Texas, Barataria Bay, Louisiana, and St. Joseph Bay, Florida (Table 1). Previous population size (Table 1) was estimated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana; in September-October 1993 in Louisiana, Mississippi, Alabama and the Florida Panhandle (Blaylock and Hoggard 1994); and in September-November 1994 along the west coast of Florida (NMFS unpublished data). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used. Stock size in Sarasota Bay, Florida, was obtained through direct count of known individuals (Wells 1992). Analyses are currently underway that should provide updated abundance estimates for Sarasota Bay, Lemon Bay, Gasparilla Sound, Charlotte Harbor, and Pine Island Sound during 2008 (R.S. Wells, pers. comm.).

Minimum Population Estimate

The population size for all but 3 stocks is currently unknown and the minimum population estimates are given for those 3 stocks in Table 1. 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 for each block from the estimated population size and its associated coefficient of variation. Where the population size resulted from a direct count of known individuals, the minimum population size was identical to the estimated population size.

Current Population Trend

The data are insufficient to determine population trends for all of the Gulf of Mexico bay, sound and estuary bottlenose dolphin communities. Ten anomalous mortality events have occurred among portions of these dolphin communities between 1990 and 2007; however, it is not possible to accurately partition the mortalities between bay and coastal stocks, thus the impact of these mortality events on communities is not known.

For Barataria Bay, Louisiana, Miller (2003) estimated a population size ranging from 138 to 238 bottlenose dolphins (95% CI = 128-297) using mark-recapture techniques with data collected from June 1999 to May 2002. The previous estimate for Barataria Bay from 1994, 219 dolphins, falls at the high end of this range. Irwin and Würsig (2004) estimated annual population sizes ranging from 28 to 38 dolphins during 1997-2001 for the San Luis Pass/Chocolate portion of West Bay, Texas, where the previous estimate from 1992 was 29 dolphins.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the dolphin communities that comprise these stocks. While productivity rates may be estimated for individual females within communities, such estimates are confounded at the stock level due to the influx of dolphins from adjacent areas which balance losses, and the unexplained loss of some individuals which offset births and recruitment (Wells 1998). Continued monitoring and expanded survey coverage will be

required to address and develop estimates of productivity for these dolphin communities. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is unknown for most stocks because the population size estimate is more than 8 years old. 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 those stocks with population size estimates less than 8 years old is given in Table 1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Some of the bay, sound and estuarine communities were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and public display for more than 2 decades ending in 1989 (NMFS unpublished data). During the period 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, Charlotte Harbor, Tampa Bay, and elsewhere. Mississippi Sound sustained the highest level of removals with 202 dolphins taken from this stock during this period, representing 41% of the total and an annual average of 12 dolphins (compared to a previous PBR of 13). The annual average number of removals never exceeded previous 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.

One research-related mortality occurred during November 2002 in Sarasota Bay, Florida. The animal was a 35-year-old male, and it died in a health assessment research project. The histopathology report stated that drowning was the cause of death. However, the necropsy revealed that the animal was in poor condition as follows: anemic, thin (ribs evident, blubber thin and grossly lacking lipid), no food in the stomach and little evidence of recent feeding in the digestive tract, vertebral fractures with muscle atrophy, with additional conditions present. This has been the only such loss during capture/release research conducted over a 36-year period on Florida's central west coast. Another research-related mortality occurred during July 2006 in St. Joseph Bay, near Panama City, Florida, during a NMFS health assessment research project to investigate a series of Unusual Mortality Events in the region. The animal became entangled deep in the capture net and was found dead during extrication of other animals from the net. The cause of death was determined to be asphyxiation.

As part of its annual coastal dredging program, the Army Corps of Engineers conducts sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles. Five incidents have been documented in the Gulf of Mexico involving bottlenose dolphins and relocation trawling activities. Four of the incidents were mortalities, and 1 occurred during each of the following years: 2003, 2005, 2006 and 2007. An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally.

Fishery Information

The commercial fisheries which potentially could interact with these stocks in the Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden and gillnet fisheries (Appendix I). Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. The blue crab fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery. There is no observer program data for the Gulf of Mexico menhaden fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). The menhaden fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken. No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.

Table 2. Bottlenose dolphin strandings in the U.S. Gulf of Mexico (West Florida to Texas) from 2002 to 2006. Data are from the Southeast Marine Mammal Stranding Database (SESUS). Percent of animals with indications of human interactions were calculated based on animals which were determined as "yes" or "no" for human interactions. Animals that were "CBD" (could not be determined) were excluded from % with human interactions calculations. Please note human interaction does not necessarily mean the interaction caused the animal's death.

STATE	2002	2003	2004	2005	2006	TOTAL
Florida						
No. Stranded	82 [a]	64 [d]	162	135	166 [h]	609
No. Human Interactions	6	7	4	4	18	39
No. CBD	44	34	63	84	112	337
% With Human Interactions	16%	23%	4%	8%	33%	14%
Alabama						
No. Stranded	12	7	18	19	20	76
No. Human Interactions	0	1	0	0	1	2
No. CBD	9	4	18	15	17	63
% With Human Interactions	0%	33%	CBD	0%	33%	15%
Mississippi						
No. Stranded	21 [b]	37 [e]	27	11	8	104
No. Human Interactions	0	0	1	0	0	1
No. CBD	6	29	13	6	6	60
% With Human Interactions	0%	0%	7%	0%	0%	2%
Louisiana						
No. Stranded	2	33 [f]	26	22	13	96
No. Human Interactions	0	0	2	1	1	4
No. CBD	2	29	24	15	8	78
% With Human Interactions	CBD	0%	100%	14%	20%	22%
Texas						
No. Stranded	154 [c]	154 [g]	110	96	92	606
No. Human Interactions	15	10	12	3	7	47
No. CBD	57	101	41	17	42	258
% With Human Interactions	15%	19%	17%	4%	14%	14%
TOTAL						
No. Stranded	271	295	343	283	299	1491
No. Human Interactions	21	18	19	8	27	93
No. CBD	118	197	159	137	185	796
% With Human Interactions	14%	18%	10%	5%	24%	13%

a	Florida mass stranding of 2 animals in December 2002
b	Mississippi mass stranding of 2 animals in March 2002
c	Texas mass strandings (2 animals in January 2002, 2 animals in March 2002)
d	Florida mass stranding of 2 animals in May 2003
e	Mississippi mass stranding of 2 animals in April 2003
f	Louisiana mass stranding of 3 animals in July 2003
g	Texas mass stranding of 5 animals in March 2003
h	Florida mass strandings (2 animals in July 2006, 3 animals in November 2006)

Other Mortality

A total of 1,491 bottlenose dolphins were found stranded in the U.S. Gulf of Mexico from 2002 through 2006 (Table 2) (NMFS unpublished data). Of these, 93 showed evidence of human interactions as the cause of death (e.g., gear entanglement, mutilation, gunshot wounds). Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Wells *et al.* 1998; Gorzelany 1998), and some are struck by vessels (Wells and Scott 1997).

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

Since 1990, there have been 10 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). An unusual mortality event was declared for Sarasota Bay, Florida in 1991, but the cause was not determined. In March and April 1992, 111 bottlenose dolphins stranded in Texas; about 9 times the average number. The cause of this event was not determined, but carbamates were a suspected cause.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 7 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. 1) In 1993-1994 an UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). From February through April 1994, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. 2) In 1996 an UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. 3) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle (additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesopolodon densirostris*, and 4 unidentified dolphins). 4) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 107 bottlenose dolphins stranded dead (NMFS 2004). Although there was no indication of a *K. brevis* bloom at the time, high levels of brevetoxin were found in the stomach contents of the stranded dolphins (Flewelling *et al.* 2005). 5) In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in December 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and a few unidentified dolphins). The investigation into this event is still ongoing, however, the evidence is highly suggestive of a relationship between the red tide bloom and the dolphin deaths. 6) A separate UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and September 2006 when the event was officially declared over, a total of 94 bottlenose dolphin strandings occurred (plus strandings of 1 striped dolphin, *Stenella coeruleoalba*, and 4 unidentified dolphins). 7) During February and March of 2007 an event was declared for northeast Texas and western Louisiana involving 66 bottlenose dolphins. Decomposition prevented conclusive analyses on most carcasses.

Feeding or provisioning, and swimming with wild bottlenose dolphins have been documented in Florida, particularly

near Panama City Beach in the Panhandle. Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, Samuels and Bejder (2004) observed a high rate of uncontrolled provisioning near Panama City Beach in 1998, and Cunningham-Smith *et al.* (2006) have observed provisioning south of Sarasota Bay continuing since 1990. The effects of swim-with activities on dolphins and their legality under the MMPA are less clear and are currently under review. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, an estimated 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (R.S. Wells, pers. comm.).

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 found to be relatively low in most; however, some had concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation.

Analyses of organochlorine concentrations in the tissues of bottlenose dolphins in Sarasota Bay, Florida, have found that the concentrations found in male dolphins exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring, and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

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 10 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 relatively high number of bottlenose dolphin deaths which occurred during the mortality events since 1990 suggests that some of these stocks may be stressed. Human-caused mortality and serious injury for each of these stocks is not known, but considering the evidence from stranding data (Table 2), the total human-caused mortality and serious injury exceeds 10% of the total known PBR or previous PBR, and, therefore, it is probably not insignificant and approaching the zero mortality and serious injury rate. Because these stocks are small and relatively few mortalities and serious injuries would exceed PBR, NMFS considers that each of these stocks is a strategic stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin *et al.* 1987). The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al*. 1987, 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 200-m isobath; and the smaller, less spotted island and offshore form which occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling *et al.* 2003; Mullin and Fulling 2003; Mullin and Fulling 2004). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea.

The Atlantic spotted dolphin is endemic to the Atlantic Ocean in temperate to tropical waters (Perrin *et al.* 1987, 1994). In the Gulf of Mexico, Atlantic spotted dolphins occur primarily from continental shelf waters 10-200 m deep to slope waters <500 m deep (Fulling *et al.* 2003; Mullin and Fulling 2004). Atlantic spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). It has been suggested that this species may move inshore seasonally during spring, but data supporting this hypothesis are limited (Caldwell and Caldwell 1966; Fritts *et al.* 1983).

In a recent study, Adams and Rosel (2005) presented strong genetic support for differentiation between Gulf of Mexico and western North Atlantic management stocks using both mitochondrial and nuclear markers. However, this study did not test for further population subdivision within the Gulf of Mexico.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. 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 an underestimate because the continental shelf was not entirely covered during these surveys.
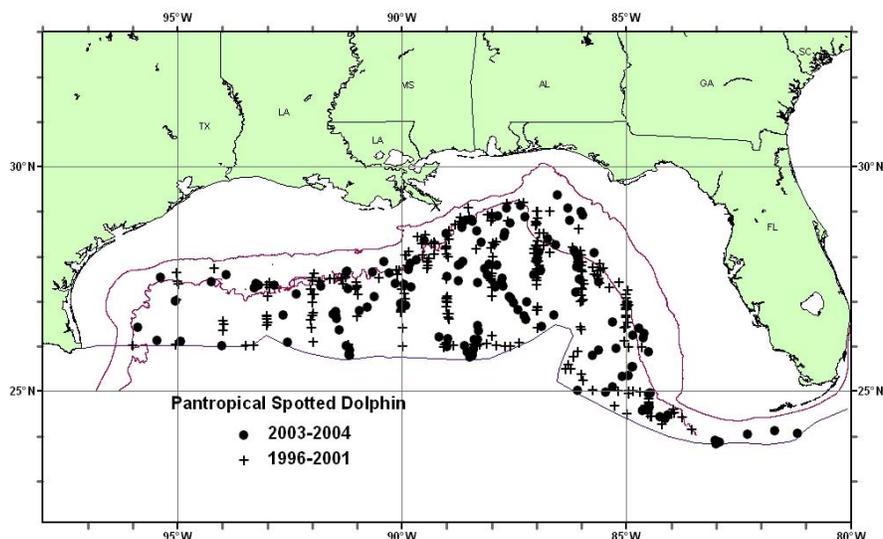

Figure 1. *Distribution of Atlantic spotted dolphin sightings from SEFSC spring and fall vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Data were collected from 1996 to 2001 during spring and fall plankton surveys conducted from NOAA ships *Oregon II* (1996, 1997, 1999, 2000) and *Gordon Gunter* (1998, 2000, 2001). Tracklines, which were perpendicular to the bathymetry, covered shelf waters from the 20-m to the 200-m isobaths in the fall of 1998 through 2001. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates using data older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. The combined estimated abundance of Atlantic spotted dolphins, pooled from 2000 through 2001, for the fall outer continental shelf shipboard surveys was 37,611
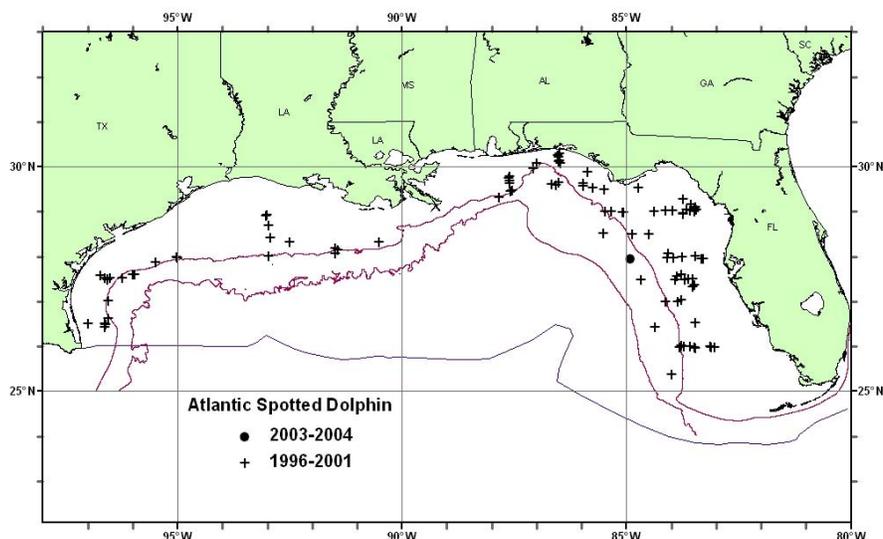
(CV=0.28) (Figure 1, Table 1; see Fulling *et al.* 2003). Spring surveys were conducted from April to May 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico from 200 m to the offshore extent of the U.S. EEZ. Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Mullin and Fulling 2004). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both areas. The estimate of abundance for Atlantic spotted dolphins in oceanic waters, pooled from 1996 through 2001, was 175 (CV=0.84) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extend of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007). The estimate of abundance for Atlantic spotted dolphins in oceanic waters, pooled from 2003 to 2004, was 0 (Mullin 2007). Because most of the data for oceanic estimates prior to 2003 were older than the 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable for oceanic waters.

The best available abundance estimate for the Atlantic spotted dolphin in the northern Gulf of Mexico is the combined estimate of abundance for both the outer continental shelf (fall surveys, 2000-2001) and oceanic waters (spring and summer surveys, 2003-2004), which is 37,611 (CV=0.28) (Table 1). This estimate is considered the best because these surveys have the most complete coverage of the species' habitat.

Table 1. Abundance estimates (N_{best}) and Coefficient of Variation (CV) of Atlantic spotted dolphins in the northern U.S. Gulf of Mexico outer continental shelf (OCS) (waters 20-200 m deep) during fall 2000-2001 and oceanic waters (200 m to the offshore extent of the EEZ) during spring/summer 2003-2004.			
Month/Year	**Area**	**N_{best}**	**CV**
Fall 1999-2001	Outer Continental Shelf	37,611	0.28
Spring/Summer 2003-2004	Oceanic	0	-
Fall & Spring/Summer	**OCS & Oceanic**	**37,611**	**0.28**

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Atlantic spotted dolphins is 37,611 (CV=0.28). The minimum population estimate for the northern Gulf of Mexico is 29,844 Atlantic spotted dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a "recovery" factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 29,844. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico Atlantic spotted dolphin is 298.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a spotted dolphin during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007). One mortality occurred during 2006 off Ft. Myers, Florida, when a dolphin was captured during sea turtle relocation trawling activities. As part of its annual coastal dredging program, the Army Corps of Engineers conducts

sea turtle relocation trawling during hopper dredging as a protective measure for marine turtles.

Fisheries Information

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. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were 2 observed incidental takes and releases of spotted dolphins in the Gulf of Mexico during 1994, but no recent reported takes of Atlantic spotted dolphins by this fishery in the Gulf of Mexico. Either spotted dolphin species may have been involved in the observed fishery-related mortality and serious injury incidents, but because of the uncertainty in species identification by fishery observers, they cannot currently be separated. 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).

Other Mortality

A total of 17 Atlantic spotted dolphins stranded in the Gulf of Mexico during 1999-2006 (Table 2 displays 2002-2006 data). There were indications of human interactions for 2 animals that stranded in Alabama during 2004, both of 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 UMEs have been declared in the Gulf of Mexico, and 2 of these included Atlantic spotted dolphins. Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. Additional strandings included 3 Atlantic spotted dolphins, 1 Risso's dolphin, *Grampus griseus*, 2 Blainville's beaked whales, *Mesopolodon densirostris*, and 4 unidentified dolphins. In 2005, a particularly destructive red tide (*K. brevis*) bloom occurred off of central west Florida. Manatee, sea turtle, bird and fish mortalities were reported in the area in early 2005 and a manatee UME had been declared. Bottlenose dolphin mortalities began to rise above the historical averages by late July 2005, continued to increase through October 2005, and were then declared to be part of a multi-species UME. The multi-species UME extended into 2006, and ended in December 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins plus strandings of 1 Atlantic spotted dolphin and a few unidentified dolphins. The investigation into this event is still ongoing, however, the evidence is highly suggestive of a relationship between the red tide bloom and the dolphin deaths.

Table 2. Atlantic spotted dolphin (*Stenella frontalis*) strandings along the U.S. Gulf of Mexico coast, 2002-2006.

STATE	2002	2003	2004	2005	2006	TOTAL
Alabama	0	1	4	0	0	5
Florida	0	1	4	2	0	7
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	0	0	0	0	0	0
TOTAL	0	2	8	2	0	12

STATUS OF STOCK

The status of Atlantic spotted dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin *et al.* 1987). The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al*. 1987, 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 200-m isobath; and the smaller, less spotted island and offshore form which occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling *et al.* 2003; Mullin and Fulling 2003; Mullin and Fulling 2004). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be 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 occur in oceanic waters of the northern Gulf of Mexico (Mullin and Fulling 2004). Pantropical spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

Some of the Pacific Ocean populations have been divided into different geographic stocks based on morphological characteristics (Perrin *et al.* 1987; Perrin and Hohn 1994). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of pantropical spotted dolphins for all surveys combined was 31,320 (CV=0.20) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of pantropical spotted dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for pantropical spotted dolphins in oceanic waters, pooled from 1996 to 2001, was 91,321 (CV=0.16) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

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As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for pantropical spotted dolphins in oceanic waters, pooled from 2003 to 2004, was 34,067 (CV=0.18) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for pantropical spotted dolphins is 34,067 (CV=0.18). The minimum population estimate for the northern Gulf of Mexico is 29,311 pantropical spotted dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 34,067 (CV=0.18) and that for 1996-2001 of 91,321 (CV=0.16) are significantly different (P<0.05). However, the 2003-2004 estimate is similar to that for 1991-1994 of 31,320 (CV=0.20). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of pantropical spotted dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 29,311. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico pantropical spotted dolphin is 293.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of pantropical spotted dolphins during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of pantropical spotted dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to pantropical spotted dolphins by this fishery during 1998-2005.

Other Mortality

Seven pantropical spotted dolphins stranded in the Gulf of Mexico during 1999-2006 (1 in Alabama, 4 in Florida, 2 in Texas). There was no evidence of human interactions for the stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of pantropical spotted dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The striped dolphin is distributed worldwide in tropical to temperate oceanic waters (Leatherwood and Reeves 1983; Perrin *et al.* 1994). Sightings of these animals in the northern Gulf of Mexico occur in oceanic waters (Mullin and Fulling 2004). Striped dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of striped dolphins for all surveys combined was 4,858 (CV=0.44) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of striped dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for striped dolphins in oceanic waters, pooled from 1996 to 2001, was 6,505 (CV=0.43) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for striped dolphins in oceanic waters, pooled from 2003 to 2004, was 3,325 (CV=0.48) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal

distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for striped dolphins is 3,325 (CV=0.48). The minimum population estimate for the northern Gulf of Mexico is 2,266 striped dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 3,325 (CV=0.48) and that for 1996-2001 of 6,505 (CV=0.43) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These estimates are similar to that for 1991-1994 of 4,858 (CV=0.44). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of striped dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 2,266. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico striped dolphin is 23.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of striped dolphins during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of striped dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to striped dolphins by this fishery.

Other Mortality

There were 2 reported strandings of a striped dolphin in the Gulf of Mexico during 1999-2005. There was no evidence of human interaction for these stranded animals. During 2006, 1 striped dolphin stranded alive in Florida with evidence of human interaction from a boat collision. The animal had propeller marks on its peduncle and near its left eye. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 UMEs have been declared in the Gulf of Mexico, and 1 of these included a striped dolphin. An UME was declared in the Florida Panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom in September 2005. Dolphin strandings remained elevated through the spring of 2006 and brevetoxin was again detected in the tissues of some of the stranded dolphins. Between September 2005 and September 2006 when the event was officially declared over, a total of 94 bottlenose dolphin, *Tursiops truncatus*, strandings occurred plus strandings of 1 striped dolphin and 4 unidentified dolphins.

STATUS OF STOCK

The status of striped dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The spinner dolphin is distributed worldwide in tropical to temperate oceanic waters (Leatherwood and Reeves 1983; Perrin and Gilpatrick 1994). Sightings of these animals in the northern Gulf of Mexico occur in oceanic waters (Mullin and Fulling 2004). Spinner dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of spinner dolphins for all surveys combined was 6,316 (CV=0.43) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of spinner dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for spinner dolphins in oceanic waters, pooled from 1996 to 2001, was 11,971 (CV=0.71) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for spinner dolphins in oceanic waters, pooled from 2003 to 2004, was 1,989 (CV=0.48) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate

as specified by Wade and Angliss (1997). The best estimate of abundance for spinner dolphins is 1,989 (CV=0.48). The minimum population estimate for the northern Gulf of Mexico is 1,356 spinner dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,989 (CV=0.48) and that for 1996-2001 of 11,971 (CV=0.71) are significantly different (P<0.05). The 1991-1994 estimate of 6,316 (CV=0.43) was intermediate to these two estimates. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of spinner dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,356. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico spinner dolphin is 14.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of spinner dolphins during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of spinner dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to spinner dolphins by this fishery.

Other Mortality

There were 6 reported strandings of spinner dolphins in the Gulf of Mexico during 1999-2006 (2 in Alabama, 4 in Texas). There was evidence of human interaction for 1 animal that stranded during 2003 in Texas. This animal had monofilament line around its tail stock but not into the skin, and abrasions around its flukes as though the animal had been towed. In addition, possible propeller marks were noted. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of spinner dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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). Rough-toothed dolphins occur in both oceanic and continental shelf waters in the northern Gulf of Mexico (Fulling *et al.* 2003; Mullin and Fulling 2004). Rough-toothed dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). Four dolphins from a mass stranding of 62 animals in the Florida Panhandle in December 1997 were rehabilitated and released in 1998, and satellite-linked transmitters tracked for 4 - 112 days. A report after 5 months ,indicated that the animals returned to, and remained in, Gulf waters averaging about 195 m deep offshore of the original stranding site (Wells *et al.* 1999).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of rough-toothed dolphins for all surveys combined was 852 (CV= 0.31) (Hansen *et al.* 1995). This was probably an underestimate and should be considered a partial stock estimate because the continental shelf area was not entirely covered.

Figure 1. *Distribution of rough-toothed dolphin sightings from SEFSC spring and fall vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico from 200 m to the offshore extent of the U.S. EEZ. Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Mullin and Fulling 2004). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both continental shelf and oceanic waters. The estimate of abundance for rough-toothed dolphins in oceanic waters, pooled from 1996 through 2001, was 985 (CV=0.44) (Mullin and Fulling 2004). Data were collected from 1998 to 2001 during fall plankton surveys. Tracklines, which were perpendicular to the bathymetry, covered shelf waters from 20 to 200 m deep in the fall of 1998 through 2001 (Figure 1 and Table 1; see Fulling *et al.* 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates using data older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Therefore, the
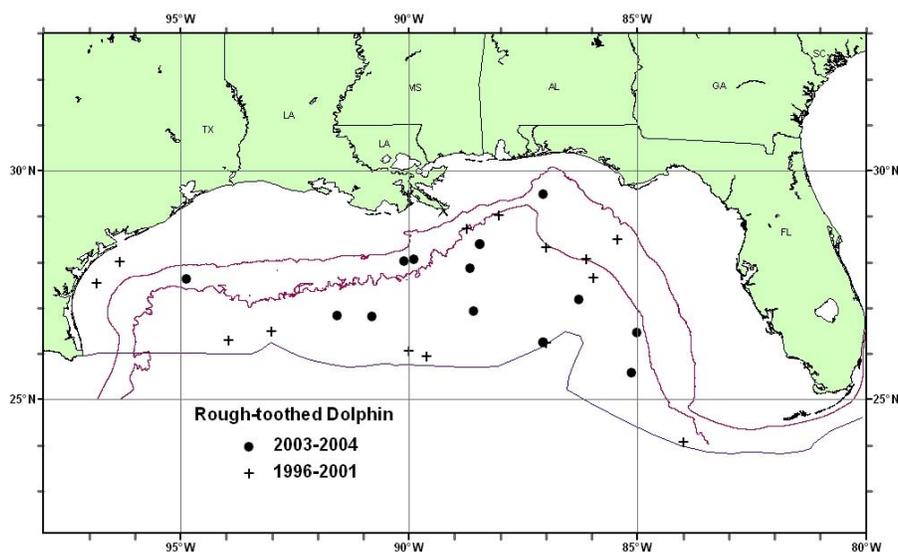
estimated abundance of rough-toothed dolphins was based on data pooled from 2000 through 2001, for the outer continental shelf shipboard surveys and was 1,145 (CV=0.83) (see Fulling *et al.* 2003).

Table 1. Abundance estimates (N_{best}) and Coefficient of Variation (CV) of rough-toothed dolphins in the northern U.S. Gulf of Mexico outer continental shelf (OCS) (waters 20-200 m deep) during fall 2000-2001 and oceanic waters (200 m to the offshore extent of the EEZ) during spring/summer 2003-2004.

Month/Year	Area	N_{best}	CV
Fall 1999-2001	Outer Continental Shelf	1,145	0.83
Spring/Summer 2003 -2004	Oceanic	1,508	0.39
Spring/Summer & Fall	**OCS & Oceanic**	**2,653**	**0.42**

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter*. The estimate of abundance for rough-toothed dolphins in oceanic waters from 2003 and 2004, was 1,508 (CV=0.39) (Mullin 2007).

Because most of the data for oceanic estimates prior to 2003 were older than the 8-year limit and due to the different oceanic sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable for oceanic waters. The best available abundance estimate for the rough-toothed dolphin in the northern Gulf of Mexico is the combined estimate of abundance for both the outer continental shelf and oceanic waters which is 2,653 (CV=0.42).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for rough-toothed dolphins is 2,653 (CV=0.42). The minimum population estimate for the northern Gulf of Mexico is 1,890 rough-toothed dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are 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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a "recovery" factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,890. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico rough-toothed dolphin is 18.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of rough-toothed dolphins during 1992-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of rough-toothed dolphins in the northern Gulf of Mexico

is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to rough-toothed dolphins by this fishery in the Gulf of Mexico during 1992-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Other Mortality

There were 49 stranded rough-toothed dolphins in the northern Gulf of Mexico during 1999-2006, including a mass stranding of 19 animals in February 2001 and a mass stranding of 11 animals in March 2005 (Table 2 displays 2002-2006 data). There was no evidence of human interactions for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Table 2. Rough-toothed dolphin (*Steno bredanensis*) strandings along the U.S. Gulf of Mexico coast, 2002-2006.

STATE	2002	2003	2004	2005	2006	TOTAL
Alabama	0	0	0	0	0	0
Florida	1	1	12	11[a]	1	26
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	0	0	1	1	1	3
TOTAL	1	1	13	12	2	29

[a] Florida mass stranding of 11 animals in March 2005

STATUS OF STOCK

The status of rough-toothed dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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 GulfCet aerial surveys of the northern Gulf of Mexico during 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200 m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Clymene dolphins for all surveys combined was 5,571 (CV=0.37) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern

Figure 1. *Distribution of Clymene dolphin sightings from SEFSC shipboard spring surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for Clymene dolphins in oceanic waters, pooled from 1996 to 2001, was 17,355 (CV=0.65) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Clymene dolphins in oceanic waters, pooled from 2003 to 2004, was 6,575 (CV=0.36) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Clymene dolphins is 6,575 (CV=0.36). The minimum population estimate for the northern Gulf of Mexico is 4,901 Clymene dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 6,575 (CV=0.36) and that for 1996-2001 of 17,355 (CV=0.65) are significantly different (P<0.05). However, the 2003-2004 estimate is similar to that for 1991-1994 of 5,571 (CV=0.37). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Clymene dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 4,901. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico Clymene dolphin is 49.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of Clymene dolphins during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of Clymene dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Clymene dolphins by this fishery.

Other Mortality

There were 3 reported stranding events of Clymene dolphins in the Gulf of Mexico during 1999-2006. One animal stranded in Florida in July 2002, 2 animals mass stranded in Louisiana in September 2003, and 1 animal stranded in Texas in April 2004. There were no indications of human interactions for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of Clymene dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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 in the northern Gulf of Mexico occur in oceanic waters (>200 m) (Figure 1). Fraser's dolphins have been observed in the northern Gulf of Mexico during all seasons (Leatherwood *et al.* 1993; Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Fraser's dolphins for all surveys combined was 127 (CV= 0.90) (Hansen *et al.* 1995). Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey

Figure 1. *Distribution of Fraser's dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for Fraser's dolphins in oceanic waters, pooled from 1996 to 2001, is 726 (CV=0.70) (Mullin and Fulling 2004), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Fraser's dolphins in oceanic waters, pooled from 2003 to 2004, was 0 (Mullin 2007). Because sightings of groups of Fraser's dolphins have historically been uncommon to rare, it is probable that Fraser's dolphins were in the northern Gulf of Mexico during 2003 and 2004 but were not encountered. Therefore, the best available abundance estimate for this species in the northern Gulf of Mexico is unknown.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate

as specified by Wade and Angliss (1997). The best estimate of abundance for Fraser's dolphins is unknown. The minimum population estimate for the northern Gulf of Mexico for Fraser's dolphins is unknown.

Current Population Trend

There are insufficient data to determine the population trends for this species. The best available abundance estimate is unknown. The pooled abundance estimate for 1996-2001 of 726 (CV=0.70) and that for 1991-1994 of 127 (CV=0.89) were not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Fraser's dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Fraser's dolphin is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Fraser's dolphin during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of Fraser's dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Fraser's dolphins by this fishery.

Other Mortality

There was 1 reported stranding event of Fraser's dolphins in the Gulf of Mexico during 1999-2006. Ten animals mass stranded in Florida during April 2003. There was no evidence of human interaction for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of Fraser's dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. Despite an unknown PBR, this is not a strategic stock because there is no documented human-related mortality and serious injury.

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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 during 1951-1995 occurred primarily in oceanic waters ranging from 256 to 2,652 m (averaging 1,242 m) in the north-central Gulf of Mexico (O'Sullivan and Mullin 1997). Despite extensive shelf surveys (O'Sullivan and Mullin 1997), no killer whales have been reported on the Gulf of Mexico shelf waters other than those reported in 1921, 1985 and 1987 by Katona *et al.* (1988). Killer whales were seen only in the summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000), were reported from May through June during vessel surveys (Mullin and Fulling 2004) and recorded in May, August, September and November by earlier opportunistic ship-based sources (O'Sullivan and Mullin 1997).

Different stocks were 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 Ocean population, although an analysis of vocalizations of killer whales from Iceland and Norway indicated that whales from these areas may represent different stocks (Moore *et al.* 1988). Thirty-two individuals have been photographically identified to date, with 6 individuals having been sighted over a 5 year period, and 1 whale resighted over 10 years. Three animals have been sighted over a range of more than 1,100 km (O'Sullivan and Mullin 1997). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during summer in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of killer whales for all surveys combined was 277 (CV=0.42) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for killer whales in oceanic waters, pooled from 1996 to 2001, was 133 (CV=0.49) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for killer whales in oceanic waters, pooled from 2003 to 2004, was 49 (CV=0.77) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for killer whales is 49 (CV=0.77). The minimum population estimate for the northern Gulf of Mexico is 28 killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 49 (CV=0.77) and that for 1996-2001 of 133 (CV=0.49) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for 1991-1994 was 277 (CV=0.42). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of killer whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 28. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico killer whale is 0.3.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a killer whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of killer whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to killer whales by this fishery.

Other Mortality

There were no reported strandings of killer whales in the Gulf of Mexico during 1999-2006. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of killer whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but the rarity of mortality reports for this species suggests that this level is insignificant and approaching a zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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 in oceanic waters (Figure 1; Mullin and Fulling 2004). False killer whales were seen only in the spring and summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000) and in the spring during vessel surveys (Mullin and Fulling 2004).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of false killer whales for all surveys combined was 381 (CV=0.62) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of false killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for false killer whales in oceanic waters, pooled from 1996 to 2001, was 1,038 (CV=0.71) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for false killer whales in oceanic waters, pooled from 2003 to 2004, was 777 (CV=0.56) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal

distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for false killer whales is 777 (CV=0.56). The minimum population estimate for the northern Gulf of Mexico is 501 false killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 777 (CV=0.56) and that for 1996-2001 of 1,038 (CV=0.71) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of false killer whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 501. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico false killer whale is 5.0.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been 1 reported fishing-related mortality of a false killer whale during 1998-2006, which was a stranding in 1999 classified as likely caused by fishery interactions or other human-related causes due to mutilation of limbs (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of false killer whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to false killer whales by this fishery.

Other Mortality

There was 1 reported stranding of a false killer whale in the Gulf of Mexico during 1999-2006. This animal, which stranded in Alabama in 1999, was classified as likely caused by fishery interactions or other human-related causes. The fins and flukes of the animal had been amputated. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of false killer whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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 in oceanic waters (Mullin and Fulling 2004). Sightings of pygmy killer whales were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of pygmy killer whales for all surveys combined was 518 (CV=0.81) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of pygmy killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for pygmy killer whales in oceanic waters, pooled from 1996 to 2001, was 408 (CV=0.60) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for pygmy killer whales in oceanic waters, pooled from 2003 to 2004, was 323 (CV=0.60) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal

distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for pygmy killer whales is 323 (CV=0.60). The minimum population estimate for the northern Gulf of Mexico is 203 pygmy killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 323 (CV=0.60) and that for 1996-2001 of 408 (CV=0.60) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These estimates are generally similar to that for 1991-1994 of 518 (CV=0.81). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of pygmy killer whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al*. 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 203. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico pygmy killer whale is 2.0.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a pygmy killer whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of pygmy killer whales in the northern Gulf of Mexico is unknown. There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and Caldwell 1971). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to pygmy killer whales by this fishery.

Other Mortality

There were 2 reported strandings of a pygmy killer whale in the Gulf of Mexico during 1999-2006. One pygmy killer whale stranded in Florida in 2001, and 1 stranded in Texas in 2004. There was no evidence of human interaction for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of pygmy killer whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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DWARF SPERM WHALE (*Kogia sima*):
Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). Sightings of these animals in the northern Gulf of Mexico occur primarily in oceanic waters (Figure 1; Mullin *et al.* 1991; Mullin and Fulling 2004). Dwarf sperm whales and pygmy sperm whales (*Kogia breviceps*) are difficult to differentiate at sea, and sightings of either species are usually categorized as *Kogia* spp. Sightings of this category were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The difficulty in sighting dwarf and pygmy sperm whales may be exacerbated by their avoidance reaction towards ships, and change in behavior towards approaching survey aircraft (Würsig *et al.* 1998).

In a study using hematological and stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales and/or dive deeper during feeding bouts. Diagnostic morphological characters have also been useful in distinguishing the 2 *Kogia* species (Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin, in proportion to the animal's total length, can be used to differentiate between the 2 *Kogia* species when such measurements are obtainable (Barros and Duffield 2003).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of dwarf and pygmy sperm whales for all surveys combined was 547 (CV=0.28) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of dwarf and pygmy sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for dwarf and pygmy sperm whales in oceanic waters, pooled from 1996 to 2001, was 742 (CV=0.29) (Mullin and Fulling 2004). A separate estimate of abundance for dwarf sperm whales could not be estimated due to uncertainty of species identification at sea.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from

a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for dwarf and pygmy sperm whales in oceanic waters, pooled from 2003 to 2004, was 453 (CV=0.35) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for dwarf and pygmy sperm whales is 453 (CV=0.35). It is not possible to determine the minimum population estimate for only dwarf sperm whales. The minimum population estimate for the northern Gulf of Mexico is 340 dwarf and pygmy sperm whales.

Current Population Trend

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Kogia* spp. for 2003-2004 of 453 (CV=0.35) and that for 1996-2001 of 742 (CV=0.29) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for *Kogia* spp. for 1991-1994 was 547 (CV=0.28). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for dwarf and pygmy sperm whales is 340. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico dwarf and pygmy sperm whales is 3.4. It is not possible to determine the PBR for only dwarf sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of dwarf or pygmy sperm whales during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of dwarf sperm whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to dwarf sperm whales by this fishery.

Other Mortality

There were no documented strandings of dwarf sperm whales in the northern Gulf of Mexico during 1999-2006 which were classified as likely caused by fishery interactions. At least 12 dwarf sperm whale strandings were documented in the northern Gulf of Mexico from 1999 through 2006 (Table 1 displays 2002-2006 data; 9 showed no signs of human interaction and 3 were designated "could not be determined"). An additional 9 *Kogia* spp. stranded during 1999-2006 (2 in

Texas in 2000, 1 in Texas in 2001, 2 in Texas in 2002, 1 in Mississippi in 2003, 1 in Florida in 2004, and 2 in Florida in 2006). 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Table 1. Dwarf sperm whale (*Kogia sima*) strandings along the U.S. Gulf of Mexico coast, 2002-2006.						
STATE	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
Alabama	0	0	0	0	0	0
Florida	3	1	1[c]	1	1[d]	7
Louisiana	0	0	0	0	0	0
Mississippi	0	0[b]	0	0	0	0
Texas	1[a]	0	2	0	0	3
TOTAL	4	1	3	1	1	10

[a] 2 additional *Kogia* sp. stranded
[b] 1 additional *Kogia* sp. stranded
[c] 1 additional *Kogia* sp. stranded
[d] 2 additional *Kogia* sp. stranded

STATUS OF STOCK

The status of dwarf sperm whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR. However, the continuing inability to distinguish between species of *Kogia* raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

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PYGMY SPERM WHALE (*Kogia breviceps*):
Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). Sightings of these animals in the northern Gulf of Mexico occur primarily in oceanic waters (Figure 1; Mullin *et al.* 1991; Mullin and Fulling 2004). Pygmy sperm whales and dwarf sperm whales (*Kogia sima*) are difficult to differentiate at sea, and sightings of either species are often categorized as *Kogia* sp. Sightings of this category were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The difficulty in sighting pygmy and dwarf sperm whales may be exacerbated by their avoidance reaction towards ships, and change in behavior towards approaching survey aircraft (Würsig *et al.* 1998).

In a study using hematological and stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. Diagnostic morphological characters have also been useful in distinguishing the 2 *Kogia* species (Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin, in proportion to the animal's total length, can be used to differentiate between the 2 *Kogia* species when such measurements are obtainable (Barros and Duffield 2003).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of pygmy and dwarf sperm whales for all surveys combined was 547 (CV=0.28) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of pygmy and dwarf sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for pygmy and dwarf sperm whales in oceanic waters, pooled from 1996 to 2001, was 742 (CV=0.29) (Mullin and Fulling 2004). A separate estimate of abundance for pygmy sperm whales could not be estimated due to uncertainty of species identification at sea.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from

a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for pygmy and dwarf sperm whales in oceanic waters, pooled from 2003 to 2004, was 453 (CV=0.35) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for pygmy and dwarf sperm whales is 453 (CV=0.35). It is not possible to determine the minimum population estimate for only pygmy sperm whales. The minimum population estimate for the northern Gulf of Mexico is 340 pygmy and dwarf sperm whales.

Current Population Trend

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Kogia* spp. for 2003-2004 of 453 (CV=0.35) and that for 1996-2001 of 742 (CV=0.29) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for *Kogia* spp. for 1991-1994 was 547 (CV=0.28). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for pygmy and dwarf sperm whales is 340. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico pygmy and dwarf sperm whales is 3.4. It is not possible to determine the PBR for only pygmy sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of dwarf or pygmy sperm whales during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of dwarf sperm whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to dwarf sperm whales by this fishery.

Other Mortality

At least 17 pygmy sperm whale strandings were documented in the northern Gulf of Mexico during 1999-2006 (Table 1 displays 2002-2006 data; 15 showed no signs of human interaction and 2 were designated "could not be determined"). Two animals mass stranded in Florida during January 2001. An additional 9 *Kogia* spp. stranded during 1999-2006 (2 in Texas in 2000, 1 in Texas in 2001, 2 in Texas in 2002, 1 in Mississippi in 2003, 1 in Florida in 2004, and 2 in Florida in

2006). 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Table 1. Pygmy sperm whale (*Kogia breviceps*) strandings along the U.S. Gulf of Mexico coast, 2002- 2006.						
STATE	**2002**	**2003**	**2004**	**2005**	**2006**	**TOTAL**
Alabama	0	0	0	0	0	0
Florida	2	3	1[c]	0	1[d]	7
Louisiana	0	0	0	0	0	0
Mississippi	0	0[b]	0	0	0	0
Texas	2[a]	1	0	2	1	6
TOTAL	4	4	1	2	2	13

[a] 2 additional *Kogia* sp. stranded
[b] 1 additional *Kogia* sp. stranded
[c] 1 additional *Kogia* sp. stranded
[d] 2 additional *Kogia* sp. stranded

STATUS OF STOCK

The status of pygmy sperm whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR. However, the continuing inability to distinguish between species of *Kogia* raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

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MELON-HEADED WHALE (*Peponocephala electra*):
Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The melon-headed whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994). Sightings in the northern Gulf of Mexico occur in oceanic waters (Mullin *et al.* 1994; Mullin and Fulling 2004). Sightings of melon-headed whales were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of melon-headed whales for all surveys combined was 3,965 (CV=0.39) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of melon-headed whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for melon-headed whales in oceanic waters, pooled from 1996 to 2001, was 3,451 (CV=0.55) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for melon-headed whales in oceanic waters, pooled from 2003 to 2004, was 2,283 (CV=0.76) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal

distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for melon-headed whales is 2,283 (CV=0.76). The minimum population estimate for the northern Gulf of Mexico is 1,293 melon-headed whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003 to 2004 of 2,283 (CV=0.76) and that for 1996-2001 of 3,451 (CV=0.55) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These estimates are generally similar to that for 1991-1994 of 3,965 (CV=0.39). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of melon-headed whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,293. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico melon-headed whale is 13.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a melon-headed whale during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of melon-headed whales in the northern Gulf of Mexico is unknown. There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell *et al.* 1976). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to melon-headed whales by this fishery.

Other Mortality

There were 8 reported strandings of melon-headed whales in the Gulf of Mexico during 1999-2006 (Table 1 displays 2002-2006 data). There was no evidence of human interactions for these stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

Table 1. Melon-headed whale (*Peponocephala electra*) strandings along the U.S. Gulf of Mexico coast, 2002-2006.

STATE	2002	2003[a]	2004	2005	2006	TOTAL
Alabama	0	0	0	0	0	0
Florida	0	2	0	0	0	2

Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	0	1	1	0	1	3
TOTAL	0	3	1	0	1	5

[a] Strandings from 2003 were reported incorrectly in previous reports

STATUS OF STOCK

The status of melon-headed whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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). Risso's dolphins in the northern Gulf of Mexico occur throughout oceanic waters but are concentrated in continental slope waters (Baumgartner 1997). Risso's dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently little information to differentiate this stock from the Atlantic Ocean stock(s). In 2006, a Risso's dolphin that stranded on the Florida Gulf Coast was rehabilitated, satellite tagged and released into the Gulf southwest of Tampa Bay. Over a 23-day period the Risso's dolphin moved from the Gulf release site, into the Atlantic Ocean, and north to just off of Delaware (Wells 2006). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Risso's dolphins for all surveys combined was 2,749 (CV=0.27) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from

Figure 1. *Distribution of Risso's dolphin sightings from SEFSC vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for Risso's dolphins in oceanic waters, pooled from 1996 to 2001, was 2,169 (CV=0.32) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Risso's dolphins in oceanic waters, pooled from 2003 to 2004, was 1,589 (CV=0.27) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

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Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 1,589 (CV=0.27). The minimum population estimate for the northern Gulf of Mexico is 1,271 Risso's dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,589 (CV=0.27) and that for 1996-2001 of 1,777 (CV=0.34) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is relatively low. These estimates are generally similar to that for 1991-1994 of 2,749 (CV=0.27). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Risso's dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,271. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico Risso's dolphin is 13.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Risso's dolphin during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007). However, during 2005 there was one Risso's dolphin released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield Walsh and Garrison 2006).

Fisheries Information

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. pelagic longline fishery in the northern Gulf of Mexico and in the U.S. Atlantic (Lee *et al.* 1994). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico (see Appendix III for a description of the large pelagics longline fishery). There were no reports of mortality or serious injury to Risso's dolphins in the Gulf of Mexico by this fishery during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007). However, during 2005, 1 Risso's dolphin was observed entangled and released alive in the Gulf of Mexico. The animal was not hooked, but was tangled with mainline and leader around its flukes. All gear was removed and the animal dove immediately. It is presumed to have not been seriously injured (Fairfield Walsh and Garrison 2006). 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). Estimated average annual fishery-related mortality and serious injury attributable to the pelagic longline fishery in the Gulf of Mexico during 1992-1993 was 19 Risso's dolphins (CV=0.20).

Other Mortality

There were 9 reported strandings of Risso's dolphin in the Gulf of Mexico during 1999-2006 (6 in Florida, 3 in Texas). This includes one mass stranding of 5 animals in Florida during July 2005 (1 was rehabilitated and released by Mote Marine Laboratory). There was no evidence of human interactions for any of the stranded animals. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an unusual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 8 UMEs have been declared in the Gulf of Mexico, and 1 of these included a Risso's dolphin. Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. Additional strandings included 3 Atlantic spotted dolphins, *Stenella frontalis*, 1 Risso's dolphin, 2 Blainville's beaked whales, *Mesopolodon densirostris*, and 4 unidentified dolphins.

STATUS OF STOCK

The status of Risso's dolphins in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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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 temperate waters (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily on the continental slope (Mullin and Fulling 2004). Short-finned pilot whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200-m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of short-finned pilot whales for all surveys combined was 353 (CV=0.89) (Hansen *et al.* 1995).

Similar surveys were conducted during spring from 1996 to 2001 (excluding 1998) in

Figure 1. *Distribution of short-finned pilot whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

oceanic waters of the northern Gulf of Mexico. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for short-finned pilot whales in oceanic waters, pooled from 1996 to 2001, was 2,388 (CV=0.48) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200-m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for short-finned pilot whales in oceanic waters, pooled from 2003 to 2004, was 716 (CV=0.34) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal

distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for short-finned pilot whales is 716 (CV=0.34). The minimum population estimate for the northern Gulf of Mexico is 542 short-finned pilot whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 716 (CV=0.34) and that for 1996-2001 of 2,388 (CV=0.48) are not significantly different (P>0.05), but due to the imprecision of the estimates, the power to detect a difference is low. The abundance estimate for 1991-1994 was 353 (CV=0.52). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of short-finned pilot whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 542. 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 the stock is of unknown status. PBR for the northern Gulf of Mexico short-finned pilot whale is 5.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of short-finned pilot whales during 1998-2006 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007). However, during 2006 there was one short-finned pilot whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield-Walsh and Garrison 2007).

Fisheries Information

The level of past or current, direct, human-caused mortality of short-finned pilot whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no recent reports of mortality or serious injury to short-finned pilot whales by this fishery. During 2006 one short-finned pilot whale was observed entangled and released alive with no serious injury. The animal was not hooked, but was lassoed around its body in front of the flippers (not through the mouth). It was disentangled and was observed swimming away quickly (Fairfield-Walsh and Garrison 2007). There was 1 logbook report of a fishery-related injury of a pilot whale in the northern Gulf of Mexico in 1991.

Other Mortality

There have been 2 reported mass strandings of short-finned pilot whales in the Gulf of Mexico since 1999. Both mass strandings occurred in Florida. Two animals mass stranded in May 1999, and 9 animals in October 2001. There was no evidence of human interactions for these stranded animals. There were no other documented strandings of short-finned pilot whales in the Gulf of Mexico during 1999-2005. One short-finned pilot whale stranded during 2006 in Florida; this animal did not show signs of human interaction. 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 in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, 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 interactions.

STATUS OF STOCK

The status of short-finned pilot whales in the northern Gulf of Mexico, relative to OSP, 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 level of U.S. Gulf of Mexico fishery-caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual human-related mortality and serious injury does not exceed PBR.

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APPENDIX I. Estimated serious injury and mortality (SI&M) of Western North Atlantic marine mammals listed by U.S. observed fisheries for 2002-2006. Marine mammal species with zero (0) observed SI&M during 2002 to 2006 are not shown in this table.

(tbd = to be determined; n/a = not available; unk = unknown; JV = Joint Venture).

Category, Fishery (estimated # of vessels/persons), Species	Yrs. observed	observer coverage	Est. SI by Year (CV)	Est. Mortality by Year (CV)	Mean Annual Mortality (CV)	PBR
CATEGORY I						
Gillnet Fisheries: Northeast gillnet (unk)						
Harbor porpoise - after Take Reduction Plan	2002-2006	.02, .03, .06, .07, .04		444 (.37), 592 (.33), 654(.36), 630(.23), 514(.31)	567 (.14)	610
White sided dolphin	2002-2006	.02, .03, .06. .07, .04		30 (.74), 31 (.93), 7(.98), 59(.49), 41(.71)	34 (.33)	509
Common dolphin	2002-2006	.02, .03, .06, .07, .04		0, 0, 0, 0, 26(.8), 20(1.05)	9 (.64)	1,000
Risso's dolphin	2002-2006	.02, .03, .06, .07, .04		0, 0, 0, 15 (.93), 0	3(.93)	129
Bottlenose dolphin (offshore)	2002-2006	.02, .03, .06, .07, .04		0, 0, 0, unk, unk	unk	566
Harbor seal	2002-2006	.02, .03, .06, .07, .04		787 (.32), 542 (.28), 792(.34), 719(.20), 87(.58)	585(.15)	2,746
Gray seal	2002-2006	.02, .03, .06, .07, .04		0(0), 242 (.47), 504(.34), 574(.44), 248(.47)	314(.22)	n/a
Harp seal	2002-2006	.02, .03, .06, .07, .04		0, 0, 303(.30), 35(.68), 65(.66)	80 (.31)	n/a
Hooded seal	2001-2005	.04, .02, .03, .06, .07		82(1.14), 0, 0, 43(.95), 0	25(.82)	n/a
Gillnet Fisheries:US Mid-Atlantic gillnet (unk)						
Harbor porpoise - after Take Reduction Plan	2002-2006	.01, .01, .02, .03, .04		unk, 76 (1.13), 137(.91), 470(.23), 511(.52)	299(.27)	610
Bottlenose dolphin (offshore)	2002-2006	.01, .01, .02, .03, .04		unk, 0, 0, unk, unk	unk	566
Harbor seal	2002-2006	.01, .01, .02, .03, .04		unk, 0, 15(.86), 63(.67), 26 (.98)	26 (.49)	2,746
Gray seal	2002-2006	.01, .01, .02, .03, .04		unk, 0, 69(.92), 0, 0	17 (.92)	n/a
Longline Fisheries: Pelagic longline (excluding NED-E)[a]						
Risso's dolphin	2002-2006	.05, .09, .09, .06, .07	8(1.0), 40(.63), 28(.72), 3(1.0), 0	20(.86), 0, 0, 0, 0	20 (.38)	124
Long and short-finned pilot whale	2002-2006	.05, .09, .09, .06, .07	52(.48), 21(.49), 74(.42), 212(.21), 169(.50)	2 (1.0), 0, 0, 0, 16 (1.0)	109 (.20)	249

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Unidentified beaked whale	2002-2006	.05, .09, .09, .06, .07	0, 5.3(1.0), 0, 0, 0	0, 0, 0, 0, 0	1(1.0)	17
Longline Fisheries: Pelagic longline (NED-E area only)[a]						
Risso's dolphin	2002-2003	1.0, 1.0	3 (0), 0	0, 1 (0)	2 (0)	124
CATEGORY II						
Mid-Atlantic Mid-Water Trawl – Including Pair Trawl						
White-sided dolphin	2002-2006	.003, .018, .064, .084, .089	0, 0, 0, 0, 0	unk, 51(.46), 105(.38), 97(.76), 54(.57)	77(.21)	509
Long and short-finned pilot whale	2002-2006	.003, .018, .064, .084, .089	0, 0, 0, 0, 0	3.9(.46), 8.1(.38), 7.5(.76), 0	5(.34)	249
Trawl Fisheries:Northeast bottom trawl (unk)						
Harp seal	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	0, 0, 0, unk, 0	unk	n/a
Harbor seal	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	unk, 0, 0, unk, 0	unk	2,746
Gray Seal	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	0, 0, 0, unk, 0	unk	n/a
Long and short-finned pilot whale [b]	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	22(.26), 20(.26), 15(29) 15(.30), 14(.28)	17 (0.14)	249
Common dolphin [b]	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	26(.29), 26(.29), 26(.29), 32(.28), 25(.28)	27 (.13)	1,000
White-sided dolphin [b]	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	170(.32), 216(.27), 200(.30), 213(.28), 164(.35)	193 (0.13)	509
Minke whale	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	unk	unk	19
Harbor porpoise	2002-2006	.03, .04, .05, .12, .06	0, 0, 0, 0, 0	0, unk, 0, unk, unk	unk	610
Mid-Atlantic Bottom Trawl						
White-sided dolphin [b]	2002-2006	.01, .01, .03, .03, .02	0, 0, 0, 0, 0	25(.17), 31(.25), 26(.20), 38(.29), 26(.25)	29 (.11)	509
Long and short-finned pilot whale [b]	2002-2006	.01, .01, .03, .03, .02	0, 0, 0, 0, 0	38(.36), 31(.31), 35(.33), 31(.31), 37(.34)	34(.15)	249
Common dolphin	2002-2006	.01, .01, .03, .03, .02	0, 0, 0, 0, 0	87(.27), 99(.28), 159(.30), 141(.29), 131(.28)	123 (.12)	1,000
Northeast Mid-Water Trawl Including Pair Trawl (25)						
Long and short-finned pilot whale	2002-2006	0, .031, .126, .199, .031	0, 0, 0, 0,0	unk, 1.9(.56), 1.4(.58), 1.1(.68), 0	1(.35)	249
White-sided dolphin	2002-2006	0, .031, .126, .199, .031	0, 0, 0,0 ,0	unk, 24(.56), 19(.58), 15(.31), 19(.44)	19(.26)	509
Gillnet Fisheries:SE U.S. Atlantic shark gillnet (12)						
Bottlenose dolphin (Central Florida, coastal)	2002-2006	1, .34, .43, 1, 1	0, 0, 0, 0, 0,	1(0), 2(.64), 1(.64), 0, 0	0.8(.36)	n/a

NOTES: The estimated number of vessels/participants is expressed in terms of the number of active participants in the fishery, when possible. If this information is not available, the estimated number of vessels or persons licensed for a particular fishery is provided. Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates to

reflect the effective range of this stock.

a.   An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001 - December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison 2003; Garrison and Richards 2004).

b.   A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast trawl fisheries for pilot whales, common dolphins and white-sided dolphins during 2000-2006. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2006.

APPENDIX II. Summary of the confirmed human-caused mortality and serious injury (SI) events involving baleen whale stocks along the Gulf of Mexico coast, U.S. East coast and adjacent Canadian Maritimes, 2002 - 2006, with number of events attributed to entanglements or vessel collisions by year.

Stock	Mean annual mortality and SI rate (and PBR)	Entanglements			Vessel Collisions		
		Annual rate (US waters / Canadian waters)	Confirmed mortalities (2002, 2003, 2004, 2005, 2006)	Confirmed SI's (2002, 2003, 2004, 2005, 2006)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (2002, 2003, 2004, 2005, 2006)	Confirmed SI's (2002, 2003, 2004, 2005, 2006)
Western North Atlantic right whale	3.8 (0)	1.4 (0.6 / 0.8)	3 (1, 0, 1, 0, 1)	4 (2, 1, 0, 0, 1)	2.4 (1.8 / 0.6)	10 (1, 1, 2, 2, 4)	2 (0, 0, 0, 1, 1)
Gulf of Maine humpback whale[a]	4.4 (1.1)	3.0 (2.6 / 0.4)	6 (3, 1, 1, 0, 1)	9 (1, 4, 1, 0, 3)	1.4 (1.4 / 0)	7 (2, 1, 1, 0, 3)	0
Western North Atlantic fin whale	2.0 (4.0)	0.8 (0.8 / 0)	2 (1, 0, 1, 0, 0)	2 (0, 0, 1, 0, 1)	1.2 (0.8 / 0.4)	6 (0, 0, 2, 4, 0)	0
Nova Scotian sei whale	0.6 (0.3)	0.2 (0.2 / 0)	0	1 (0, 0, 0, 0, 1)	0.4 (0.4 / 0)	2 (0, 1, 0, 0, 1)	0
Western North Atlantic blue whale[b]	0 (–)	0	0	0	0	0	0
Canadian East Coast minke whale	2.2 (9.2)	1.8 (1.8 / 0)	9 (2, 5, 2, 0, 0)	0	0.4 (0.4 / 0)	2 (0, 0, 1, 1, 0)	0
Western North Atlantic Brydes whale	0.2 (0.3)	0.2 (0.2 / 0)	1 (0, 1, 0, 0, 0)	0	0	0	0

[a] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock.

[b] Stock abundance estimates outdated; no PBR established for this stock.

Appendix III
Fishery Descriptions

This appendix is broken into two parts: Part A describes commercial fisheries that have documented interactions with marine mammals in the Atlantic Ocean; and Part B describes commercial fisheries that have documented interactions with marine mammals in the Gulf of Mexico. A complete list of all known fisheries for both oceanic regions, the 2007 List of Fisheries, is published in the *Federal Register*, (72 FR 14466, March 28, 2007). Each part of this appendix contains three sections: I) data sources used to document marine mammal mortality/entanglements and commercial fishing effort trip locations, II) fishery descriptions for Category I, II and III fisheries that have documented interactions with marine mammals and their historical level of observer coverage, and III) historical fishery descriptions.

Part A. Description of U.S Atlantic Commercial Fisheries

I. Data Sources
Items 1-5 describe sources of marine mammal mortality, serious injury or entanglement data; items 6-8 describe the sources of commercial fishing effort data used to summarize different components of each fishery (i.e. active number of permit holders, total effort, temporal and spatial distribution) and generate maps depicting the location and amount of fishing effort.

1. Northeast Region Fisheries Observer Program (NEFOP)
In 1989 a Fisheries Observer Program was implemented in the Northeast Region (Maine-Rhode Island) to document incidental bycatch of marine mammals in the Northeast Region Multi-species Gillnet Fishery. In 1993 sampling was expanded to observe bycatch of marine mammals in Gillnet Fisheries in the Mid-Atlantic Region (New York-North Carolina). The Northeast Fisheries Observer Program (NEFOP) has since been expanded to sample multiple gear types in both the Northeast and Mid-Atlantic Regions for documenting and monitoring interactions of marine mammals, sea turtles and finfish bycatch attributed to commercial fishing operations. At sea observers onboard commercial fishing vessels collect data on fishing operations, gear and vessel characteristics, kept and discarded catch composition, bycatch of protected species, animal biology, and habitat (NMFS-NEFSC 2003).

2. Southeast Region Fishery Observer Programs
Three Fishery Observer Programs are managed by the Southeast Fisheries Science Center (SEFSC) that observe commercial fishery activity in U.S. Atlantic waters. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992 and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species Fisheries Management Plan (HMS FMP, 50 CFR Part 635). The second program is the Shark Gillnet Observer Program that observes the Southeastern U.S. Atlantic Shark Gillnet Fishery. The Observer Program is mandated under the HMS FMP, the Atlantic Large Whale Take Reduction Plan (ALWTRP) (50 CFR Part 229.32), and the Biological Opinion under Section 7 of the Endangered Species Act. Observers are deployed on any active fishing vessel reporting shark drift gillnet effort. In 2005, this program also began to observe sink gillnet fishing for sharks along the southeastern U.S. coast. The observed fleet includes vessels with an active directed shark permit and fish with sink gillnet gear (Carlson and Bethea 2007). The third program is the Southeastern Shrimp Otter Trawl Fishery Observer Program. This is a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program is funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. The total level of observer coverage for this program is <1% of the total fishery effort. In each Observer Program, the observers record information on the total target species catch, the number and type of interactions with protected species (including both marine mammals and sea turtles), and biological information on species caught. The shrimp fishery observer program has been very recently expanded and began including mandatory coverage during 2007.

3. Regional Marine Mammal Stranding Networks
The Northeast and Southeast Region Stranding Networks are components of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate

collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). Since 1997, the Northeast Region Marine Mammal Stranding Network has been collecting and storing data on marine mammal strandings and entanglements that occur between the states of Maine and Virginia. The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the Atlantic coast from North Carolina to Florida, along the U.S. Gulf of Mexico coast from Florida through Texas, and in the U.S. Virgin Islands and Puerto Rico. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement, collect data on stranded animals that include: species; event date and location; details of the event (i.e., signs of human interaction) and determination on cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

4. Marine Mammal Authorization Program

Commercial fishing vessels engaging in Category I or II fisheries are required to register under the Marine Mammal Authorization Program (MMAP) in order to lawfully capture a marine mammal incidental to fishing operations. All vessel owners, regardless of the category of fishery they are operating in, are required to report all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR 2003). Events are reported by fishermen on Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions.

5. Other Data Sources for Protected Species Interactions/Entanglements/Ship Strikes

In addition to the above, data on fishery interactions/entanglements and vessel collisions with large cetaceans are reported from a variety of other sources including the New England Aquarium (Boston, Massachusetts); Provincetown Center for Coastal Studies (Provincetown, Massachusetts); U.S. Coast Guard; whale watch vessels; and Canadian Department of Fisheries and Oceans (DFO). These data, photographs, etc. are maintained by the Protected Species Branch at the Northeast Fisheries Science Center (NEFSC) and the SEFSC.

6. Northeast Region Vessel Trip Reports

The Northeast Region Vessel Trip Report Data Collection System is a mandatory, but self-reported, commercial fishing effort database (Wigley *et al.* 1998). The data collected include: species kept and discarded; gear types used; trip location; trip departure and landing dates; port; and vessel and gear characteristics. The reporting of these data is mandatory only for vessels fishing under a federal permit. Vessels fishing under a federal permit are required to report in the Vessel Trip Report even when they are fishing within state waters.

7. Southeast Region Fisheries Logbook System

The Fisheries Logbook System (FLS) is maintained at the SEFSC and manages data submitted from mandatory Fishing Vessel Logbook Programs under several FMPs. In 1986 a comprehensive logbook program was initiated for the Large Pelagics Longline Fishery and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

8. Northeast Region Dealer Reported Data

The Northeast Region Dealer Database houses trip level fishery statistics on fish species landed by market category, vessel ID, permit number, port location and date of landing, and gear type utilized. The data are collected by both federally permitted seafood dealers and NMFS port agents. Data are considered to represent a census of both vessels actively fishing with a federal permit and total fish landings. It also

includes vessels that fish with a state permit (excluding the state of North Carolina) that land a federally managed species. Some states submit the same trip level data to the Northeast Region, but contrary to the data submitted by federally permitted seafood dealers, the trip level data reported by individual states does not include unique vessel and permit information. Therefore, the estimated number of active permit holders reported within this appendix should be considered a minimum estimate. It is important to note that dealers were previously required to report weekly in a dealer call in system. However, in recent years the NER regional dealer reporting system has instituted a daily electronic reporting system. Although the initial reports generate from this new system did experience some initial reporting problems, these problems have been addressed and the new daily electronic reporting system is providing better real time information to managers.

II. U.S Atlantic Commercial Fisheries

Northeast Sink Gillnet (text includes descriptions of Northeast anchored float and Northeast drift gillnets)

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Windowpane Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, and Skate spp.

Number of Permit Holders: In 2006, approximately 1,500 federal northeast permit holders identified sink gillnet as a potential gear type.
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Number of Active Permit Holders: In 2006, approximately 220 federal northeast permit holders reported the use of sink gillnets in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total metric tons of fish landed from 1998 to 2006 were 22,933, 18,681, 14,487, 14, 634, 15,201, 17,680, 19,080, 15.390, and 14,950 respectively (NMFS). Data on total quantity of gear fished (i.e., number of sets) have not been reported consistently among commercial gillnet fishermen on vessel logbooks, therefore will not be reported here.

Temporal and Spatial Distribution: Effort is distributed throughout the Gulf of Maine, Georges Bank, and Southern New England Regions. Effort occurs year-round with a peak during May, June, and July primarily on the continental shelf region in depths ranging from 30 to 750 feet. Some nets are set in water depths greater than 800 feet. Figures 1-5 document the distribution of sets and marine mammal interactions observed from 2002 to2006 respectively.

Gear Characteristics: The Northeast Sink Gillnet Fishery is dominated by a bottom-tending (sink) net. Less than 1% of the fishery utilizes a gillnet that either is anchored floating or drift (i.e. Northeast anchored float and Northeast drift gillnet fisheries). Monofilament is the dominant material used with stretched mesh sizes ranging from 6 to 12 inches. String lengths range from 600 to 10,500 feet long. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Northeast Sink Gillnet Fishery has been defined as a category I fishery, and both the Northeast anchored float and Northeast drift gillnet fisheries as category II fisheries, in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). This gear is managed by several federal and state FMPs that range North and East of the 72 degree 30 min line. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648.80 through 648.97); Monkfish (FR 68(81), 50 CFR Part 648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.237); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); Atlantic Bluefish (FR 68(91), 50 CFR Part 648.160 through 648.165); and Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322). These fisheries are primarily managed by total allowable catch (TACs); individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1990-2006, estimated observer coverage (number of trips observed/total commercial trips reported) was 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6%, 4%, 2%, 3%, 6%, 7% and 4% respectively.

Comments: Effort patterns in this fishery are heavily influenced by pinger requirements, marine mammal time/area closures, fish time/area closures, and gear restrictions due to fish conservation measures, the ALWTRP, and the Harbor Porpoise Take Reduction Plan (HPTRP).

Protected Species Interactions: Documented interaction with Harbor Porpoise, White-sided Dolphin, Harbor Seal, Gray Seal, Harp Seal, Hooded Seal, Long-finned Pilot Whale, Offshore Bottlenose Dolphin, Risso's Dolphin, and Common Dolphin. Not mentioned here are possible interactions with sea turtles and sea birds.

Bay of Fundy Sink Gillnet

Target Species: Atlantic cod and other groundfish.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: To Be Determined

Total Effort: To Be Determined

Temporal and Spatial Distribution: In Canadian waters the Gillnet Fishery occurs during the summer and early autumn months mostly in the western portion of the Bay of Fundy.

Gear Characteristics: Typical gillnet strings are 300 m long (three 100 m panels), 4 m deep, with stretched mesh size of 15 cm, strand diameter of 0.57-0.60 mm, and are usually set at a depth of about 100 m for 24 hours.

Management and Regulations: To Be Determined

Observer Coverage: During the period 1994 to 2001, the estimated observer coverage of the Grand Manan portion of the sink gillnet fishery was 49%, 89%, 80%, 80%, 24%, 11%, 41%, and 56%. The fishery was not observed during 2002 and 2003.

Comments: Marine mammals in Canadian waters are regulated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). DFO Maritimes Region has developed a Harbour Porpoise Conservation Strategy that has set a maximum take of 110 Harbor Porpoise per year in the Bay of Fundy. Bycatch mitigation measures include acoustic pingers and nylon barium-sulphate netting that target cetacean and sea bird bycatch reduction goals, and fishery effort restrictions that target fish management goals.

Protected Species Interactions: Documented interactions with Harbor Porpoise and sea birds.

Mid-Atlantic Gillnet

Target Species: Monkfish, Spiny and Smooth Dogfish, Bluefish, Weakfish, Menhaden, Spot, Croaker, Striped Bass, Coastal Sharks, Spanish Mackerel, King Mackerel, American Shad, Black Drum, Skate spp., Yellow perch, White Perch, Herring, Scup, Kingfish, Spotted Seatrout, and Butterfish.

Number of Permit Holders: In 2006, approximately 700 federal mid-Atlantic permit holders identified sink gillnet as a potential gear type.

Number of Active Permit Holders: In 2006, approximately 230 federal mid-Atlantic permit holders reported the use of sink gillnets in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total metric tons of fish landed from 1998 to 2006 were 15,494, 19,130, 16,333, 14,855,

13,389, 13,107, 15,124, 12, 994, and 8,755 respectively (NMFS). Data on total quantity of gear fished (i.e. number of sets) have not been reported consistently among commercial gillnet fishermen on vessel logbooks, therefore will not be reported here. During 1998 it was estimated that 302 full- and part-time sink gillnet vessels and an undetermined number of drift gillnet vessels participated in this fishery. This is the number of unique vessels in the Commercial Landings Database (Weighout) that reported catch from this fishery during 1998 from the states of Connecticut to North Carolina. This does not include a small percentage of records where the vessel number was missing.

Temporal and Spatial Distribution: This fishery operates year-round, extending from New York to North Carolina. It's comprised of a combination of small vessels that target a variety of fish species. This fishery can be prosecuted right off the beach (6 feet) or in nearshore coastal waters to offshore waters (250 feet). Figures 6-10 document the distribution of sets and marine mammal interactions observed from 2002 to 2006 respectively.

Gear Characteristics: The Mid-Atlantic Gillnet Fishery utilizes both drift and sink gillnets, including nets set in a sink, stab, set, strike, or drift fashion. These nets are most frequently attached to the bottom, although unanchored drift or sink nets are also utilized to target specific species. Monofilament twine is the dominant material used with stretched mesh sizes ranging from 2.5 to 12 inches. String lengths range from 150 to 8400 feet. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Mid-Atlantic Gillnet Fishery has been defined as a Category I fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007). This gear is managed by several federal FMPs, Inter-State Fishery Management Plans (ISFMP's) managed by the Atlantic States Marine Fisheries Commission (ASMFC), the Atlantic Large Whale TRP, the Harbor Porpoise TRP, and the Bottlenose Dolphin TRP. This fishery operates west of a line drawn at 72° 30' N lat. and east to the eastern edge of the EEZ, and north of the North Carolina/South Carolina border, not including waters where Category II and III inshore gillnet fisheries operate in bays, estuaries, and rivers. The relevant FMPs include, but may not be limited to: Atlantic Bluefish (FR 68(91), 50 CFR Part 648.160 through 648.165); Weakfish (FR 68(191), 50 CFR 697.7); Shad and River Herring (ASMFC ISFMP 2002); Striped Bass (FR68(202), 50 CFR part 697.7); Spanish Mackerel (FR 65(92), 50 CFR 622.1 through 622.48); Monkfish (FR 68(81), 50 CFR Part 648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.273); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322); and Atlantic Coastal Sharks (FR 68(247), 50 CFR 600-635). These fisheries are primarily managed by TACs; individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1995-2006, the estimated observer coverage was 5%, 4%, 3%, 5%, 2%, 2%, 2%, 1%, 1%, 2%, 3%, and 4% respectively.

Comments: Effort patterns in this fishery are heavily influenced by marine mammal time/area closures, gear restrictions due to fish conservation measures, the ALWTRP, and the HPTRP and Bottlenose Dolphin Take Reduction Plan (BDTRP).

Protected Species Interactions: Documented interaction with Harbor Porpoise, White-sided Dolphin, Harbor Seal, Gray Seal, Harp Seal, Coastal Bottlenose Dolphin, Offshore Bottlenose Dolphin, Common Dolphin, Minke Whale (Canadian East Coast stock), Humpback Whale (Gulf of Maine stock), and Long-Finned and Short-Finned Pilot Whale. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Bottom Trawl

Target Species: Include, but are not limited to: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny and Smooth Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, Scup, Black Sea Bass, Skate spp, Atlantic Mackerel, *Loligo* Squid, *Illex* Squid, and Atlantic Butterfish.

Number of Permit Holders: In 2006, approximately 830 federal mid-Atlantic permit holders identified bottom trawl (including beam, bottom fish, bottom shrimp, and bottom scallop trawls) as a potential gear type.

Number of Active Permit Holders: In 2006, approximately 500 federal mid-Atlantic permit holders reported the use of bottom trawls in the Northeast Region Dealer Reported Landings Database.

Mixed Groundfish Bottom Trawl Total Effort: Total effort, measured in trips, for the Mixed Groundfish Trawl from 1998 to 2006 was 27,521, 26,525, 24,362, 27,890, 28,103, 25,725, 22,303, 15,070, and 12,457 respectively (NMFS). The number of days absent from port, or days at sea, is yet to be determined.

Squid, Mackerel, Butterfish Bottom Trawl Total Effort: Total effort, measured in trips, for the domestic Atlantic Mackerel Fishery in the Mid-Atlantic Region (bottom trawl only) from 1997 to 2006 were 373, 278, 262, 102, 175, 310, 238, 231, 0, and 117 respectively (NMFS). Total effort, measured in trips, for the *Illex* Squid Fishery from 1998 to 2006 were 412, 141, 108, 51, 39, 103, 445, 181, and 159 respectively (NMFS). Total effort, measured in trips, for the *Loligo* Squid Fishery from 1998 to 2006 were 1,048, 495, 529, 413, 3,585, 1,848, 1,124, 1,845, and 3,058 respectively (NMFS). Atlantic Butterfish is a bycatch (non-directed) fishery, therefore effort on this species will not be reported. The number of days absent from port, or days at sea, is yet to be determined.

Temporal and Spatial Distribution: The Mixed Groundfish Fishery occurs year-round from Cape Cod, Massachusetts to Cape Hatteras, North Carolina. Because of spatial and temporal differences in the harvesting of *Illex* and *Loligo* Squid and Atlantic Mackerel, each one of these sub-fisheries is described separately. Figures 11-15 document the distribution of tows and marine mammal interactions observed from 2002 to2006 respectively.

      ***Illex* Squid**

The U.S. domestic fishery for *Illex* Squid, ranging from Southern New England to Cape Hatteras, North Carolina, reflects patterns in the seasonal distribution of *Illex* Squid (*Illex illecebrosus*). *Illex* is harvested offshore (along or outside of the 100-m isobath), mainly by small-mesh otter trawlers, when the Squid are distributed in continental shelf and slope waters during the summer months (June-September) (Clark 1998).

      ***Loligo* Squid**

The U.S. domestic fishery for *Loligo* Squid (*Loligo pealeii*) occurs mainly in Southern New England and mid-Atlantic waters. Fishery patterns reflect *Loligo* seasonal distribution, therefore most effort is directed offshore near the edge of the continental shelf during the fall and winter months (October-March) and inshore during the spring and summer months (April-September) (Clark 1998).

      Atlantic Mackerel

The U.S. domestic fishery for Atlantic Mackerel (*Scomber scombrus*) occurs primarily in the Southern New England and mid-Atlantic waters between the months of January and May (Clark 1998). An Atlantic Mackerel Trawl Fishery also occurs in the Gulf of Maine during the summer and fall months (May-December) (Clark 1998).

      Atlantic Butterfish

Atlantic Butterfish (*Peprilus triacanthus*) undergo a northerly inshore migration during the summer months, a southerly offshore migration during the winter months, and are mainly caught as bycatch to the directed Squid and Mackerel Fisheries. Fishery Observers suggest that a significant amount of Atlantic Butterfish discarding occurs at sea.

Gear Characteristics: The Mixed Groundfish Bottom Trawl Fishery gear characteristics have not yet been determined or summarized. The *Illex* and *Loligo* Squid Fisheries are dominated by small-mesh otter trawls, but substantial landings of *Loligo* Squid are also taken by inshore pound nets and fish traps during the spring and summer months (Clark 1998). The Atlantic Mackerel Fishery is prosecuted by both mid-water (pelagic) and bottom trawls.

Management and Regulations: The Mid-Atlantic Bottom Trawl Fishery has been defined as a Category II fishery in the 2007List of Fisheries (72 FR 14466, March 28, 2007). There are at least 2 distinct components to this fishery. One is the mixed groundfish bottom trawl fishery. It is managed by several federal and state FMPs that range from Massachusetts to North Carolina. The relevant FMPs include, but may not be limited to, Monkfish (FR 68(81), 50 CFR Part 648.648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.237); Summer Flounder, Scup, and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); and Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322). The second major component is the squid, mackerel, butterfish fishery. This component

is managed by the federal Squid, Mackerel, Butterfish FMP (50 CFR Part 648.20 through 648.24). The *Illex* and *Loligo* Squid Fisheries are managed by moratorium permits, gear and area restrictions, quotas, and trip limits. The Atlantic Mackerel and Atlantic Butterfish Fisheries are managed by an annual quota system.

Observer Coverage: During the period 1996-2006, estimated observer coverage (measured in trips) for the Mixed Groundfish Bottom Trawl Fishery was 0.24%, 0.22%, 0.15%, 0.14%,1%, 1%, 1%, 1%, 3%, 3%, and 2% respectively.

During the period 1996-2006, estimated observer coverage (trips) in the *Illex* Fishery was 3.7%, 6.21%, 0.97%, 2.84%, 11.11%, 0.00%, 0.00%, 8.74%, 5.07%, 6%, and 15% respectively. During the period 1996-2006, estimated observer coverage (trips) of the *Loligo* Fishery was 0.37%, 1.07%, 0.72%, 0.69%, 0.61%, 0.95%, 0.42%, 0.65%, 5.07%, 4%, and 3% respectively. During the period 1997-2006, estimated observer coverage (trips) of the domestic Atlantic Mackerel Fishery was 0.81%, 0%, 1.14%, 4.90%, 3.43%, 0.97%, 5.04%, 18.61%, 0%, and 3% respectively. Mandatory 100% observer coverage is required on any Joint Venture (JV) fishing operation. The most recent Atlantic Mackerel JV fishing activity occurred in 1998 and 2002 where 152 and 62 transfers from USA vessels were observed respectively. Only the net transfer operations from the USA vessel to the foreign processing vessel are observed. The actual net towing and hauling operations conducted on the USA vessel are not observed.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of scup. The GRAs are spread out in time and space along the edge of the Southern New England and Mid-Atlantic Continental Shelf Region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. Access to the GRAs to harvest non-exempt species (*Loligo* Squid, Black Sea Bass, and Silver Hake) can be granted by a special permit. For detailed information regarding GRAs refer to (FR 70(2), (50 CFR Part 648.122 parts A and B)).

Protected Species Interactions: Documented interaction with White-sided Dolphin, Common Dolphin, Long-finned Pilot Whale, Short-finned Pilot Whale, Harbor Seal, Gray Seal, and Harp Seal. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Bottom Trawl

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, *Loligo* squid and Skate spp.

Number of Permit Holders: In 2006, approximately 1,600 federal northeast permit holders identified bottom trawl (including beam, bottom fish, bottom shrimp, and bottom scallop trawls) as a potential gear type.

Number of Active Permit Holders: In 2006, approximately 600 federal northeast permit holders reported the use of bottom trawls in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total effort, measured in trips, for the North Atlantic Bottom Trawl Fishery from 1998 to2006was 13,263, 10,795, 12,625, 12,384, 12,711, 11,577, 10,354, and 10,803 respectively (NMFS). An average mean of 970 (CV=0.04) vessels (full- and part time) participated annually in the fishery during 1989-1993. The number of days absent from port, or days at sea, is yet to be determined.

Temporal and Spatial Distribution: Effort occurs year-round with a peak during May, June, and July primarily on the continental shelf and is distributed throughout the Gulf of Maine, Georges Bank and Southern New England Regions. Figures 16-20 document the distribution of tows and marine mammal interactions observed from 2002 to 2006 respectively .

Gear Characteristics: The average footrope length for the bottom trawl fleet was about 84 feet from 1996 – 1999; in 2000 there was a sharp increase to almost 88 feet followed by a steady decline to 85 feet in 2004. Seasonality was evident, with larger footrope lengths in the first quarter, which drop sharply from March to the low in May, and followed by a steady increase in size until December. There are some differences in

mean gear size between species. Compared to other species, gear size was smaller for trips that caught winter flounder, cod, yellowtail flounder, fluke, skate, dogfish, and Atlantic herring. Trips that caught haddock, *Illex* squid, and monkfish tended to have larger gear. For most species, seasonal variation was limited. Seasonality was evident for witch flounder, American plaice, scup, butterfish, both squid species, and monkfish. (further characterization of the Northeast and Mid-Atlantic bottom and mid-water trawl fisheries based on Vessel Trip Report (VTR) data can be found at http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0715/).

Management and Regulations: The Northeast Bottom Trawl Fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007). This gear is managed by several federal and state FMPs that range from Maine to Connecticut. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648); Monkfish (FR 68(81), 50 CFR Part 648.91 through 648.97); Spiny Dogfish (FR 65(7), 50 CFR Part 648.230 through 648.237); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648.100 through 648.147); Atlantic Bluefish (FR 68(91), 50 CFR Part 648.160 through 648.165); and Northeast Skate Complex (FR 68(160), 50 CFR part 648.320 through 648.322). These fisheries are primarily managed by TACs; individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1994-2006, estimated observer coverage (measured in trips) was 0.4%, 1.1%, 0.2%, 0.2%, 0.1%, 0.3%, 1%, 1%, 3%, 4%, 5%, 12% and 6% respectively.

Vessels in the Northeast bottom Trawl Fishery, a Category II fishery under the MMPA, were observed in order to meet fishery management needs rather than monitoring for bycatch of marine mammals.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: Documented interaction with White-sided Dolphin, Common Dolphin, Harbor Porpoise, Harbor Seal, and Harp Seal. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Herring and miscellaneous pelagic species.

Number of Permit Holders: In 2006, approximately 1,000 federal Northeast permit holders identified mid-water trawl as a potential gear type.

Number of Active Permit Holders: In 2006, approximately 20 federal northeast permit holders reported the use of mid-water trawls in the Northeast Region Dealer Reported Landings Database.

Gear Characteristics: Historically, the Atlantic Herring resource was harvested by the Distant Water Fleet (DWF) until the fishery collapsed in the late 1970s. There has been no DWF since then. A domestic fleet has been harvesting the Atlantic Herring resource utilizing both fixed and mobile gears. Only a small percentage of the resource is currently harvested by fixed gear due to a combination of reduced availability and less use of fixed gear (Clark 1998). The majority of the resource is currently harvested by domestic mid-water (pelagic) trawls (single and paired).

Management and Regulations: The Northeast Mid-Water Trawl Fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007). Atlantic herring are managed jointly by the MAFMC and ASMFC as one migratory stock complex. There has been a domestic resurgence in a directed fishery on the adult stock due to the recovery of the adult stock biomass.

Temporal and Spatial Distribution: The current fishery occurs during the summer months when the resource is distributed throughout the Gulf of Maine and Georges Bank regions. The stock continues on a

southerly migration into mid-Atlantic waters during the winter months. Figures 21-25 document the distribution of tows and marine mammal interactions observed from 2002 to 2006 respectively.

Total Effort: Total effort, measured in trips, for the Northeast Mid-Water Trawl Fishery (across all gear types) from 1997 to 2006 was 578, 289, 553, 1,312, 2,404, 1,736, 2,158, 1,564, 717, and 590 respectively (NMFS).

Observer Coverage: During the period 1997-2006, estimated observer coverage (trips) was 0.00%, 0.00%, 0.73%, 0.46%, 0.06%, 0% , 2.25%, 11.48%, 19.9%, and 3.1% respectively. A U.S. JV Mid-Water (pelagic) Trawl Fishery was conducted on Georges Bank from August to December 2001. A total allowable landings of foreign fishery (TALFF) was also granted during the same time period. Ten vessels (3 foreign and 7 American), fishing both single and paired mid-water trawls, participated in the 2001 Atlantic Herring JV Fishery. Two out of the three foreign vessels also participated in the 2001 TALFF and fished with paired mid-water trawls. The NMFS maintained 74% observer coverage (243 hauls) on the JV transfers and 100% observer coverage (114 hauls) on the foreign vessels granted a TALFF.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B)

Protected Species Interactions: Documented interaction with White-sided Dolphin and Long-finned Pilot Whale. There were no marine mammal takes observed from the domestic Mid-Water Trawl Fishery trips during the period 1997-2002. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Mid-Water Trawl Fishery (includes pair trawls)
Target Species: Atlantic Mackerel, Chub Mackerel and other miscellaneous pelagic species.

Number of Permit Holders: In 2006, approximately 400 federal mid-Atlantic permit holders identified mid-water trawl as a potential gear type.

Number of Active Permit Holders: In 2006, approximately 5 federal mid-Atlantic permit holders reported the use of mid-water trawls in the Northeast Region Dealer Reported Landings Database.

Management and Regulations: The Mid-Atlantic Mid-Water Trawl Fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

Temporal and Spatial Distribution: To be determined. Figures 26-30 document the distribution of tows and marine mammal interactions observed from 2002 to 2006 respectively.

Total Effort:. Total effort, measured in trips, for the mid-Atlantic Mid-Water Trawl Fishery (across all gear types) from 1997 to 2006 was 331, 223, 374, 166, 408, 261, 428, 360, 359, and 405 respectively (NMFS).

Observer Coverage:. During the period 1997-2006, estimated observer coverage (trips) was 0.00%, 0.00%, 1.01%, 8.43%, 0.00%, 0.77% , 3.5%, 12.16%, 8.4% and 8.9% respectively.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: . Documented interaction with White sided dolphins and Pilot Whale spp. Not mentioned here are possible interactions with sea turtles and sea birds.

Bay of Fundy Herring Weir

Target Species: Atlantic Herring

Number of Permit Holders: According to Canadian DFO officials, for 1998 there were 225 licenses for herring weirs on the New Brunswick and Nova Scotia sides of the Bay of Fundy (60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from the East Charlotte area, and 5 from the Saint John area). The number of licenses has been fairly consistent since 1985 (Ed Trippel, pers. comm.)

Number of Active Permit Holders: In 2002 around Grand Manan Island, the only area surveyed for active weirs, there were 22 active weirs. In 2003 the number of active weirs included: 20 around Grand Manan Island, 9 around the Wolves Islands, 10 around Campobello Island, 2 at Deer Island, and 43 in Passamaquoddy Bay and the western Bay of Fundy. The numbers in the eastern Bay of Fundy are unknown, but some do exist.

Total Effort: Effort is difficult to measure. Weirs may or may not have twine (i.e., be actively fishing) on them in a given year and the amount of time the twine is up varies from year to year. Most weirs tend to fish (i.e., have twine on them) during July, August, and September. Some fishermen keep their twine on longer, into October and November, if it is a good year or there haven't been any storms providing incentive to take the twine down. Effort cannot simply be measured by multiplying the number of weirs with twine times the average number of fishing days (this will provide a very generous estimation of effort) because if a weir fills up with fish the fisherman will pull up the drop (close the net at the mouth) which prevents loss of fish, but also means no new fish can get in, therefore the weir is not actively fishing during that period.

Temporal and Spatial Distribution: In Canadian waters, the Herring Weir Fishery occurs from May to October along the southwestern shore of the Bay of Fundy, and is scattered along the coasts of western Nova Scotia.

Gear Characteristics: Weirs are large, heart-shaped structures (roughly 100 feet across) consisting of long wooden stakes (50-80 feet) pounded 3-6 feet into the sea floor and surrounded by a mesh net (the "twine") of about ¾ inch stretch mesh. Weirs are typically located within 100-400 feet of shore. The twine runs from the sea floor to the surface, and the only opening (the "mouth") is positioned close to shore. Herring swimming along the shore at night, encounter a fence (net of the same twine from sea floor to surface) that runs from the weir to the shoreline and directs the fish into the weir. At dawn, the weir fisherman tends the weir and if Herring are present, he/she may close off the weir until the fish can be harvested. Harvesting takes place when the tidal current is the slackest, usually just before low tide. A large net ("seine") is deployed inside the weir, and, much like a purse seine, it is drawn up to the surface so that the fish become concentrated. They are then pumped out with a vacuum hose into the waiting carrier for transport to the processing plant.

Management and Regulations: To Be Determined

Observer Coverage: From mid-July to early September, on a daily basis, scientists from the Grand Manan Whale & Seabird Research Station check only the weirs around Grand Manan Island for the presence of cetaceans.

Comments: Marine mammals occasionally swim into weirs, in which they can breathe and move about. Marine mammals are vulnerable during the harvesting/seining process where they can become tangled in the seine and suffocate if care is not taken to remove them from the net or to remove them from the weir prior to the onset of the seining process. Small marine mammals, like porpoises, can be removed from the net, lifted into small boats, and taken out of the weir for release without interrupting the seining process. Larger marine mammals, such as whales, must be removed from the weir either through the creation of a large enough escape hole in the back of the weir (taking down the twine and removing some poles) or sometimes by sweeping them out with a specialized mammal net, although this approach carries with it a few more risks to the animal than the "escape hole" technique.

Through the cooperation of weir fishermen and the Grand Manan Whale & Seabird Research Station, weir-associated mortality of cetaceans is relatively low. Over 91% of all entrapped porpoises, dolphins and whales are successfully released from weirs around Grand Manan Island. Thus the total number of entrapments (which can vary annually from 6 to 312) is in no way reflective or indicative of cetacean mortality caused by this fishery.

Protected Species Interactions: Documented interactions with Harbor Porpoise and Minke Whales. Right Whales are also vulnerable to entrapment, though very rarely. The last two Minke whales in a Grand Manan weir were safely released, unharmed, through the partial disassembly of the weir.

Gulf Of Maine Atlantic Herring Purse Seine Fishery

Target Species: Atlantic Herring.

Number of Active Permit Holders: The Atlantic Herring FMP distinguishes between vessels catching herring incidentally while pursuing other species and those targeting herring by defining vessels that average less than 1 metric tons of herring caught per trip (in all areas) as incidental herring vessels. In 2002-2004 there were 7, 6, and 4 active federal permits reported in the Northeast Region Dealer Reported Landings Database.

Gear Characteristics: The purse seine is a deep nylon mesh net with floats on the top and lead weights on the bottom. Rings are fastened at intervals to the lead line and a purse line runs completely around the net through the rings (www.gma.org, Gulf of Maine Research Institute, GOMRI). One end of the net remains in the vessel and the other end is attached to a power skiff or "bug boat" that is deployed from the stern of the vessel and remains in place while the vessel encircles a school of fish with the net. Then the net is pursed and brought back aboard the vessel through a hydraulic power block. Purse seines vary in size according to the size of the vessel and the depth to be fished. Most purse seines used in the New England Herring Fishery range from 30 to 50 meters deep (100-165 ft) (NMFS 2005). Purse seining is a year round pursuit in the Gulf of Maine, but is most active in the summer when herring are more abundant in coastal waters and are mostly utilized at night, when herring are feeding near the surface. This fishing technique is less successful when fish remain in deeper water and when they do not form "tight" schools.

Management and Regulations: The Gulf Of Maine Atlantic Herring Purse Seine Fishery has been defined as a Category III fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).fishery. This gear is managed by federal and state FMPs that range from Maine to North Carolina. The relevant FMPs include, but may not be limited to the Atlantic Herring FMP (FR 70(19), 50 CFR Part 648.200 through 648.207) and the Northeast Multi-species (FR 67, CFR Part 648.80 through 648.97). This fishery is primarily managed by total allowable catch (TACs).

Temporal and Spatial Distribution: Most U.S. Atlantic herring catches occur between May and October in the Gulf of Maine, consistent with the peak season for the lobster fishery. The connection between the herring and lobster fisheries is the reliance of the lobster industry on herring for bait. In addition, there is a relatively substantial winter fishery in southern New England, and catches from Georges Bank have increased somewhat in recent years. There is a very small recreational fishery for Atlantic herring that generally occurs from early spring to late fall, and herring is caught by tuna boats with gillnets for use as live bait in the recreational tuna fisheries. In addition, there is a Canadian fishery for Atlantic herring from New Brunswick to the Gulf of St. Lawrence, which primarily utilizes fixed gear. Fish caught in the New Brunswick (NB) weir fishery are assumed to come from the same stock (inshore component) as that targeted by U.S. fishermen (http://www.nefmc.org/herring/index.html, Northeast Fisheries Management Council, NEFMC). Figures 31-35 document the distribution of sets and marine mammal interactions observed from 2002 to 2006, respectively.

Total Effort: Total metric tons of fish landed from 1998 to 2006 were 24,256, 39,866, 29,609, 20,691, 20,096, 17,939, 19,958, 19,129, and 16,030 respectively (NMFS, Unpbl.). Total effort, measured in trips, for the Gulf of Maine Atlantic Herring Purse Seine Fishery from 2002 to 2006 was 343, 339, 276, 202, and 173, respectively (NMFS, Unpbl.).

Observer Coverage: During the period 1994 to 2002, estimated observer coverage (number of trips observed/total commercial trips reported) was 0%. From 2003 to 2006, observer coverage was 0.34%, 9.8%, 0.27% and 0%, respectively. The coverage in 2004 may be considered a 'pilot' program, as sampling priorities and data collection methods were refined over the course of the year.

Protected Species Interactions: Documented interactions with harbor seals, gray seals, and unidentified seals.

Northeast/Mid-Atlantic American Lobster Trap/Pot

In the United States (US), the American lobster, *Homarus americanus*, is distributed from Maine to North Carolina and is most abundant in relatively shallow coastal zones. Inshore landings have increased since the 1970s. Fishing effort is intense and increasing throughout the range of the resource. Approximately 80% of lobster landings are derived from state waters which occur from 0-3 miles from shore. There are three distinctly identified stock areas for the American lobster: 1) Gulf of Maine, 2) Southern New England, and 3) Georges Bank. A cooperative state and Federal management plan is in place to manage the lobster resource and the plan is administered under the authority of the Atlantic Coastal Act, with oversight provided by the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC's role is to develop coastal fishery management programs, oversee state implementation of the coastal measures in state waters, and provide recommendations for the Federal government to implement complementary regulations in Federal waters. States implement management measures from 0-3 miles within their respective jurisdictions in compliance with the measures adopted in the management plan. The National Marine Fisheries Service is obliged to enact measures that support the plan in Federal waters, from 3-200 miles from shore, codified under 50 CFR 697.

American lobster is the most valuable fishery in the eastern US, with total landings of 92.5 million lbs. valued at $395 million in 2006. Combined landings from Maine and Massachusetts vessels comprised 90% of the landings for 2006, with Maine landing nearly 73 million lbs. in 2006. In 2007, approximately 3,223 vessels held permits to fish for and harvest lobsters in Federal waters, which does not include the several thousand vessels coastwide authorized to harvest lobster in state waters. The majority of vessels harvest lobster with traps, with about 2-3% of the harvest taken by mobile gear (trawlers and dredges). The offshore fishery in Federal waters has developed in the past 15 years, largely due to technological improvements in equipment and lower competition in the offshore areas.

In January 1997, NMFS changed the classification of the Gulf of Maine and Mid-Atlantic Lobster Pot Fisheries from Category III to Category I (1997 List of Fisheries 62 FR 33, January 2, 1997) based on examination of 1990 to 1994 stranding and entanglement records of large whales (including Right, Humpback and Minke whales). Both the EEZ and state fishery are operating under Federal regulations from the ALWTRP (50 CFR 229.32). Documented interaction with minke whales were reported in this fishery.

Atlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline

Target Species: Large pelagic fish species including: Swordfish, Yellowfin Tuna, Bigeye Tuna, Bluefin Tuna, Albacore Tuna, Dolphin Fish, Shortfin Mako Shark, and a variety of other shark species.

Number of Permit Holders: < 200

Number of Active Permit Holders: The number of fishing vessels in the Pelagic Longline Fishery has been declining since a peak number of 361 vessels reporting longline effort during 1995. Over the period between 1995 and 2000, the mean number of vessels reporting effort to the FLS for the entire Atlantic Ocean not including the Gulf of Mexico was 163. This declined to an annual average of 74 for the period between 2001 and 2005. Sixty-three vessels reported pelagic longline effort in the Atlantic during 2006. It is likely that some of these vessels also reported effort in the Gulf of Mexico.

Total Effort: The total fishing effort in the Atlantic component of the Pelagic Longline Fishery has been declining since a peak reported effort of 12,318 sets (7.41 million hooks) during 1995. The mean effort reported to the Fisheries Logbook System between 1995 and 2000 was 9,370 sets (5.62 million hooks). Between 2001 and 2005, a mean of 4,516 sets (3.16 million hooks) was reported each year. During 2006,

the total reported fishing effort in the Atlantic Ocean component of the fishery was 4,244 sets and 3.08 million hooks (Fairfield Walsh and Garrison 2007).

Temporal and Spatial Distribution: Fishing effort occurs year round and operates in waters both inside and outside the U.S. EEZ throughout Atlantic, Caribbean and Gulf of Mexico waters. The "Atlantic" component of the fleet operates both in coastal and continental shelf waters along the U.S. Atlantic coast from Florida to Massachusetts. The fleet also operates in distant waters of the Atlantic including the central equatorial Atlantic Ocean and the Canadian Grand Banks. Fishing effort is reported in 11 defined fishing areas including the Gulf of Mexico. During 2006, the majority of fishing effort in the Atlantic was reported in the Mid-Atlantic Bight (Virginia to New Jersey, 1,081 sets) and the South Atlantic Bight (Georgia to North Carolina, 543 sets) fishing areas (Fairfield Walsh and Garrison 2007).

Gear Characteristics: The pelagic longline gear consists of a mainline of >700-lb test monofilament typically ranging between 10 and 45 miles long. At regular intervals along the mainline, bullet-shaped floats are suspended and long sections of the gear are marked by "high-flyers" or radio beacons. Suspended from the mainline are long gangion lines of 200 to 400-lb test monofilament that are typically 100 to 200 feet in length. Fishing depths are most typically between 40 and 120 feet. Hooks of various sizes are attached by a steel swivel leader. Longline sets targeting tunas are typically set at dawn and soak throughout the day with recovery near dusk. Those sets targeting swordfish are more typically night sets. The total amount of time the gear remains in the water including set, soak, and haul times is typically 10-14 hours. As a result of a recent Biological Opinion on interactions between Atlantic longline gear targeting Tunas and Swordfish and endangered sea turtles, a comprehensive change in the fishing gear occurred in the longline fishery. After August 2004, only circle shaped hooks of 16/0 or 18/0 size can be used throughout the fishery.

Management and Regulations: The Large Pelagics Longline Fishery is listed as a Category I fishery under the MMPA due to frequently observed interactions with marine mammals (72 FR 14466, March 28, 2007). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP, 50 CFR Part 635). The fishery has also been the focus of management actions relating to bycatch of billfish. Amendment One to the Atlantic Billfish FMP also pertains to the Large Pelagics Longline Fishery and is consistent with the regulations in the HMS FMP. This fishery is also regulated under the Endangered Species Act resulting from frequent interactions with sea turtle species including both Loggerhead and Leatherback Turtles in the Atlantic and Gulf of Mexico. A Biological Opinion issued by the NMFS Southeast Regional Office in June 2004 mandated the use of circle hooks throughout the fishery, mandated the use of de-hooking and disentanglement gear by fishermen to reduce the mortality of captured sea turtles, reopened the Northeast Distant Water fishing area, and mandated increased reporting and monitoring of the fishery.

Observer Coverage: The Pelagic Longline Observer Program (POP) is a mandatory observer program managed by the SEFSC that has been in place since 1992. Observers are placed upon randomly selected vessels with total observer effort allocated on a geographic basis proportional to the total amount of fishing effort reported by the fleet. The target observer coverage level was 5% of reported sets through 2001, and was elevated to 8% of total sets in 2002. Between 2000 and 2006, observer coverage as a percentage of reported sets in the Atlantic component of the fishery was 4%, 4%, 4%, 7%, 9%, 6%, and 7%. The observer coverage during 2006 was 7% of reported sets; however, coverage was often >10% in some areas and seasons (Fairfield Walsh and Garrison 2007). These values do not include the experimental portion of the fishery in the Northeast Distant Water (NED) area, which was 100% of sets during 2001-2003. Observed longline sets and marine mammal interactions are shown for 2002-2006 in Figures 36 through 40.

Comments: This fishery has been the subject of numerous management actions since 2000 associated with bycatch of both billfish and sea turtles. These changes have resulted in a reduction of overall fishery effort and changes in the behaviors of the fishery. The most significant change was the closure of the NED area off the Canadian Grand Banks and near the Azores as of June 1, 2001 (50 CFR Part 635). An experimental fishery was conducted in this area during both 2001 and 2002 to evaluate gear characteristics and fishing practices that increase the bycatch rate of sea turtles. Several marine mammals, primarily Risso's Dolphins, were seriously injured during this experimental fishery. In addition, there have been a number of time-area closures since late 2000 including year-round closures in the DeSoto Canyon area in the Gulf of Mexico and the Florida East Coast area; and additional seasonal closures in the Charleston Bump area and off of

New Jersey (NMFS 2003). Additionally, a ban on the use of live fish bait was initiated in 1999 due to concerns over billfish bycatch. The June 2004 Biological Opinion has resulted in a significant change in the gear and fishing practices of this fishery that will likely impact marine mammal bycatch. The majority of interactions with marine mammals in this fishery have been with Pilot Whales and Risso's Dolphin. These interactions primarily occurred along the shelf break in the Mid-Atlantic Bight region during the third and fourth quarters (Garrison 2003; 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007). The Pelagic Longline Take Reduction Team was convened during 2005 to develop approaches to reduce the serious injury of pilot whales in the mid-Atlantic, and the resulting take reduction plan is currently being implemented by NOAA Fisheries.

Protected Species Interactions: Documented interactions with Minke Whale, Risso's Dolphin, Long-finned Pilot Whale, Short-finned Pilot Whale, Common Dolphin, Atlantic Spotted Dolphin, Pantropical Spotted Dolphin, Striped Dolphin, Offshore Bottlenose Dolphin, Pygmy Sperm Whale, Northern Bottlenose Whale, and unidentified Beaked Whales. Not mentioned here are documented interactions with sea turtles and sea birds.

Southeastern U.S. Atlantic Shark Gillnet

Target Species: Large and small coastal sharks including: Blacktip, Blacknose, Finetooth, Bonnethead, and Sharpnose Sharks

Number of Permit Holders: 30

Number of Active Permit Holders: 30

Total Effort: Gillnets targeting sharks in the southeastern U.S. Atlantic are fished in a variety of configurations including long soak drift sets, short soak encircling strike sets, and short duration sink sets. In addition, sink gillnets are used to target other finfish species. The same fishing vessels will fish the different types of sets. It is difficult to identify these different gear types and distinguish sets targeting sharks from those targeting finfish in the reported logbook data. The total amount of effort was therefore estimated based upon observer data and reported fishing gear and catch characteristics (Garrison 2007). Between 2001 and 2005, an annual average of 74 drift sets, 40 strike sets, and 241 sink sets targeting sharks were reported and/or observed. The number of drift sets has been declining steadily while the number of strike sets has been increasing. During 2006, there were 8 drift sets, 40 strike sets, and 301 sink sets targeting sharks reported or observed (Garrison 2007). However, there is direct evidence of under-reporting as some observed sets were not reported to the FLS system, and the total effort remains highly uncertain.

Temporal and Spatial Distribution: The Shark Gillnet fleet operates primarily in the coastal waters of Florida and Georgia, but sink sets targeting sharks are reported as far north as Cape Hatteras, NC (Carlson and Bethea 2007; Garrison 2007). Prior to 2007, shark drift gillnet fishing was restricted off the coast of Florida to waters south of 27° 51' N latitude between 15 November to 31 March. Outside of this season, the drift and strike fishing vessels operated primarily north of Cape Canaveral, Florida and along the Georgia coast. In 2007, the restricted area was expanded to include the area between 29° N latitude west of 80° W longitude and within 35 nautical miles of the South Carolina coast (Southeast U.S. Restricted Area North). The area between 29° N latitude and 27° 51' N latitude west of 80° W longitude (Southeast U.S. Restricted Area South) is also closed to gillnetting from December 1 through March 31, but strikenetting for shark is permitted if special provisions are met (72 FR 34632, June 25, 2007). During the restricted periods shark drift gillnet fishing effort remains restricted to waters south of 27°51'N latitude.

Gear Characteristics: Drift gillnet fishing is characterized by large-mesh (5-10 inches) nets that are typically greater than 1500 feet long and have long, night-time soak durations exceeding 10 hours. However, in recent years, an increasing proportion of the fishing effort consists of "strike sets" in which schools of sharks are targeted and encircled. Strike sets are of much shorter duration (typically < 1 hour) than drift sets, have large mesh sizes, and use deep fishing nets (Carlson and Bethea 2007). Sink nets typically use smaller mesh sizes than strike nets, the nets are shallower and shorter, and the soak duration average approximately 2 hours (Garrison 2007).

Management and Regulations: The Southeastern U.S. Atlantic Shark Gillnet Fishery is listed as a Category II fishery under the MMPA due to occasional interactions with marine mammals (72 FR 14466, March 28, 2007). The directed fishery effort is managed under an amendment to the HMS FMP (50 CFR Part 635, 66 FR 17370 March 30, 2001) that mandates observer coverage outside of the season, defined by the ALWTRP, at levels sufficient to achieve precise estimates (coefficient of variation < 0.3) of marine mammal and sea turtle bycatch. The fishery is also managed under the ALWTRP (50 CFR Part 229.32), which includes seasonal restriction of gillnet fishing in the Southeast U.S. Restricted Area, special provisions for strikenet gear in the Southeast U.S. Restricted Area South, including 100% observer coverage, and the use of Vessel Monitoring Systems (VMS) in lieu of 100% observer coverage in the newly created Southeast U.S. Monitoring Area *72 FR 57104, October 5, 2007). Similar provisions are also included in the Biological Opinion on the fishery under section 7 of the Endangered Species Act.

Observer Coverage: A dedicated observer program for the Shark Drift Gillnet Fishery has been in place since 1998. Due to the provisions of the ALWTRP, observer coverage has been high during winter months since 2000. However, due to limits on available resources, observer coverage outside of this period was generally low (< 5%) prior to 2000 but has been increasing during the last several years. In 2005, the observer program was expanded to include a limited number of sink gillnets targeting both fish and sharks (Carlson and Bethea 2007). Due to the difficulties in identifying the reported effort, the percentage of observer coverage by gear type is difficult to quantify. From 2001 to 2006, the annual observer coverage of the drift gillnet fishery was 68%, 85%, 50%, 66%, 58%, and 48%, respectively. The annual coverage of the strike component from 2001 to 2006 was 63%, 86%, 72%, 81%, and 84%, respectively. The sink component of the fishery was observed in 2005 and 2006 with coverage levels of 10% and 22%, respectively. However, given the uncertainties surrounding the level of reported effort in the FLS, these estimates of observer coverage are highly uncertain (Garrison 2007). The locations of observed strike, drift, and sink sets and marine mammal interactions in the shark gillnet fishery are shown in Figures 41-45. There have been no observed marine mammal interactions since 2003.

Comments: There is a significant level of uncertainty surrounding estimating the total level of effort in this fishery. There is direct evidence of inconsistency in reporting. It is not possible to reliably distinguish trips targeting sharks from those targeting other fish species, and it is not possible to distinguish different types of sets in the logbook data. However, the overall marine mammal and sea turtle bycatch rate is very low, therefore it is unlikely that even severe biases would result in large increases in the estimated total protected species bycatch in this fishery. In addition to marine mammal interactions, this fishery has been the subject of management concern due to recent interactions with endangered sea turtles including Leatherback and Loggerhead Turtles.

Protected Species Interactions: Documented interactions with Coastal Bottlenose Dolphin and Atlantic Spotted Dolphin. There are two documented cases of possible interactions between North Atlantic right whales and the shark drift gillnet fishery off the Florida coast.

Atlantic Blue Crab Trap/Pot
The Blue Crab Trap/Pot Fishery is broadly distributed in estuarine and nearshore coastal waters throughout the mid and south Atlantic. The fishery is estimated to have >16,000 participants deploying gear on a year-round basis. Pots are baited with fish or poultry and are typically set in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. In recent years, reports of strandings with evidence of interactions between bottlenose dolphins and both recreational and commercial crab pot fisheries have been increasing in the Southeast region (McFee and W. Brooks 1998; Burdett and McFee 2004). Interactions with crab pots appear to generally involve a dolphin becoming wrapped in the buoy line. The total number of these interactions and associated mortality rates has not been documented, but from 2002-2006, SEFSC stranding data show 3 confirmed bottlenose dolphin mortalities due to interactions with blue crab pot gear and 11 bottlenose dolphin disentanglements with live releases. There are also documented interactions with the West Indian manatee, Florida stock. The fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

Mid-Atlantic Haul/Beach Seine
This beach-based fishery operates primarily along North Carolina's Outer Banks using small and large mesh gillnets. Small mesh gillnets are generally used in the spring and fall to target gray trout (weakfish), speckled trout, spot, kingfish (sea mullet), bluefish, and harvest fish (star butters). Large mesh gillnets are

used to target Atlantic striped bass during the winter and are regulated via North Carolina Fisheries rules and proclamations. Small mesh nets are generally constructed in the manner of a beach seine, although the net material is a combination of multifilament and monofilament. The beach seine system uses a bunt and a wash net that is attached to the beach and fished in the surf (Steve *et al.* 2001). Conversely, large mesh nets are constructed of all monofilament material. Although construction and characteristics of large and small mesh nets differ, they are set and hauled similarly. Nets are deployed out of the stern of the surf dories and set perpendicular to the shoreline. A truck is generally used to haul the net ashore by attaching one end of the net to the truck and pulling it ashore while the other end remains fixed until the end of the haul. Because of the manner in which both large and small mesh nets are constructed and fished, they are operating more in the manner of gillnets rather than beach seines and are technically a component of the Category I Mid-Atlantic Gillnet fishery. However, North Carolina Department of Marine Fisheries is currently proposing regulations requiring fishermen participating in the Atlantic striped bass beach seine fishery to use nets constructed of all multifilament material, thereby moving closer to the traditional manner of beach seine fishing. Once this regulation is finalized, the Atlantic striped bass beach seine fishery using large mesh gillnets will be the only fishery included under the Mid-Atlantic Haul/Beach Seine Fishery for North Carolina. North Carolina beach-based fishing has been observed since April 7, 1998 by the NMFS Fisheries Sampling Program (Observer Program) based at the NEFSC. Through 2001, there were 101 sets observed during the winter season (Nov-Apr) and 65 sets observed during the summer season (May-Oct). There were no sets observed during the summer of 2001. This fishery has observed interactions with coastal bottlenose dolphin. The fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007)

North Carolina Long Haul Seine

The Long Haul Seine is an estuarine fishery operating in North Carolina waters with 10-15 participants statewide. The seine consists of a 1000-1200 yard long net pulled by two boats for distances of 1-2 nautical miles (Steve *et al.* 2001). Fish are encircled by pulling the net around a fixed stake. The fishery targets Weakfish, Spot, Croaker, Menhaden, Bluefish, Spotted Seatrout, and Hagfish, and operates in Pamlico and Core sounds and tributaries. The fishery operates primarily between June and October. Occasional interactions with Coastal Bottlenose Dolphins have been reported. The fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

North Carolina Roe Mullet Stop Net

The Stop Net Fishery is unique to Bogue Banks, North Carolina. The gear consists of a stationary, multi-filament anchored net extended perpendicular to the beach to stop the alongshore migration of Striped Mullet. Once the catch accumulates near the end of the stop net, a beach haul seine is used to capture fish and bring them ashore. The stop net is traditionally left in the water for 1 to 5 days during the fishery season from October to November, but can be left as long as 15 days (Steve *et al.* 2001). Interactions between this fishery and Coastal Bottlenose Dolphins have been reported; however, the total number of interactions has not been estimated. The fishery has been defined as a Category II fishery in the 2007List of Fisheries (72 FR 14466, March 28, 2007).

Virginia Pound Net

Pound Nets are a stationary gear fished in nearshore coastal and estuarine waters of Virginia. The gear consists of a large mesh lead posted perpendicular to the shoreline extending outward to the corral, or "heart", where the catch accumulates. Target species included Weakfish, Spot, and Croaker. The NEFOP began observing effort in this fishery in 2001. In 2004 and 2005 an experimental fishery was conducted in an area of the Chesapeake Bay that was closed to commercial fishing effort from May to July for sea turtle conservation measures. Occasional interactions with Coastal Bottlenose Dolphins have been observed while monitoring for sea turtle interactions in both the commercial and experimental fisheries. In some cases it is not clear whether pound nets were the cause of death due to entanglement in other gear (monofilament). Data from the Chesapeake Bay suggest that the likelihood of Bottlenose Dolphin entanglement in pound net leads may be affected by the mesh size of the lead net (Bellmund *et al.* 1997), but the information is not conclusive. Stranded Bottlenose Dolphins have also shown evidence of interactions with pound nets. From 2002 to 2006, 16 bottlenose dolphins were removed dead from Virginia pound nets, and 3 dolphins were disentangled and released alive (Sue Barco, Virginia Aquarium). The fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

Mid-Atlantic Menhaden Purse Seine

Between 1994 and 1997, about 18-20 menhaden purse-seine vessels for reduction operated out of two processing facilities in Chesapeake Bay at Reedville, Virginia. Another fleet of vessels 2-5 vessels operated out of a smaller processing facility at Beaufort, North Carolina. Since 1998, only one plant has been operational in Virginia with a total fleet of about 10 vessels. Between 1998 and 2004 the factory at Beaufort operated with 2-3 vessels. After the 2004 fishing season, the factory at Beaufort closed permanently. A majority of the fishing effort by the Virginia fleet occurs in the Virginia portion of Chesapeake Bay, and along the ocean beaches of Eastern Shore Virginia. Most sets in Chesapeake Bay are in the main stem of the Bay, greater than one mile from shore. In summer, the Virginia fleet occasionally ranges as far north as northern New Jersey. Purse-seining for reduction purposes is prohibited by state law in Maryland, Delaware, and New Jersey; hence, purse-seine sets in the ocean off Delmarva and New Jersey are by definition greater than 3 miles from shore. The Virginia fleet ranges south into NC coastal waters during November and December, but this segment of the fishery is highly weather-dependent. Occasional interactions with Coastal Bottlenose Dolphins have been recorded historically in this fishery However, there is no observer coverage in this fishery, and the level of incidental interactions with marine mammals is undocumented. The Mid-Atlantic Menhaden Purse Seine Fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

Southeastern U.S. Atlantic Shrimp Trawl

The Shrimp Trawl Fishery operates from North Carolina through northern Florida virtually year-round, moving seasonally up and down the coast. A recent estimate of fishing effort based upon state dealer trip reports included approximately 23,000 shrimping trips (Epperly *et al.* 2002). The gear consists of relatively fine-meshed trawls typically fished in a paired fashion on either side of a fishing vessel. Effort occurs in both estuarine and nearshore coastal waters. The Shrimp Trawl Fishery has long been the focus of management actions associated with significant bycatch of both fish species and sea turtles. Observer coverage is typically very sparse and non-systematic. Occasional interactions with Bottlenose Dolphins have been observed, and there is infrequent evidence of interactions from stranded animals. The Shrimp Trawl fishery has been defined as a Category III fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

III. Historical Fishery Descriptions

Atlantic Foreign Mackerel

Prior to 1977, there was no documentation of marine mammal bycatch in 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 recorded fishery data and information on incidental bycatch of marine mammals. DWF effort in the U.S. Atlantic Exclusive Economic Zone (EEZ) under MFCMA had been directed primarily towards Atlantic Mackerel and Squid. From 1977 through 1982, an average mean 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 the 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 1977-1982, and increased to 58%, 86%, 95% and 98%, respectively, in 1983-1986. One hundred percent observer coverage was maintained during 1987-1991. Foreign fishing operations for Squid ceased at the end of the 1986 fishing season and for Mackerel at the end of the 1991 season. Documented interactions with white sided dolphins were reported in this fishery.

Pelagic Drift Gillnet

In 1996 and 1997, NMFS issued management regulations which prohibited the operation of this fishery in 1997. The fishery operated during 1998. Then, in January 1999 NMFS issued a Final Rule to prohibit the use of drift net gear in the North Atlantic Swordfish Fishery (50 CFR Part 630). In 1986,

NMFS established a mandatory self-reported fisheries information system for Large Pelagic Fisheries. Data files are maintained at the SEFSC. The estimated total number of hauls in the Atlantic Pelagic Drift Gillnet Fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls from 1991 to 1996 was 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 to 1998 there were 11, 12, 10, 0, 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, 99% in 1995, 64% in 1996, no fishery in 1997, and 99% coverage during 1998. Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras, North Carolina. Examination of the species composition of the catch and locations of the fishery throughout the year suggest that the Drift Gillnet Fishery was stratified into two strata: a southern, or winter, stratum and a northern, or summer, stratum. Documented interactions with North Atlantic right whales, humpback whales, sperm whales, pilot whale spp., Mesoplodon spp., rissos dolphins, common dolphins, striped dolphins and white sided dolphins were reported in this fishery.

Atlantic Tuna Purse Seine

The Tuna Purse Seine Fishery occurring between the Gulf of Maine and Cape Hatteras, North Carolina is directed at large medium and giant Bluefin Tuna (BFT). Spotter aircraft are typically used to locate fish schools. The official start date, set by regulation, is 15 July of each year. Individual Vessel Quotas (IVQs) and a limited access system prevent a derby fishery situation. Catch rates for large medium and giant Tuna can be high and consequently, the season can last only a few weeks, however, over the last number of years, effort expended by this sector of the BFT fishery has diminished dramatically due to the unavailability of BFT on the fishing grounds.

The regulations allocate approximately 18.6% of the U.S. BFT quota to this sector of the fishery (5 IVQs) with a tolerance limit established for large medium BFT (15% by weight of the total amount of giant BFT landed.

Limited observer data is available for the Atlantic Tuna Purse Seine Fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets were observed. A total of 136 days were covered. No trips were observed during 1997 through 1999. Two trips (seven hauls) were observed in October 2000 in the Great South Channel Region. Four trips were observed in September 2001. No marine mammals were observed taken during these trips. Documented interactions with pilot whale spp. were reported in this fishery.

Atlantic Tuna Pelagic Pair Trawl

The Pelagic Pair Trawl Fishery operated as an experimental fishery from 1991 to 1995, with an estimated 171 hauls in 1991, 536 in 1992, 586 in 1993, 407 in 1994, and 440 in 1995. This fishery ceased operations in 1996 when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in the Atlantic Tuna Fishery. The fishery operated from August to November in 1991, from June to November in 1992, from June to October in 1993 (Northridge 1996), and from mid-summer to December in 1994 and 1995. Sea sampling began in October of 1992 (Gerrior *et al.* 1994) where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% (212) and 55% (238), respectively, of the sets were observed. Nineteen vessels have operated in this fishery. The fishery operated 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 bycatch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery (Northridge 1996). During the 1994 and 1995 Experimental Pelagic Pair Trawl Fishing Seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudy 1995; 1996), but the results were inconclusive. Documented interactions with pilot whale spp., Risso's dolphin and common dolphins were reported in this fishery.

Part B. Description of U.S. Gulf of Mexico Fisheries

I. Data Sources

Items 1 and 2 describe sources of marine mammal mortality, serious injury or entanglement data, and item 3 describes the source of commercial fishing effort data used to generate maps depicting the location and amount of fishing effort and the numbers of active permit holders. In general, commercial fisheries in the Gulf of Mexico have had little directed observer coverage and the level of fishing effort for most fisheries that may interact with marine mammals is either not reported or highly uncertain. With the exception of the Large Pelagics Longline Fishery, no incidental take estimates are possible for Gulf of Mexico commercial fisheries.

1. Southeast Region Fishery Observer Programs

Two fishery observer programs are managed by the SEFSC that observe commercial fishery activity in the U.S. Gulf of Mexico. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992, and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species FMP (HMS FMP, 50 CFR Part 635). The second is the Southeastern Shrimp Otter Trawl Fishery Observer Program. This is a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program is funding and project dependent, and therefore observer coverage is not necessarily randomly allocated across the fishery. The total level of observer coverage for this program is <<1% of the total fishery effort. In each Observer Program the observers record information on the total target species catch, the number and type of interactions with protected species including both marine mammals and sea turtles, and biological information on species caught.

2. Regional Marine Mammal Stranding Networks

The Southeast Regional Stranding Network is a component of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the U.S. Gulf of Mexico coast from Florida through Texas. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement with NOAA Fisheries, collect data on stranded animals that include: species; event date and location; details of the event including evidence of human interactions; determinations of the cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

3. Southeast Region Fisheries Logbook System

The FLS is maintained at the SEFSC and manages data submitted from mandatory fishing vessel logbook programs under several FMPs. In 1986, a comprehensive logbook program was initiated for the Large Pelagics Longline Fisheries, and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

4. Marine Mammal Authorization Program

Commercial fishing vessels engaging in Category I or II fisheries are required to register under the Marine Mammal Authorization Program (MMAP) in order to lawfully capture a marine mammal incidental to fishing operations. All vessel owners, regardless of the category of fishery they are operating in, are required to report all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR 2003). Events are reported by fishermen on Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions.

II. Gulf of Mexico Commercial Fisheries

Atlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline

Target Species: Large pelagic fish species including: Swordfish, Yellowfin Tuna, Bigeye Tuna, Bluefin Tuna, Albacore Tuna, Dolphin Fish, Shortfin Mako Shark, and a variety of other shark species.

Number of Permit Holders: < 200

Number of Active Permit Holders: The number of active fishing vessels in the pelagic longline fishery has been declining since a peak number of 361 vessels reporting longline effort during 1995. Over the period between 1995 and 2000, the mean number of vessels reporting effort to the FLS in the Gulf of Mexico was 112. This declined to an annual average of 70 for the period between 2001 and 2005. The total number of fishing vessels reporting effort in the Gulf of Mexico during 2006 was 47, though some of these vessels likely also reported fishing effort in other areas.

Total Effort: The total fishing effort in the Gulf of Mexico component of the Pelagic Longline Fishery has ranged between 2.5 and 4.1 million hooks since 1992. The mean effort reported to the FLS between 1995 and 2000 was 4,545 sets and 3.32 million hooks. During 2006, the total reported fishing effort in the Gulf of Mexico component of the fishery was 3,337 sets and 2.58 million hooks (Fairfield Walsh and Garrison 2007). This reflects a significant decrease over previous years due to the effects of Hurricanes Katrina and Rita on the Gulf fleet.

Temporal and Spatial Distribution: Fishing effort occurs year round and operates in waters both inside and outside the U.S. EEZ throughout Atlantic, Caribbean and Gulf of Mexico waters. The Gulf of Mexico component of the fleet operates both in continental shelf and deep continental slope waters from Florida to Texas.

Gear Characteristics: The pelagic longline gear consists of a mainline of >700-lb test monofilament typically ranging between 10 and 45 miles long. At regular intervals along the mainline, bullet-shaped floats are suspended and long sections of the gear are marked by "high-flyers" or radio beacons. Suspended from the mainline are long gangion lines of 200 to 400-lb test monofilament that are typically 100 to 200 feet in length. Fishing depths are most typically between 40 and 120 feet. Hooks of various sizes are attached by a steel swivel leader. Longline sets targeting tunas are typically set at dawn and soak throughout the day with recovery near dusk. Those sets targeting swordfish are more typically night sets. The total amount of time the gear remains in the water including set, soak, and haul times is typically 10-14 hours. As a result of a recent Biological Opinion on interactions between Atlantic longline gear targeting Tunas and Swordfish and endangered sea turtles, a comprehensive change in the fishing gear occurred in the longline fishery. After August 2004, only circle shaped hooks of 16/0 or 18/0 size can be used throughout the fishery.

Management and Regulations: The Large Pelagics Longline Fishery is listed as a Category I fishery under the MMPA due to frequently observed interactions with marine mammals (72 FR 14466, March 28, 2007). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (Highly Migratory Species FMP, 50 CFR Part 635). The fishery has also been the focus of management actions relating to bycatch of billfish. Amendment One to the Atlantic Billfish FMP also pertains to the Large Pelagics Longline Fishery and is consistent with the regulations in the Highly Migratory Species FMP. This fishery is also regulated under the Endangered Species Act resulting from frequent interactions with endangered sea turtle species including both Loggerhead and Leatherback Turtles in the Atlantic and Gulf of Mexico. A Biological Opinion issued by the NMFS Southeast Regional Office in June 2004 mandated the use of circle hooks throughout the fishery, mandated the use of de-hooking and disentanglement gear by fishermen to reduce the mortality of captured sea turtles, and mandated increased reporting and monitoring of the fishery.

Observer Coverage: The Pelagic Longline Observer Program (POP) is a mandatory observer program managed by the SEFSC that has been in place since 1992. Observers are placed upon randomly selected vessels with total observer effort allocated on a geographic basis proportional to the total amount of fishing effort reported by the fleet. The target observer coverage level was 5% of reported sets through 2001, and was elevated to 8% of total sets in 2002. Between 2000 and 2006, observer coverage of reported sets in the Gulf of Mexico component of the fishery was 4%, 4%,3%, 5%, 5%,7%, and 8%. Observer coverage in the Gulf of Mexico during 2006 was 8.1% of reported sets; however, coverage was as high as 9.0% in some seasons (Fairfield Walsh and Garrison 2007). Observed longline sets and marine mammal interactions in the Gulf of Mexico are shown for 2002-2006 in Figures 46 through 50. Only two marine mammal interactions, one with an unidentified dolphin and one with a pilot whale, have been observed during this period.

Comments: This fishery has been the subject of numerous management actions over the last four years associated with bycatch of both billfish and sea turtles. These changes have resulted in a reduction of overall fishery effort and in the behaviors of the fishery. The most significant change was the closure of the Northeast Distant Water Area off the Canadian Grand Banks and near the Azores as of June 1, 2001 (50 CFR Part 635). In the Gulf of Mexico, a year round closure was implemented in two areas in DeSoto Canyon (NMFS 2003). Additionally, a ban on the use of live fish bait was initiated in 1999 due to concerns over billfish bycatch. The June 2004 Biological Opinion has resulted in a significant change in the gear and fishing practices of this fishery that will likely impact marine mammal bycatch. The majority of interactions with marine mammals in this fishery in the Gulf of Mexico have been with Risso's Dolphin (Garrison 2003a); however, there have been very few interactions with marine mammals observed in the last five years.

Protected Species Interactions: Gulf of Mexico stocks of Risso's Dolphin, Pantropical Spotted Dolphin, Atlantic Spotted Dolphin, Pilot Whales and Offshore Bottlenose Dolphin.

Gulf of Mexico Shrimp Trawl

The Shrimp Trawl Fishery operates along the Gulf coast of the U.S. virtually year round. Hundreds of thousands of fishing trips are reported annually in the Gulf of Mexico with effort occurring in estuarine, nearshore coastal, and offshore continental shelf waters (Epperly *et al.* 2002). The gear consists of relatively fine-meshed trawls typically fished in a paired fashion on either side of a fishing vessel. Observer coverage is typically very sparse and is not systematic. The Shrimp Trawl Fishery has long been the focus of management actions associated with significant bycatch of both fish species and sea turtles. Occasional interactions with Bottlenose Dolphins have been observed in both the Gulf and Atlantic components of this fishery, and there is infrequent evidence of interactions from stranded animals. The Shrimp Trawl Fishery is listed as a Category III fishery in the 2007 List of Fisheries (72 14466, March 28, 2007).

Gulf of Mexico Blue Crab Trap/Pot Fisheries

The Blue Crab Trap/Pot Fishery is broadly distributed in estuarine and nearshore coastal waters along the Gulf coast. The fishery is estimated to have approximately 4,000 participants deploying gear on a year-round basis. Pots are baited with fish or poultry and are typically set in rows in shallow water. Pot position is marked by either a floating or sinking buoy line attached to a surface buoy. In recent years, reports of strandings in the Atlantic with evidence of interactions between bottlenose dolphins and both recreational and commercial crab pot fisheries have been increasing in the Southeast region (McFee and W. Brooks 1998). Interactions have also been reported in the Gulf, including both stranding mortalities and entanglements/live releases. Interactions with crab pots appear to generally involve a dolphin becoming wrapped in the buoy line. The total number of these interactions and associated mortality rates has not been documented. The fishery has been defined as a Category III fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

Gulf of Mexico Menhaden Purse Seine Fishery

This fishery operates in coastal waters along the Gulf coast, with the majority of fishing effort concentrated off Louisiana and Mississippi. Fishing effort occurs both in bays, sounds, and in nearshore coastal waters. Between 1994 and 1998, fishery effort averaged approximately 23,000 sets annually (Smith *et al.* 2002). No observer data is available for the Gulf of Mexico Menhaden Fishery; however, recent interactions with Coastal Bottlenose Dolphins have been reported through the MMAP and historically

through an observer program carried out by Louisiana State University from 1994 to 1996. The fishery has been defined as a Category II fishery in the 2007 List of Fisheries (72 FR 14466, March 28, 2007).

Gulf of Mexico Gillnet Fishery

The Gulf of Mexico gillnet fishery uses strike and straight gillnets to target a wide variety of species including, but not limited to, black drum, sheepshead, weakfish, mullet, spot, croaker, king mackerel, Spanish mackerel, Florida pompano, flounder, shark, menhaden, bluefish, blue runner, ladyfish, spotted seatrout, croaker, kingfish, and red drum. This fishery operates year-round in waters north of the U.S.-Mexico border and west of the fishery management council demarcation line between the Atlantic Ocean and the Gulf of Mexico. Gillnets are not used in Texas, and large gillnets were excluded from Florida state waters after July 1995, but fixed and runaround gillnets are currently in use in Louisiana, Mississippi, and Alabama. In the Gulf of Mexico, coastal migratory pelagic resources are the only Federally managed species for which gillnet gear is authorized, and only run-around gillnetting for these species allowed (CMPR FMP). In state waters, state and Gulf States Marine Fisheries Commission (GSMFC) Interstate FMPs apply. No marine mammal mortalities associated with Gillnet Fisheries have been reported in these states, but stranding data suggest that marine mammal interactions with gillnets do occur, causing mortality and serious injury. There are no effort or observer data available for these fisheries. The Gulf of Mexico Gillnet Fisheries are listed as Category II fisheries in the 2007 List of Fisheries (72 FR 14466, March 2007).

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Appendix III: Fishery Descriptions - List of Figures

Figure 1. 2002 Northeast sink gillnet observed hauls (A) and observed takes (B).
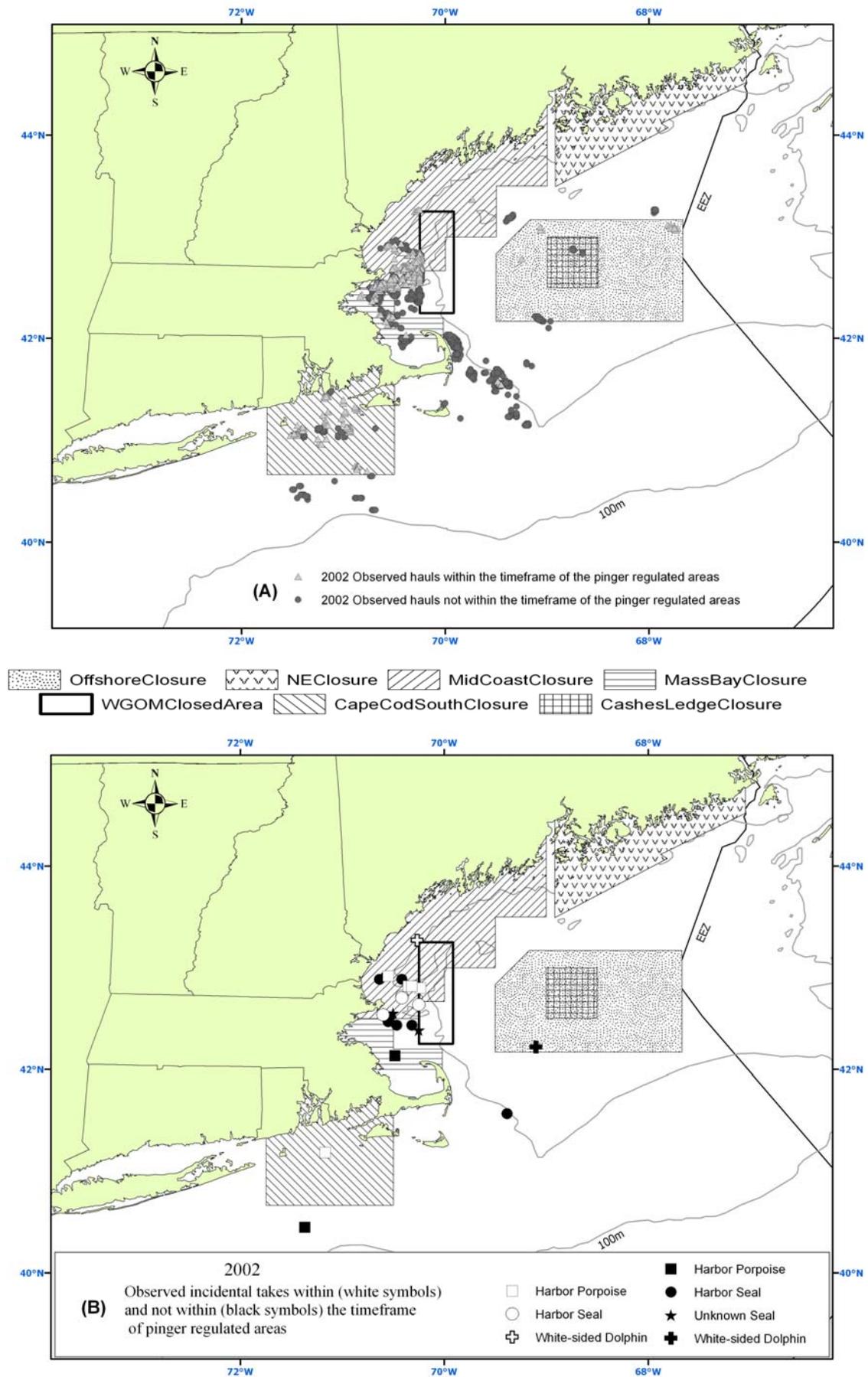
Figure 2. 2003 Northeast sink gillnet observed hauls (A) and observed takes (B).
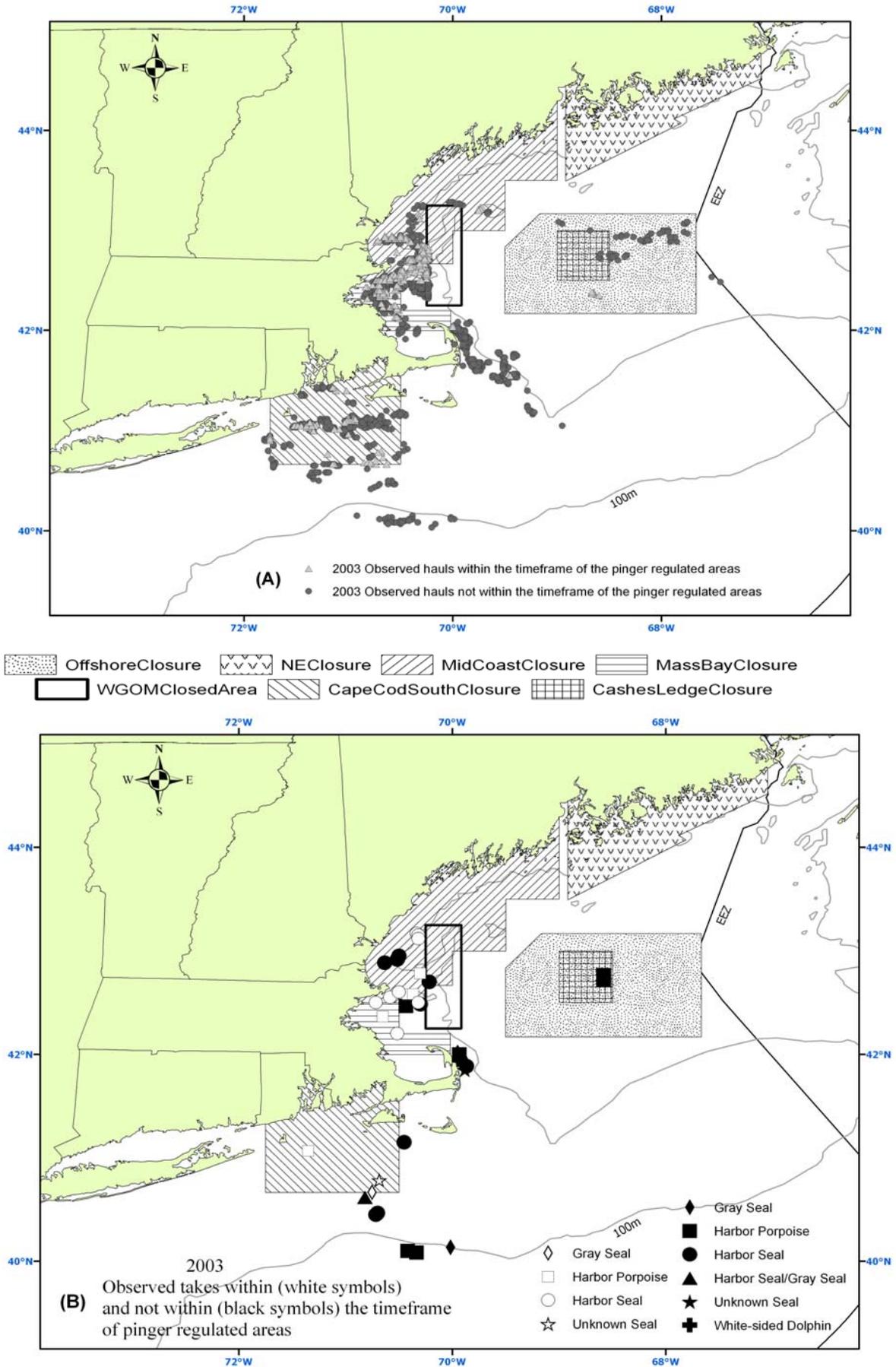
Figure 3. 2004 Northeast sink gillnet observed hauls (A) and observed takes (B).
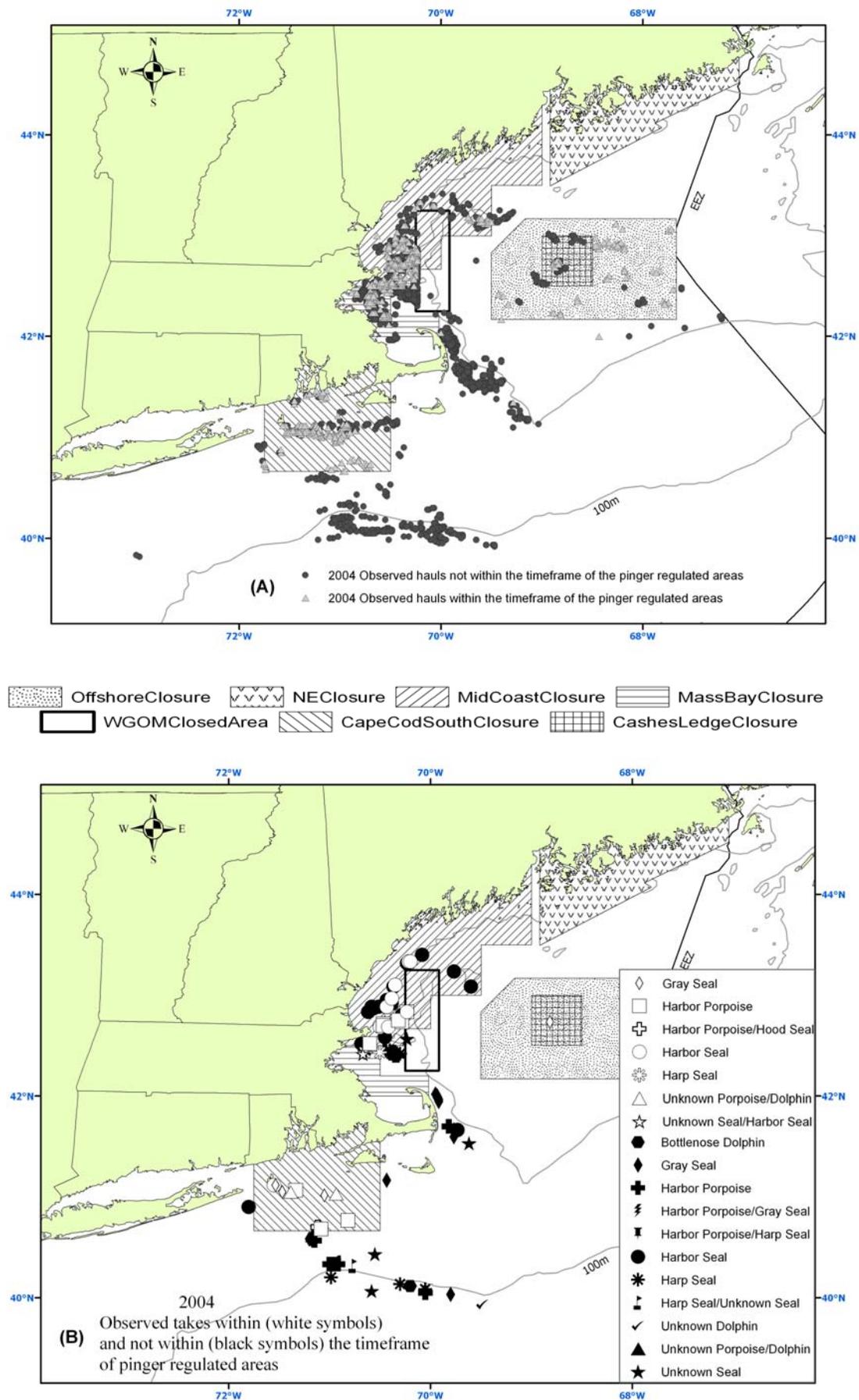
Figure 4. 2005 Northeast sink gillnet observed hauls (A) and observed takes (B).
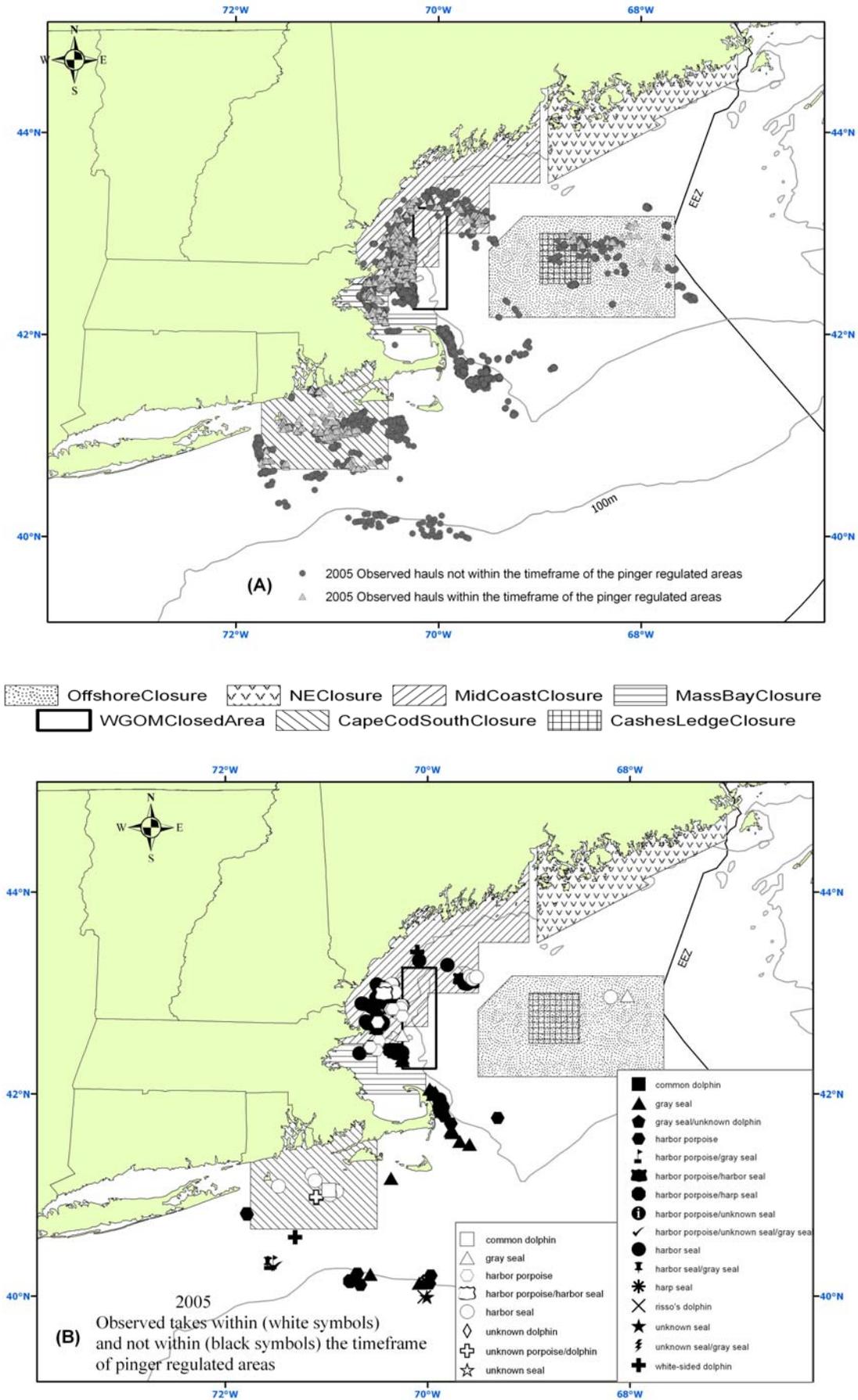
Figure 5. 2006 Northeast sink gillnet observed hauls (A) and observed takes (B).
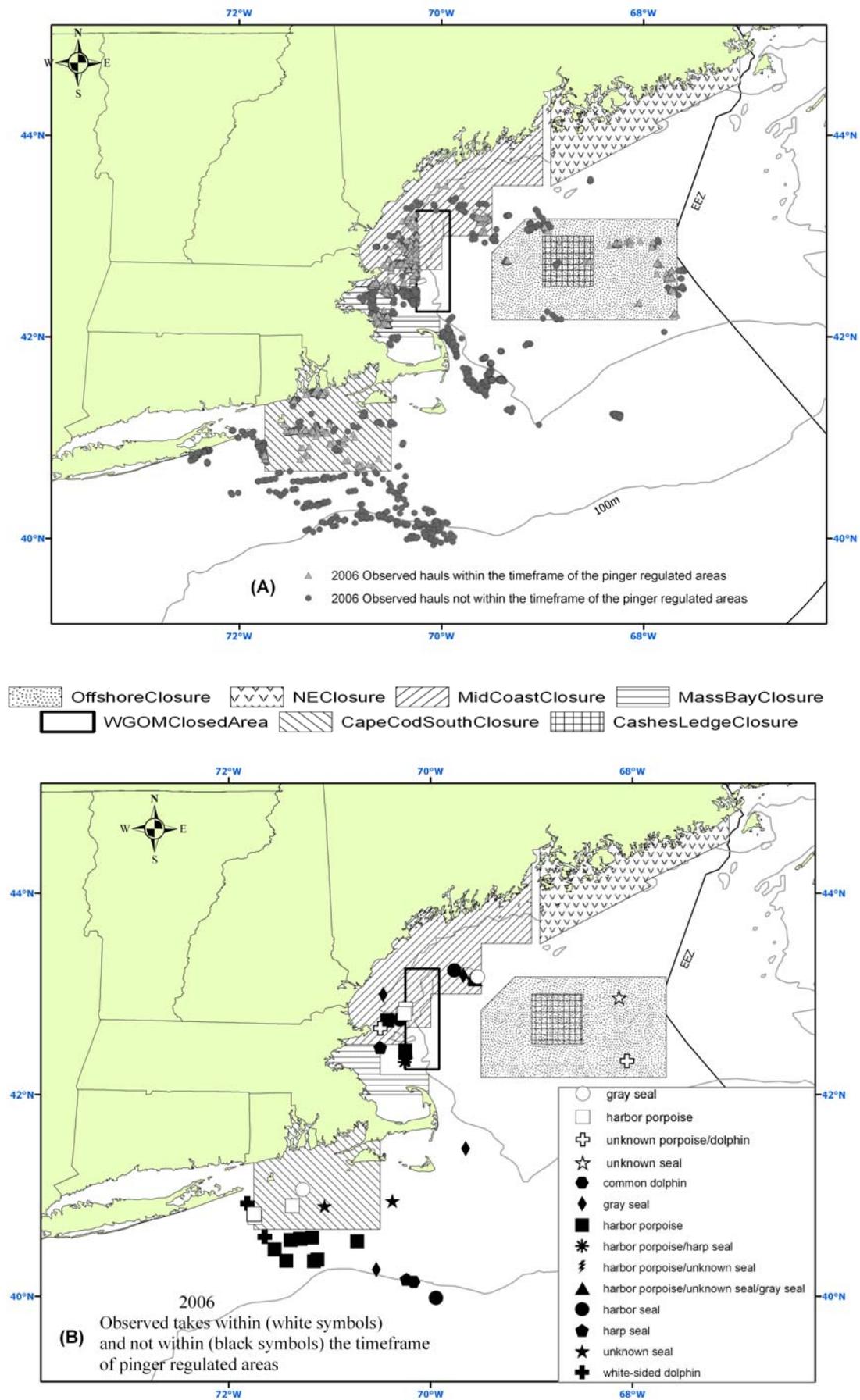
Figure 6. 2002 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).

(A)

● 2002 Observed mid-Atlantic gillnet hauls

(B)

no observed incidental takes in 2002
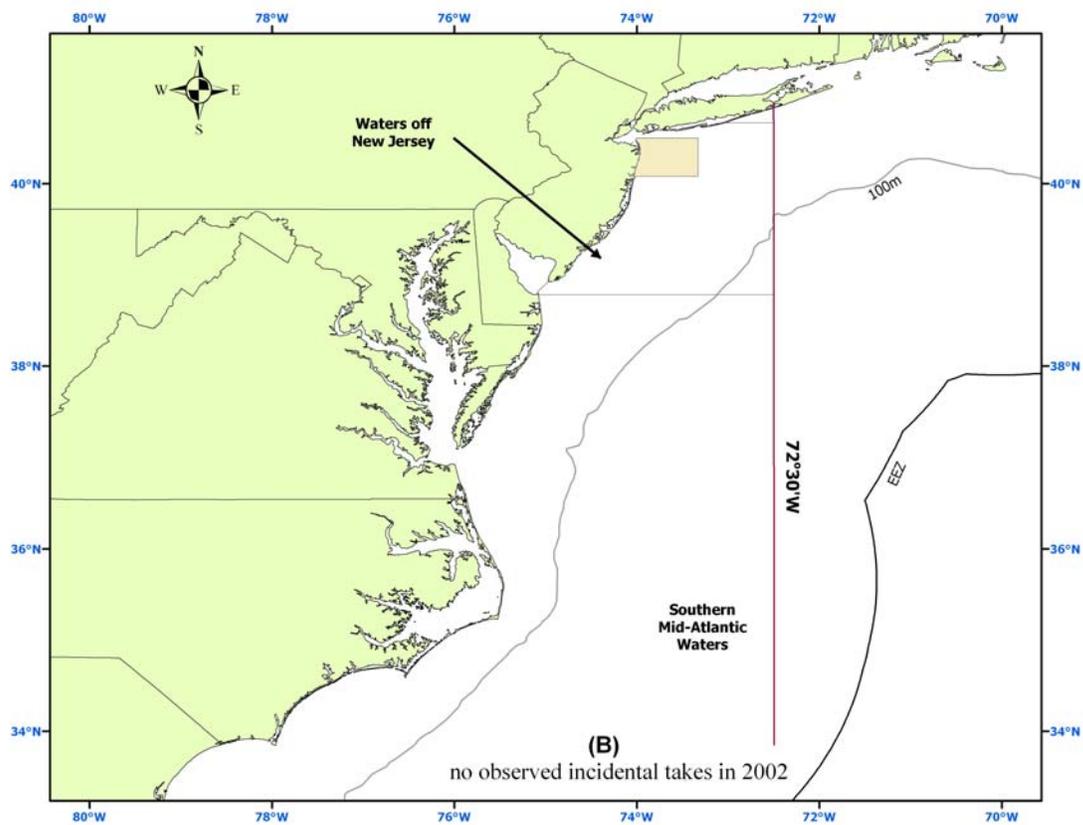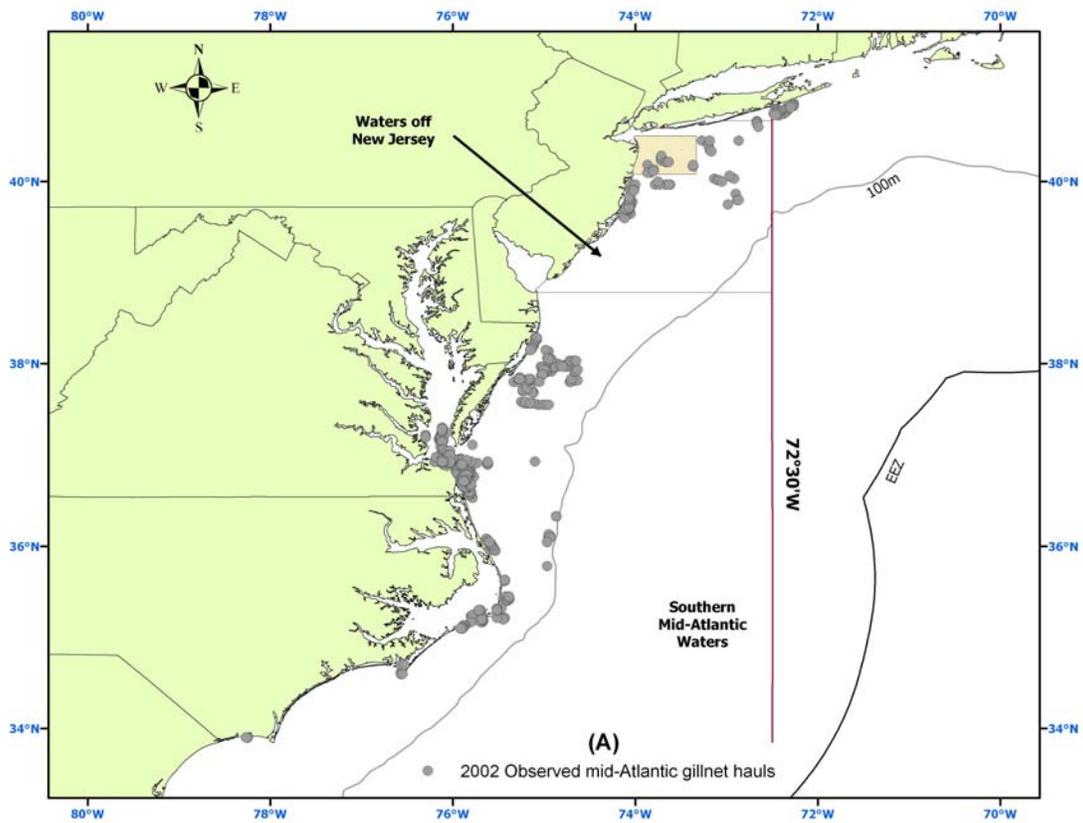
Figure 7. 2003 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).
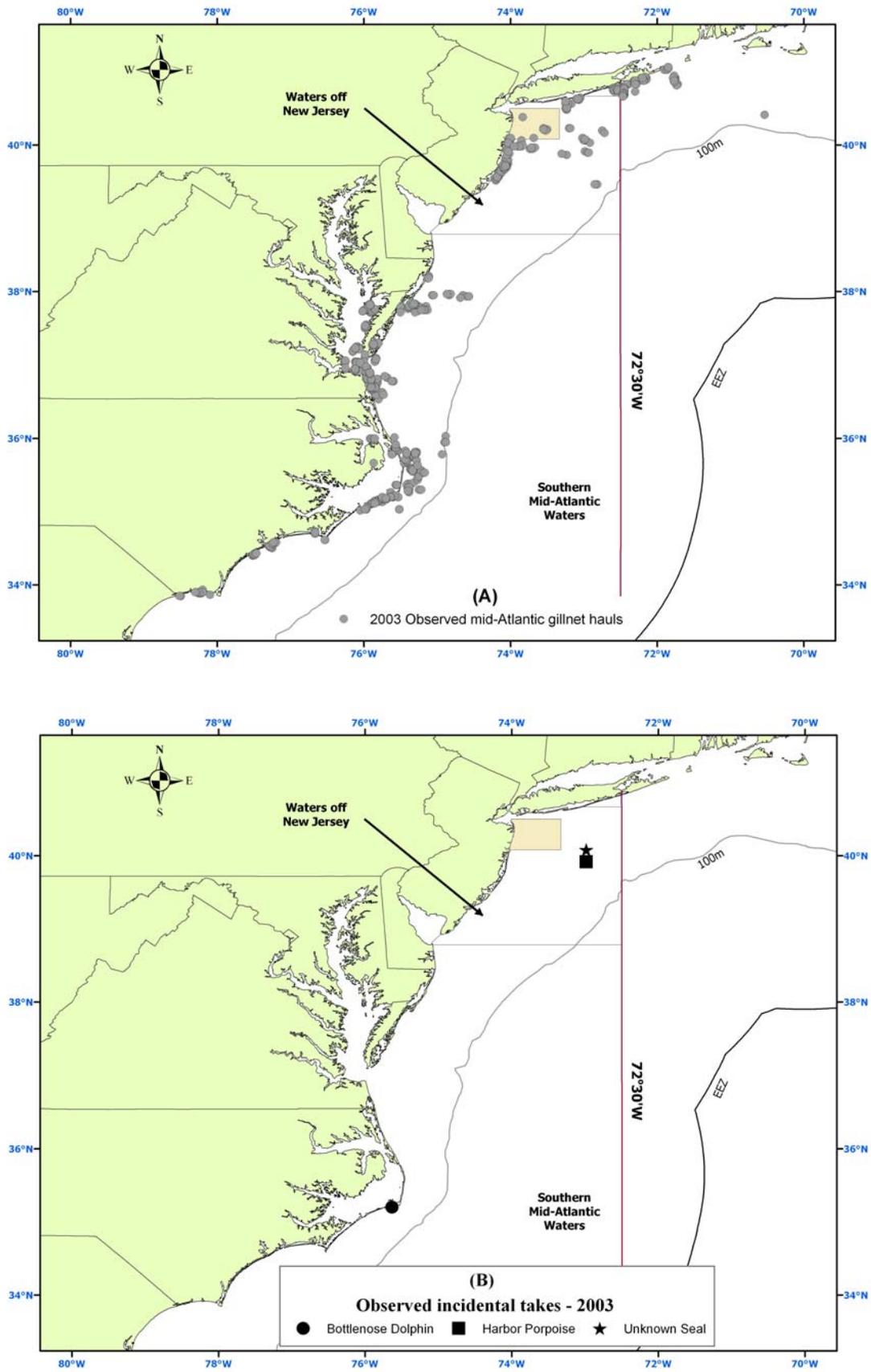
Figure 8. 2004 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).
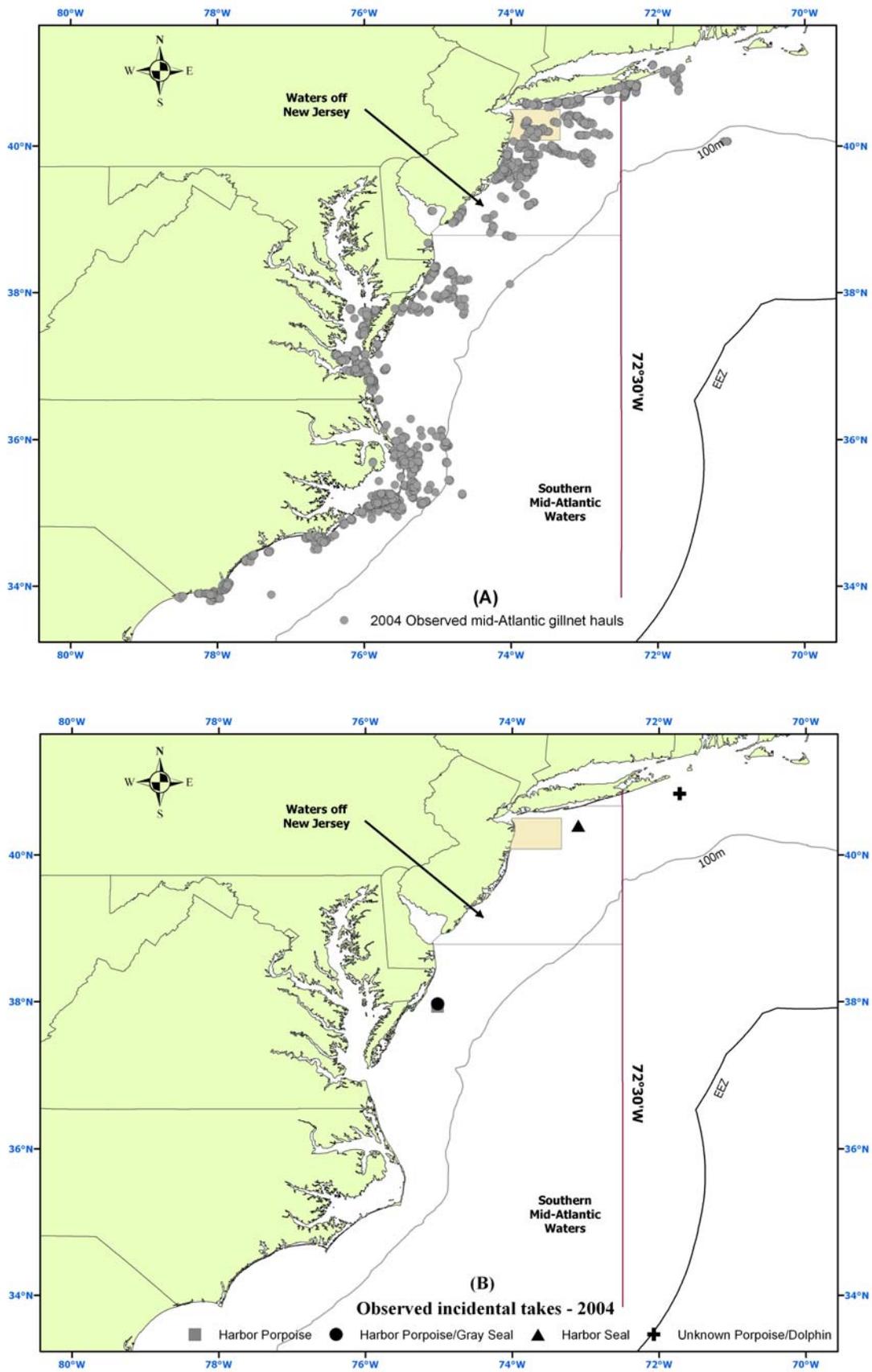
Figure 9. 2005 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).
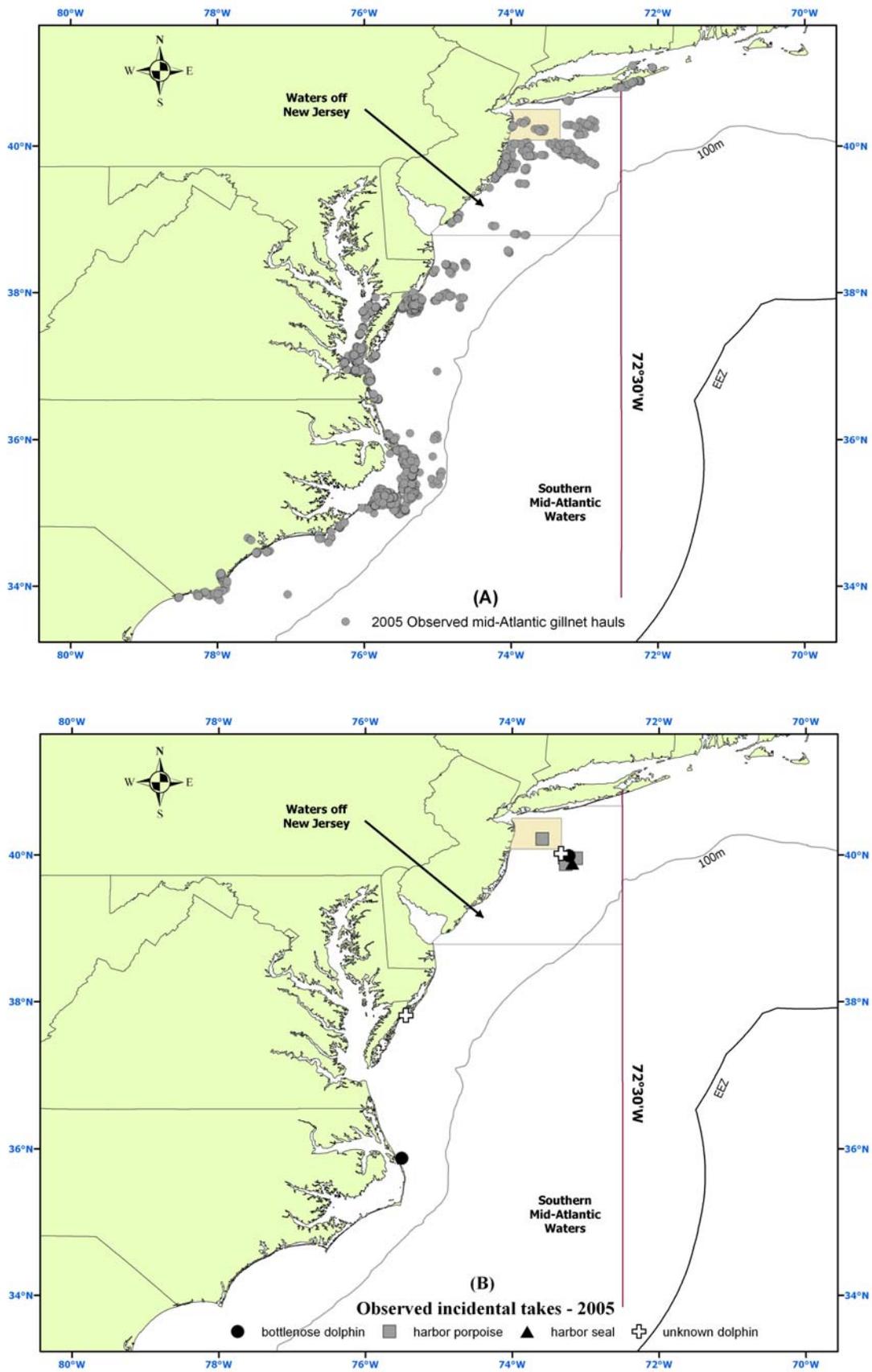
Figure 10. 2006 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).
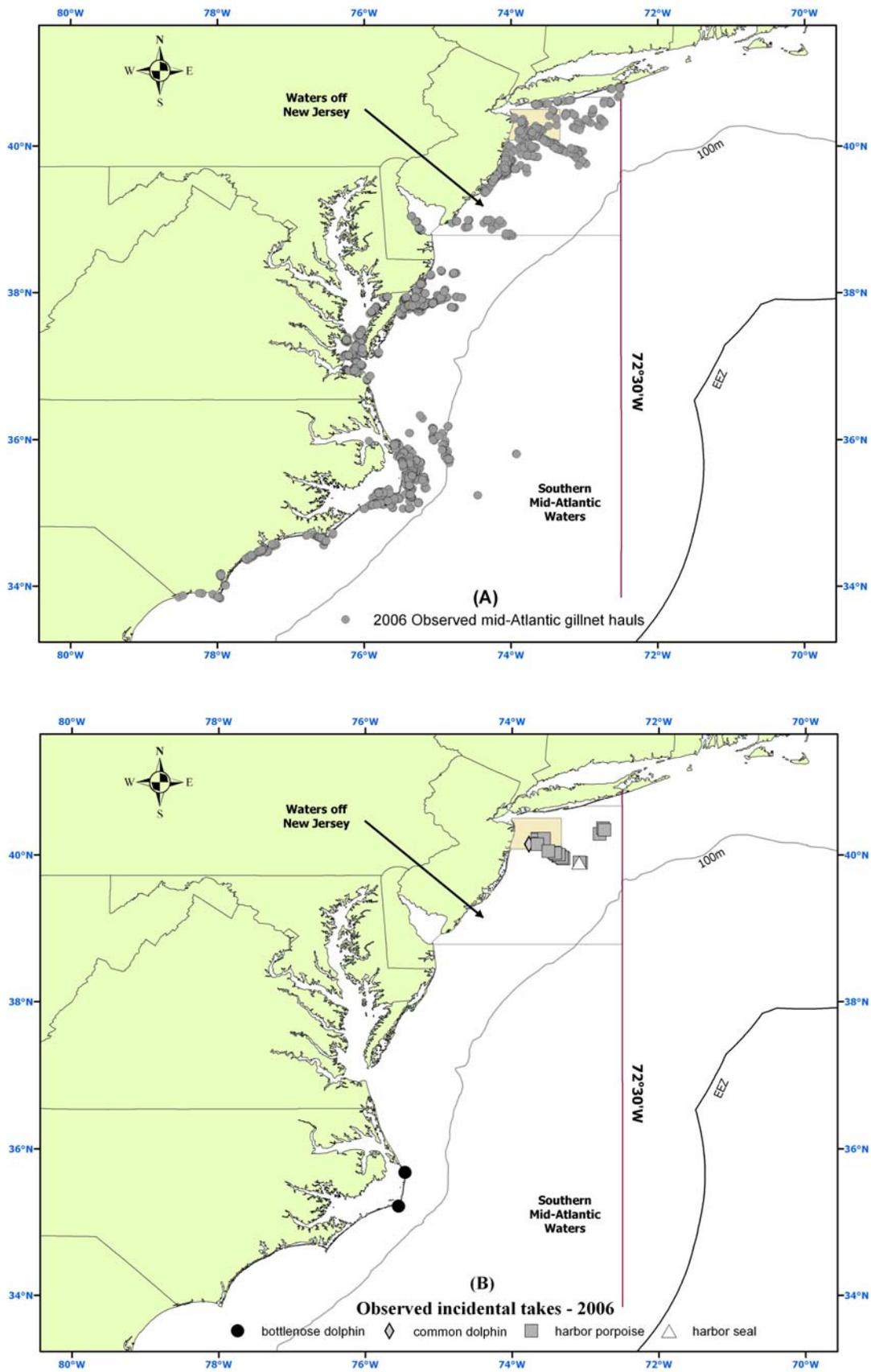
Figure 11. 2002 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

(A)

2002 Observed mid-Atlantic bottom trawl tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass

(B)

no observed incidental takes in 2002

Restricted Gear Area 2   Restricted Gear Area 3   Northern Gear Restricted Area

Restricted Gear Area 4   Southern Gear Restricted Area
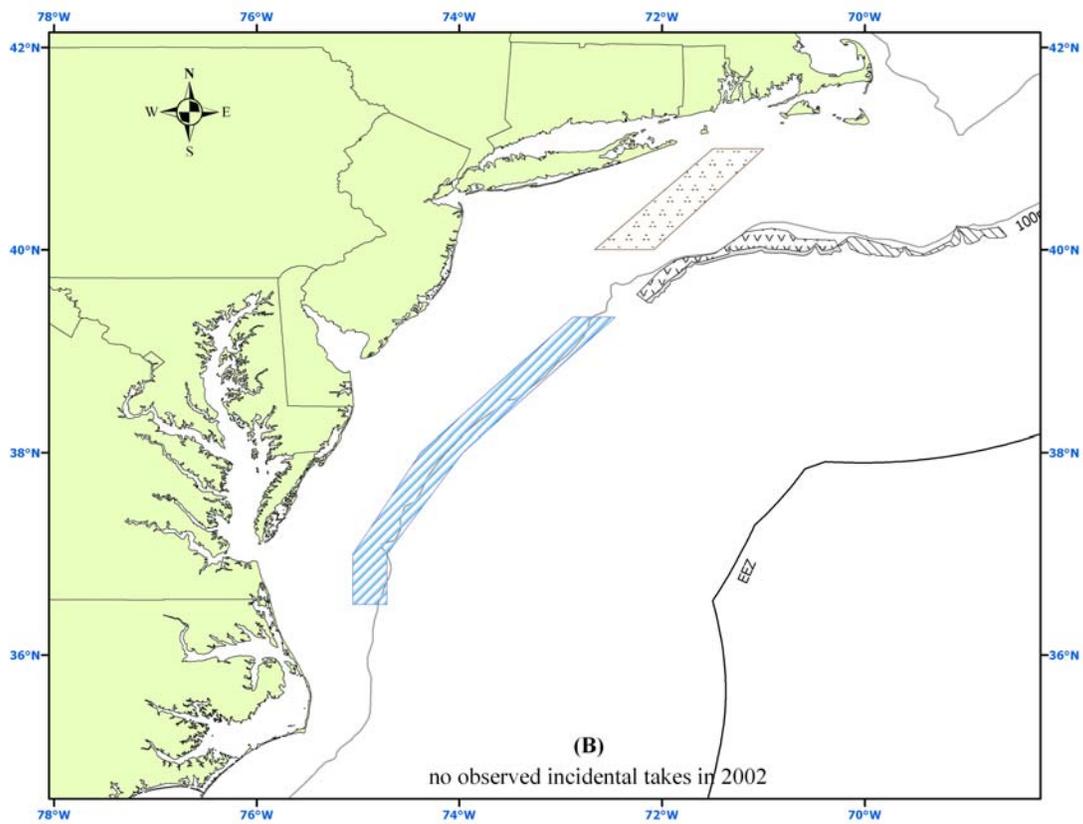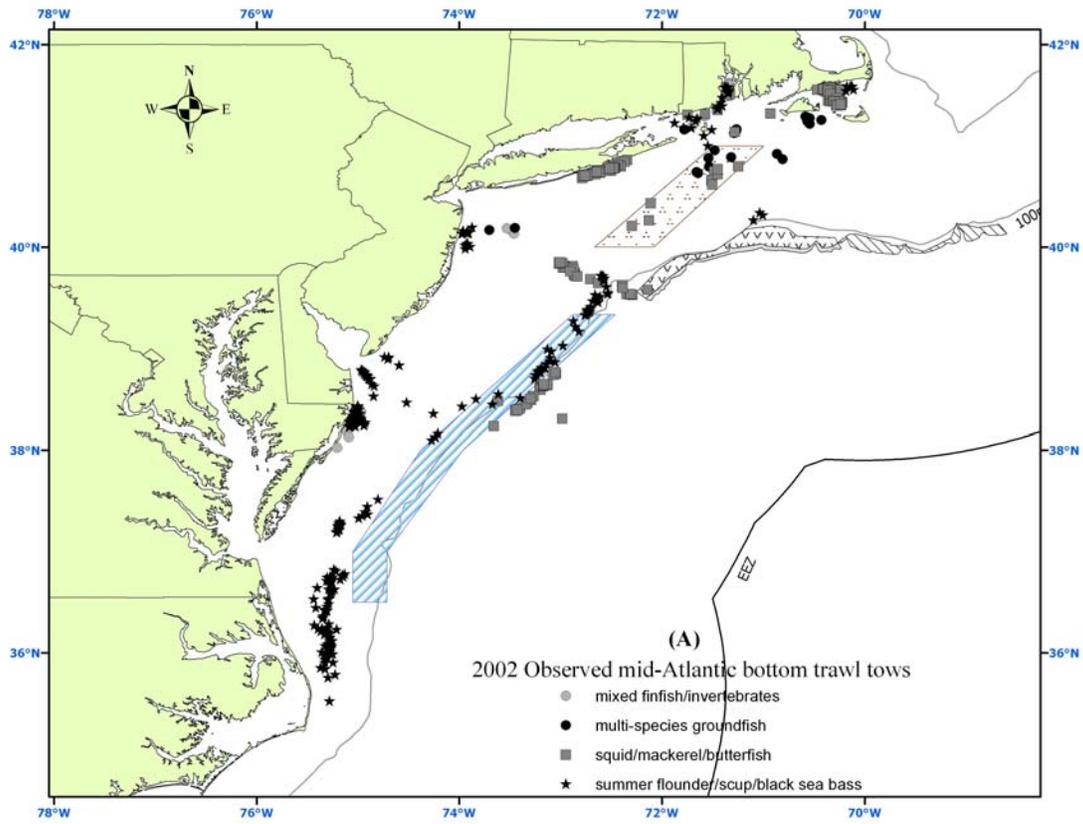
Figure 12. 2003 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).
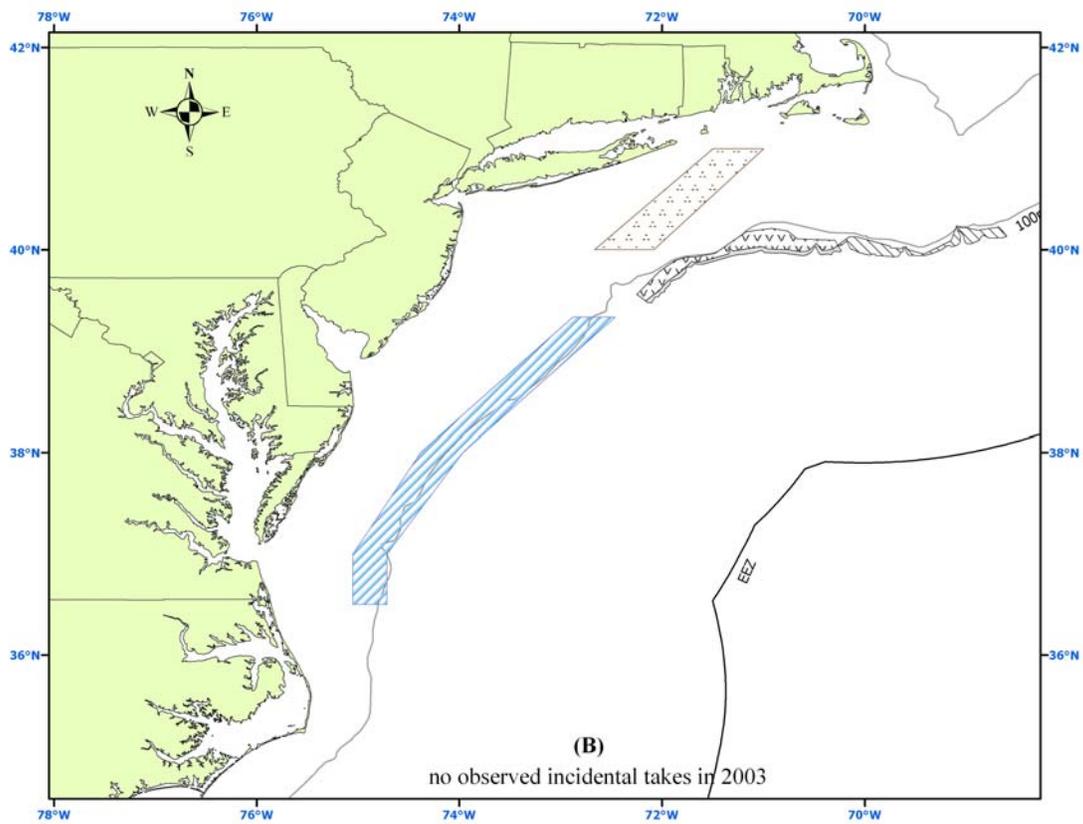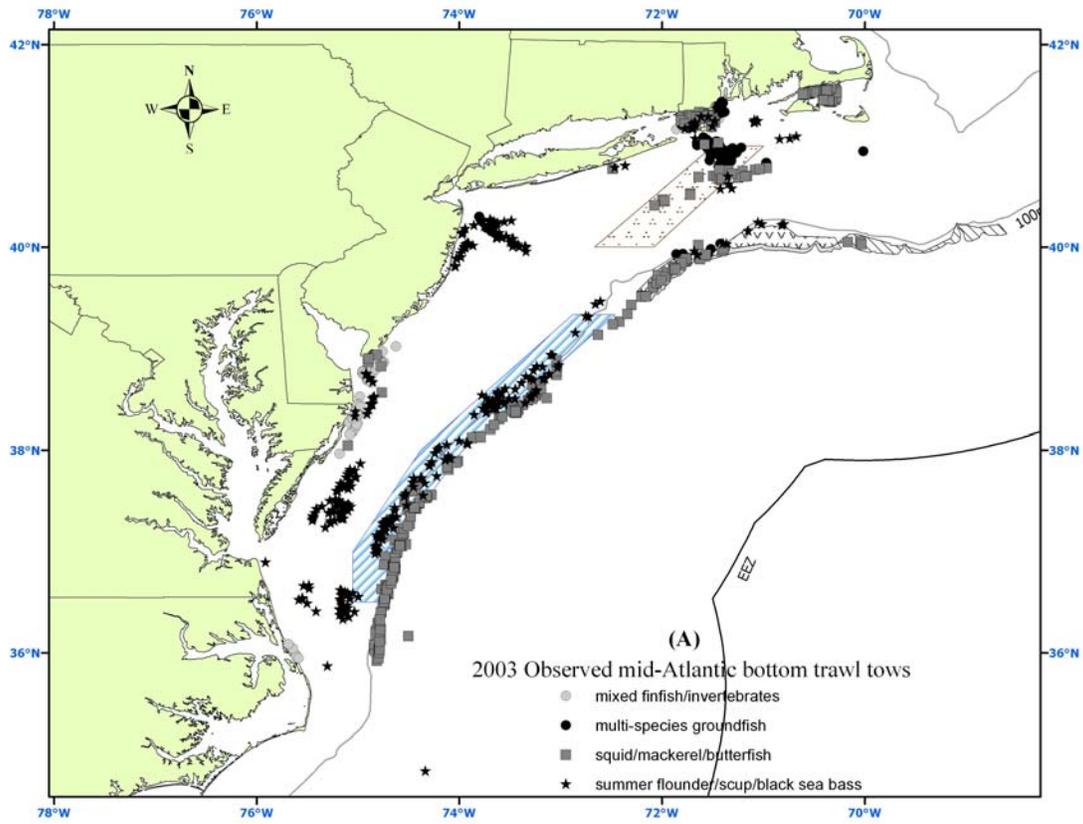
(A)

2003 Observed mid-Atlantic bottom trawl tows
- ○ mixed finfish/invertebrates
- ● multi-species groundfish
- ■ squid/mackerel/butterfish
- ★ summer flounder/scup/black sea bass

(B)

no observed incidental takes in 2003

Restricted Gear Area 2   Restricted Gear Area 3   Northern Gear Restricted Area
Restricted Gear Area 4   Southern Gear Restricted Area

Figure 13. 2004 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

(A)

2004 Observed mid-Atlantic bottom trawl tows

- ⬤ mixed finfish/invertebrates
- ● multi-species groundfish
- ■ squid/mackerel/butterfish
- ★ summer flounder/scup/black sea bass

(B)

2004 - Observed incidental takes
◇ common dolphin

Restricted Gear Area 2 | Restricted Gear Area 3 | Northern Gear Restricted Area
Restricted Gear Area 4 | Southern Gear Restricted Area
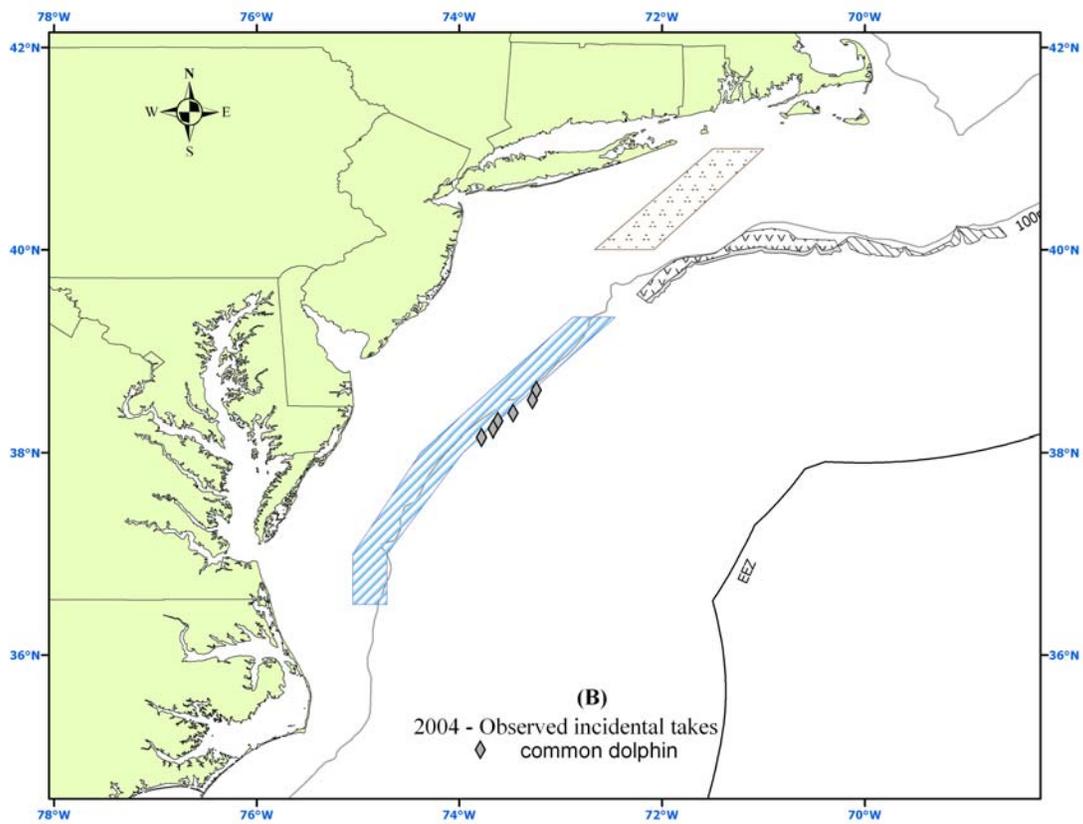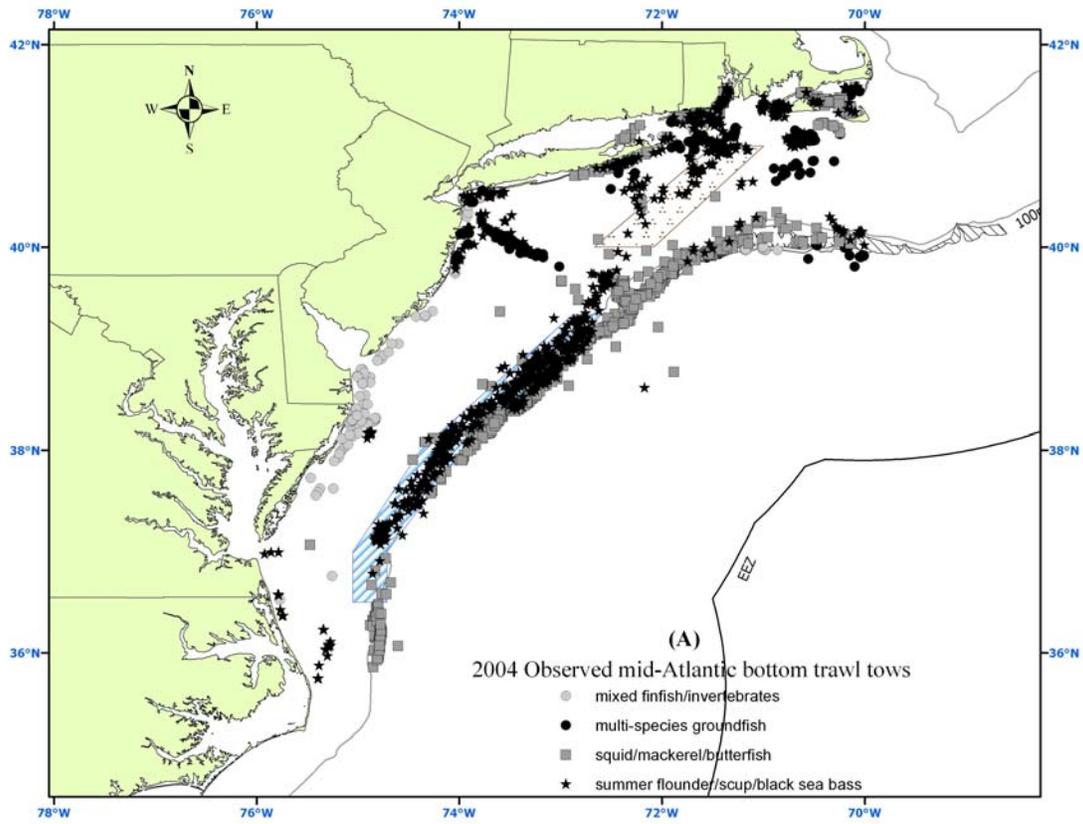
Figure 14. 2005 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).
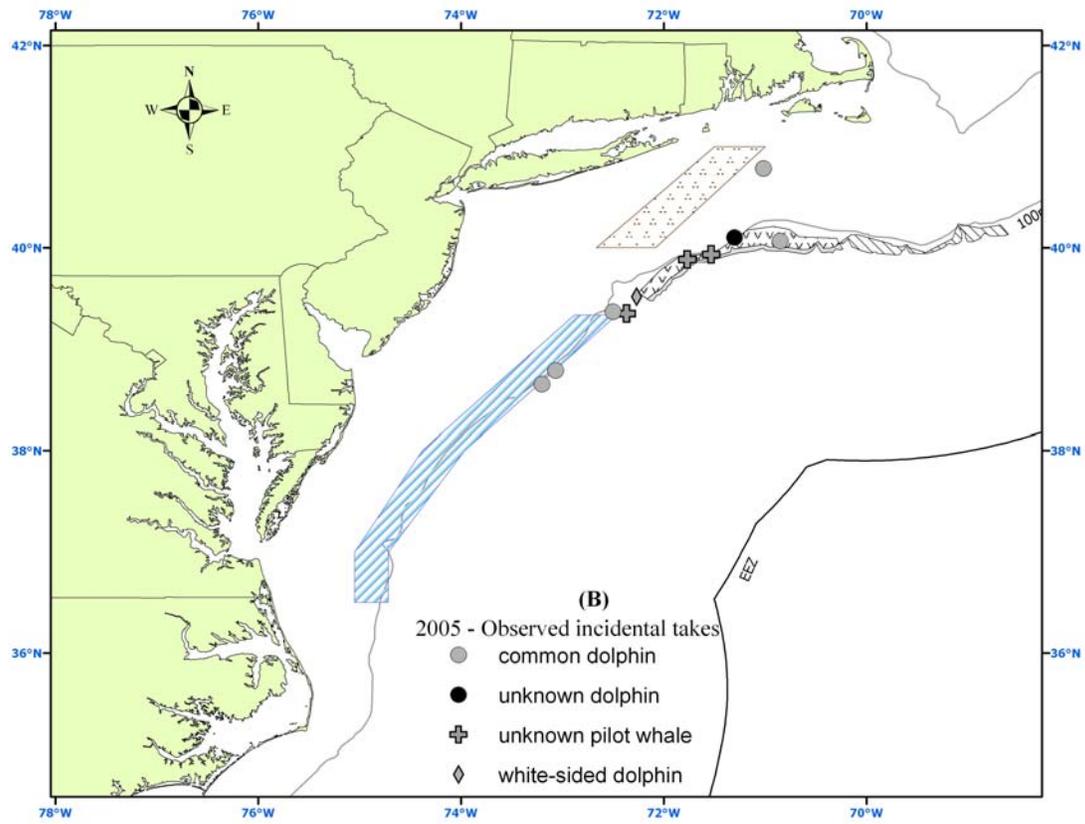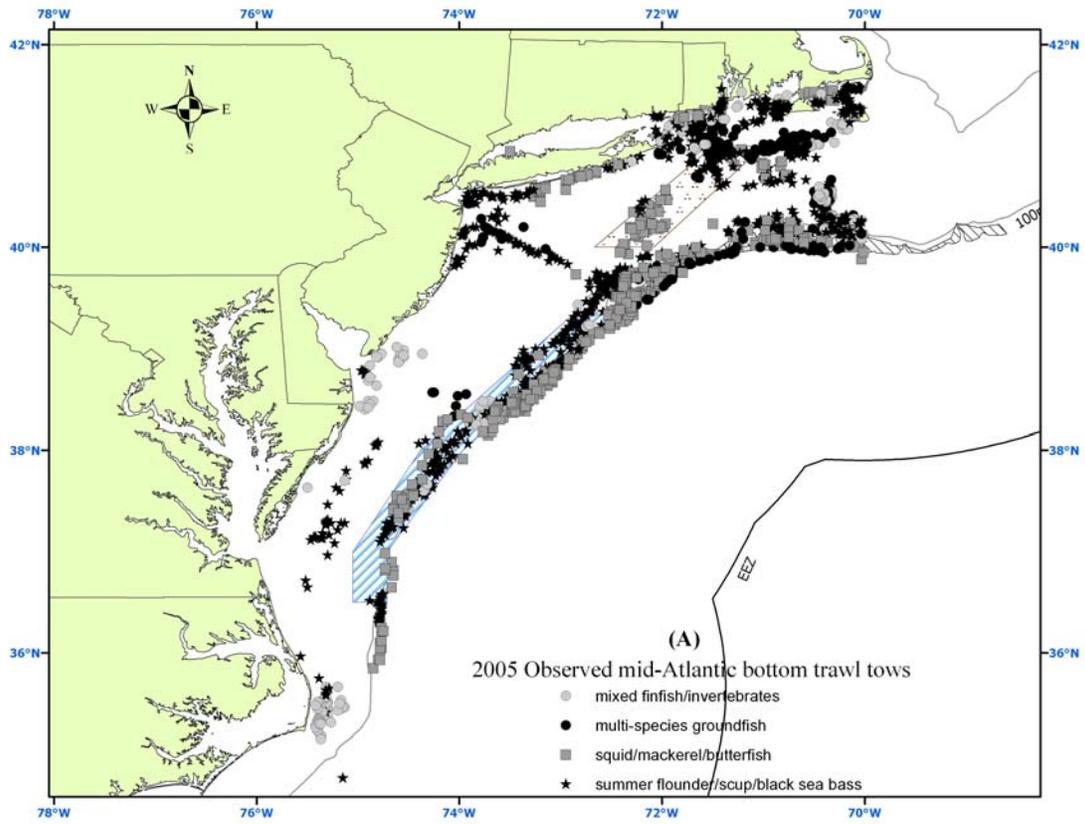
Figure 15. 2006 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

(A)
2006 - Observed hauls
○ mixed finfish/invertebrates
■ multi-species groundfish
▲ squid/mackerel/butterfish
☆ summer flounder/scup/black sea bass

(B)
2006 - Observed incidental takes
◆ common dolphin
✚ unknown pilot whale

Restricted Gear Area 2 Restricted Gear Area 3 Northern Gear Restricted Area
Restricted Gear Area 4 Southern Gear Restricted Area
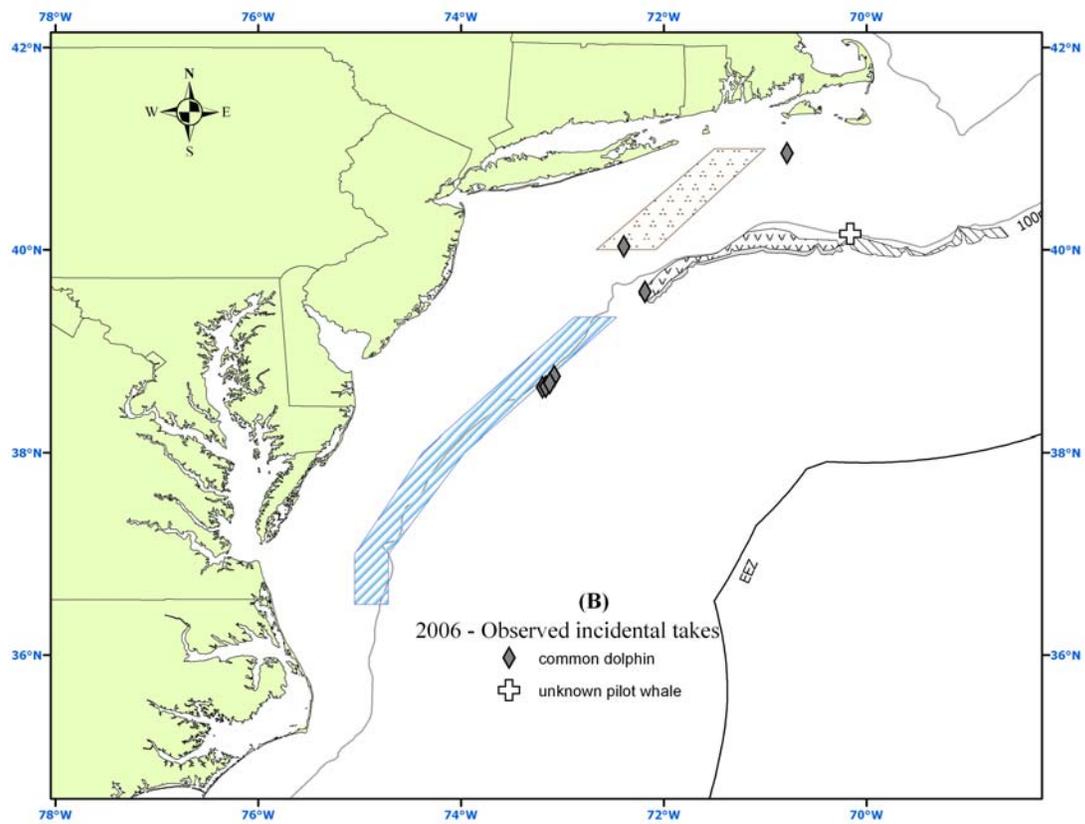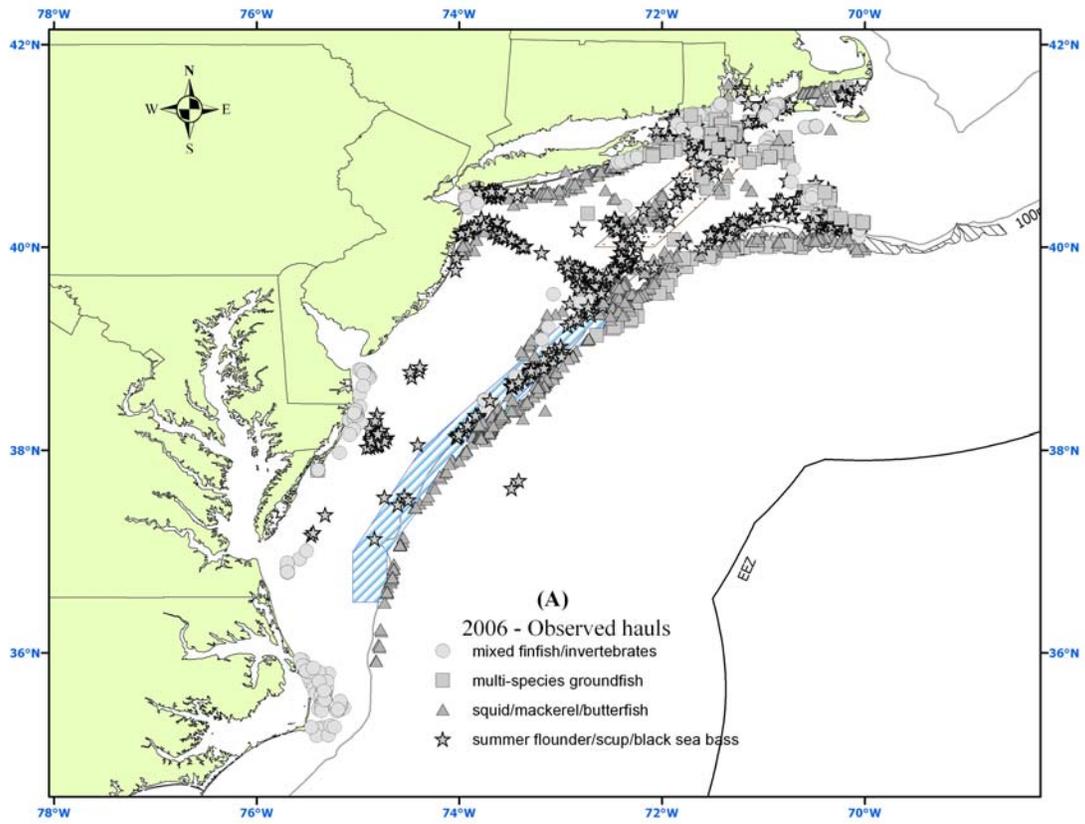
Figure 16. 2002 Northeast bottom trawl observed tows (A) and observed takes (B).

(B)
2002 - Observed hauls
★ multi-species groundfish
▲ squid/mackerel/butterfish
● mixed finfish/invertebrates

(B)
2002 - Observed incidental takes
◆ common dolphin
⬤ harbor seal
★ unknown seal
✚ white-sided dolphin

Closed Area 1   Rolling Closure Area 1   Rolling Closure Area 3   Rolling Closure Area 5
Closed Area 2   Rolling Closure Area 2   Rolling Closure Area 4   Western Gulf of Maine Closed Area
Cashes Ledge   Nantucket Lightship Closed Area

Figure 17. 2003 Northeast bottom trawl observed tows (A) and observed takes (B).
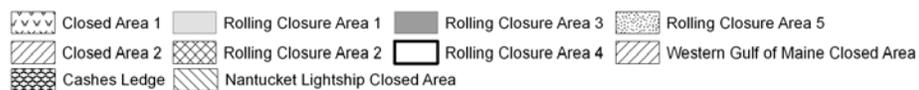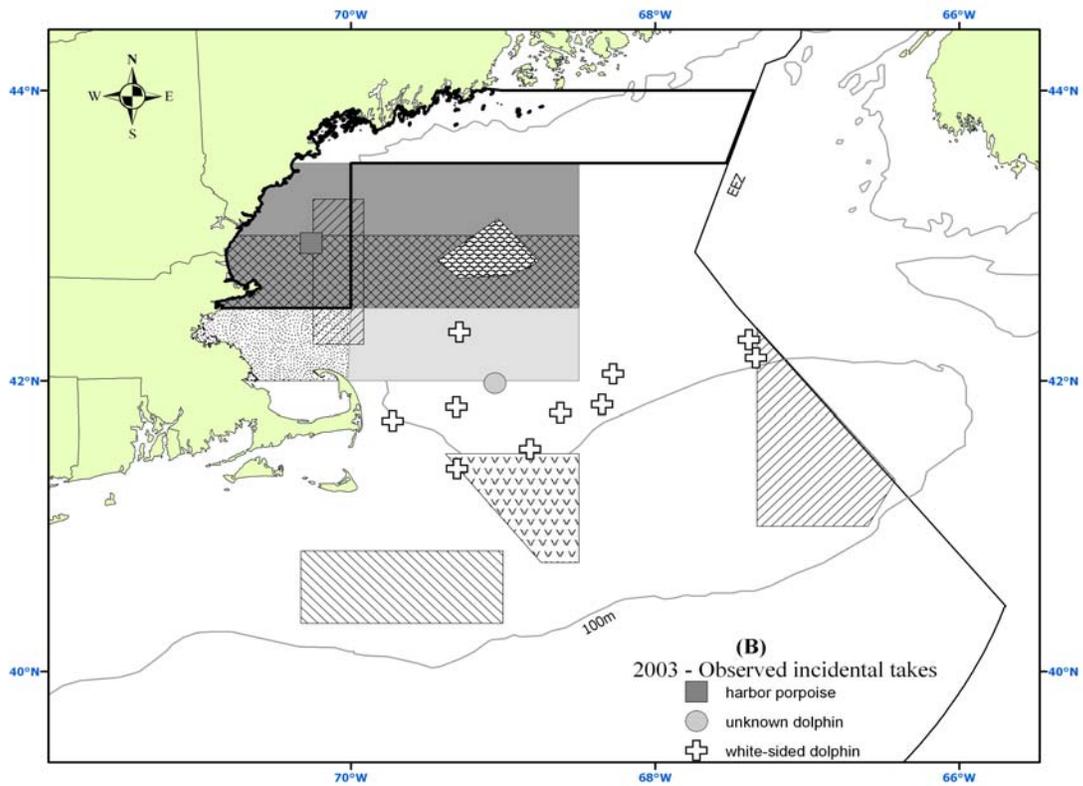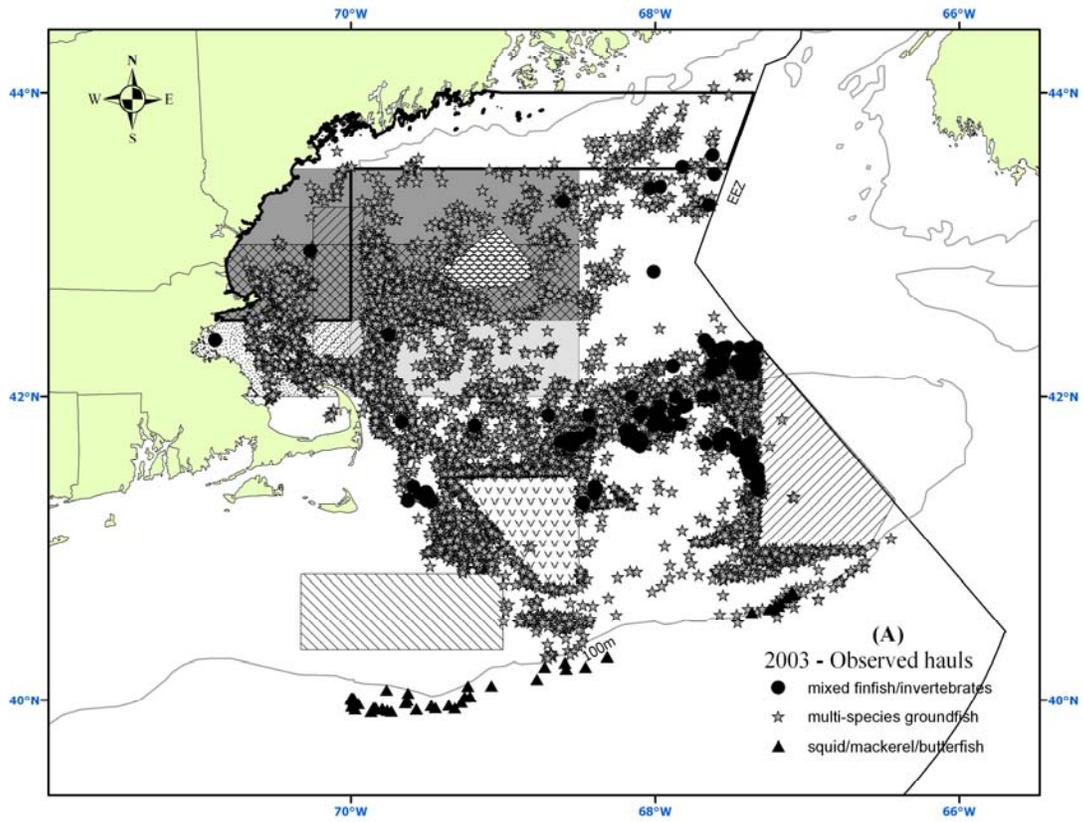
Figure 18. 2004 Northeast bottom trawl observed tows (A) and observed takes (B).

Figure 19. 2005 Northeast bottom trawl observed tows (A) and observed takes (B).
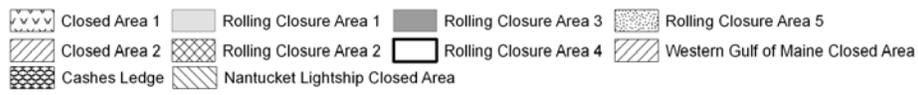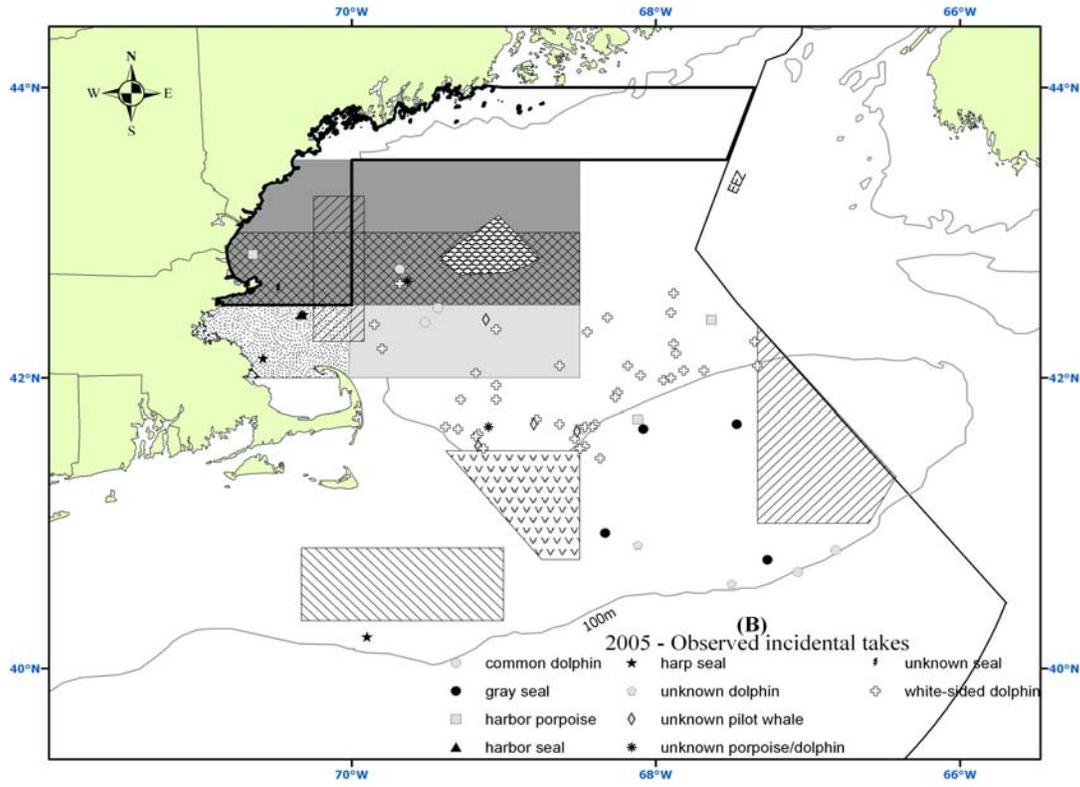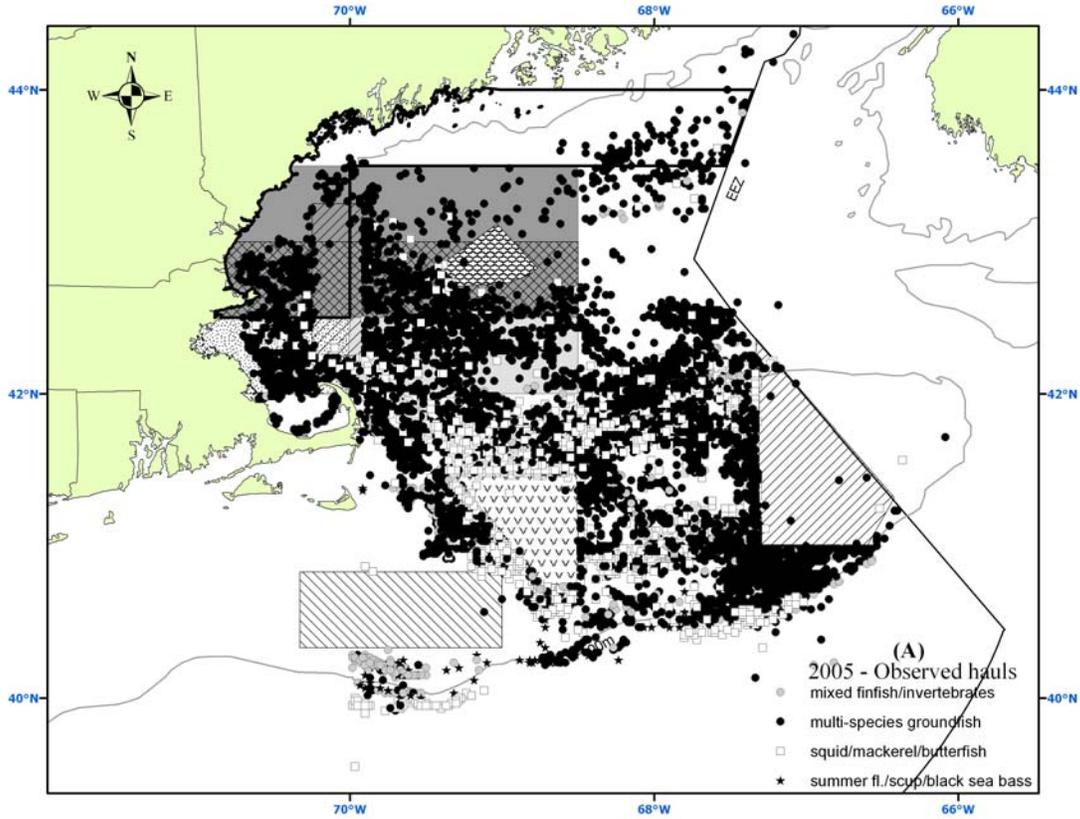
Figure 20. 2006 Northeast bottom trawl observed tows (A) and observed takes (B).
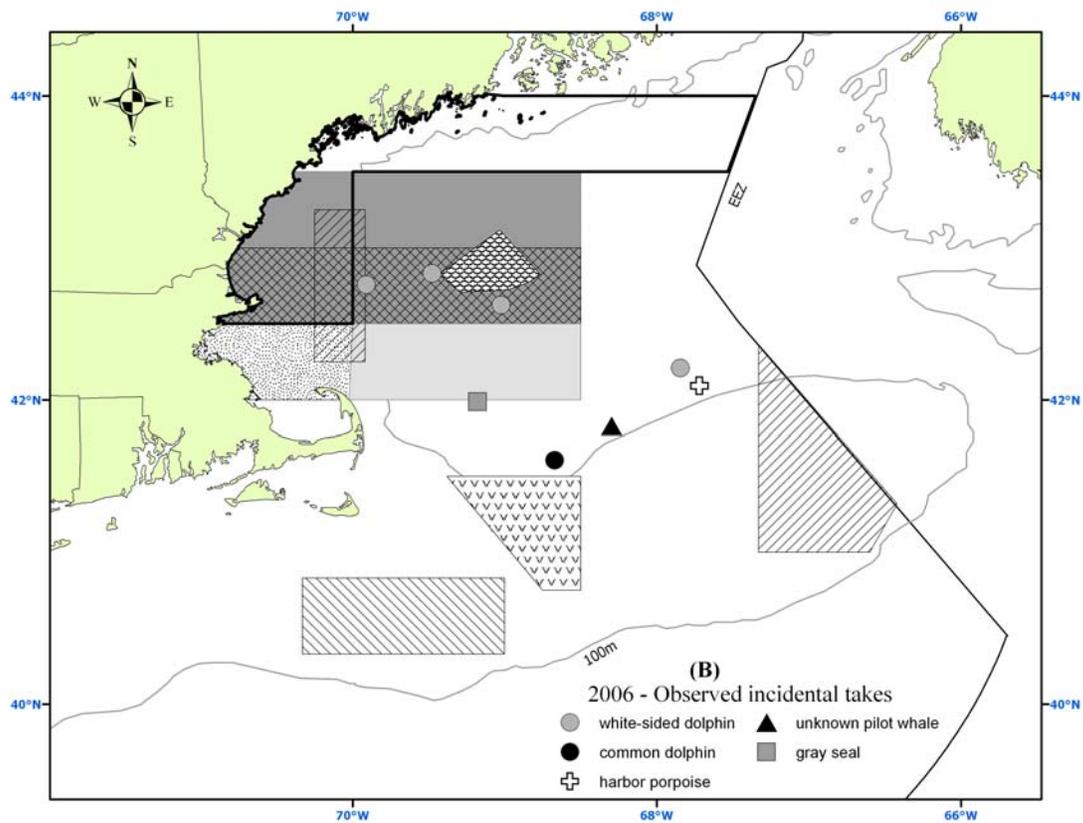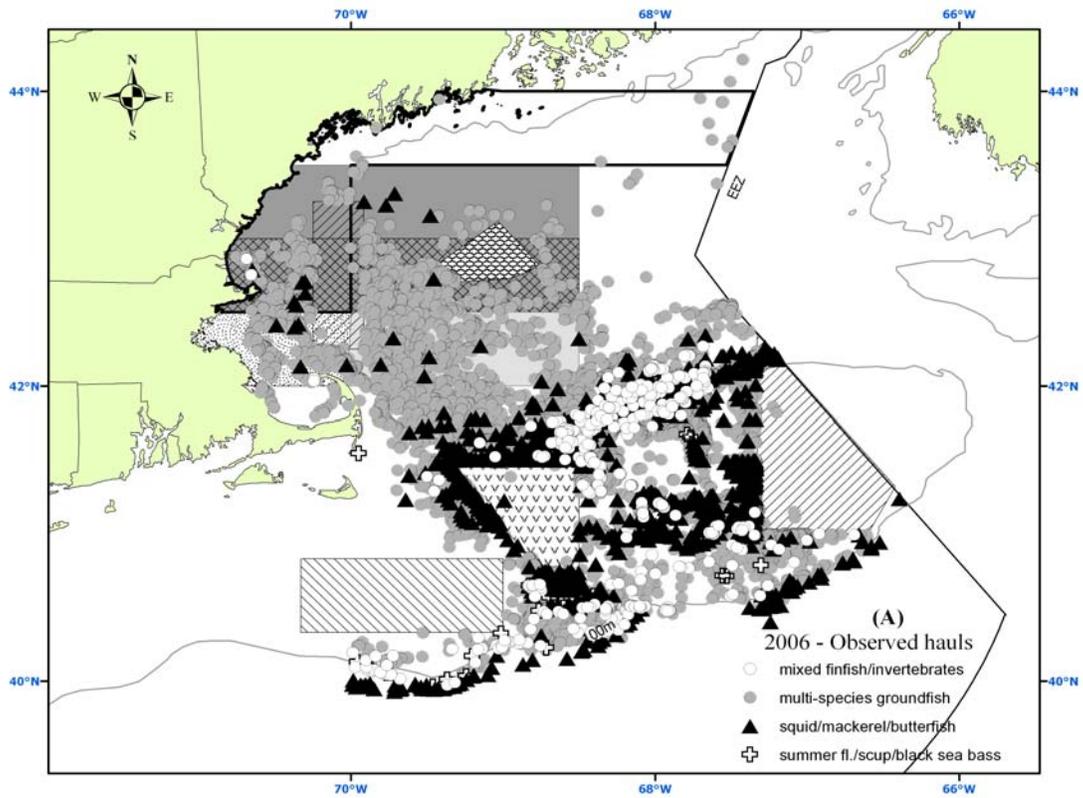
Figure 21. 2002 Northeast mid-water trawl observed tows (A) and observed takes (B).

(A)
No observed tows in 2002

(B)
No observed incidental takes in 2002
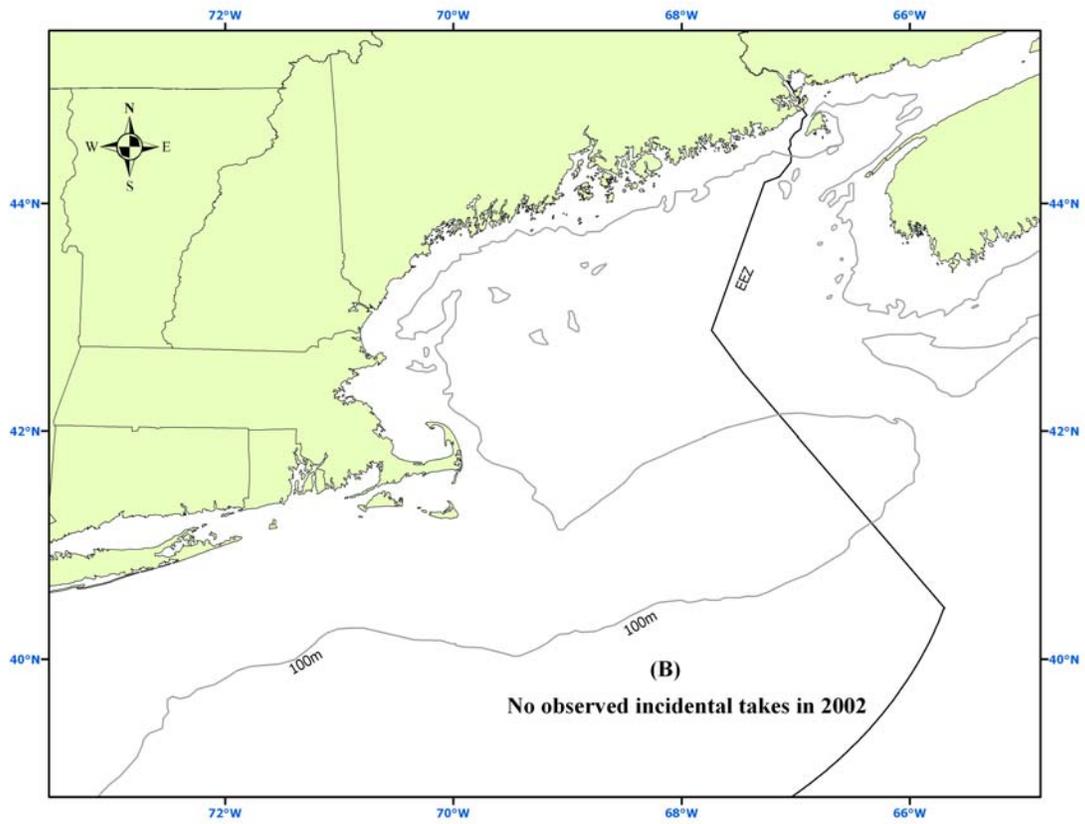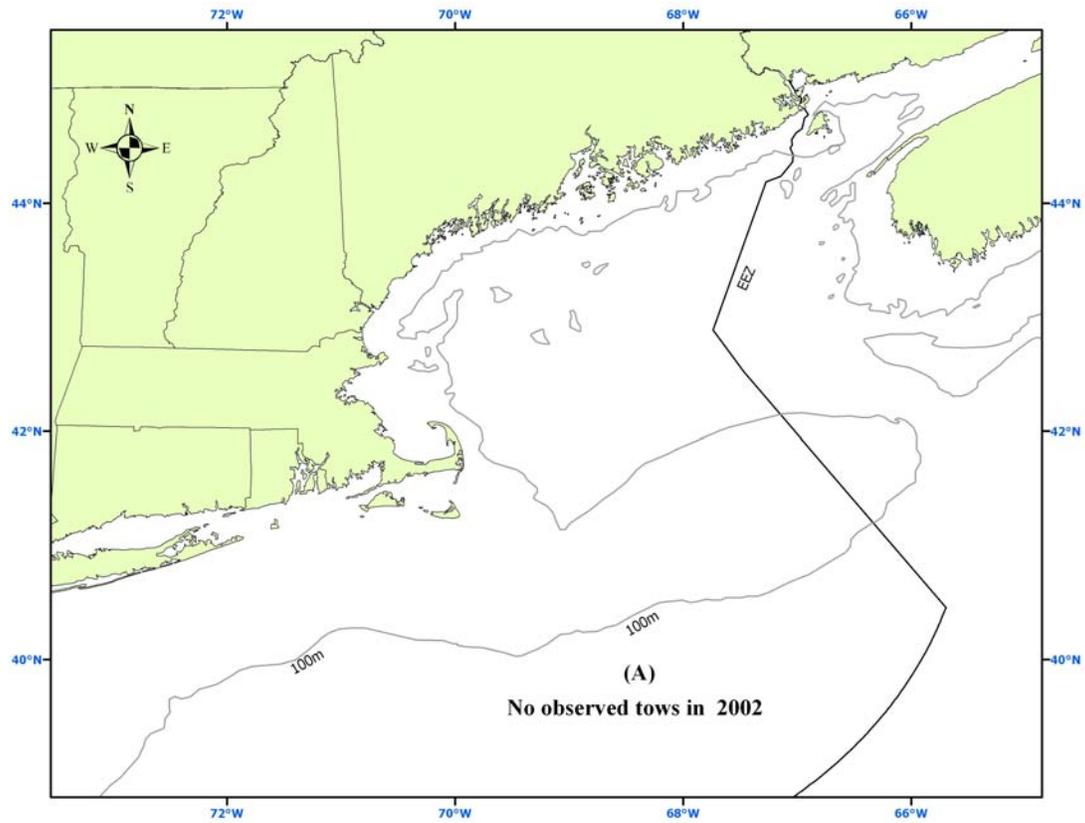
Figure 22. 2003 Northeast mid-water trawl observed tows (A) and observed takes (B).
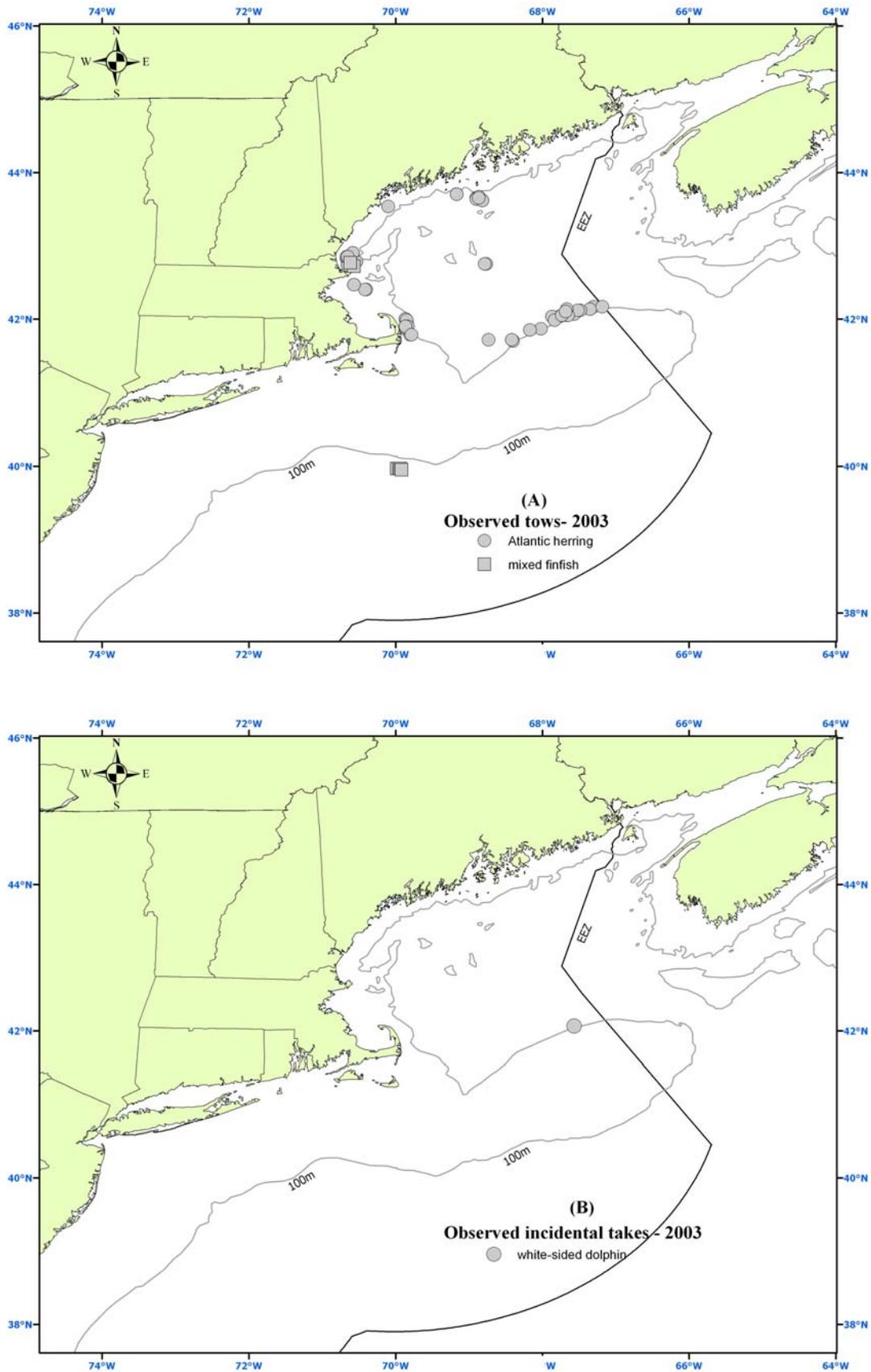
Figure 23. 2004 Northeast mid-water trawl observed tows (A) and observed takes (B).
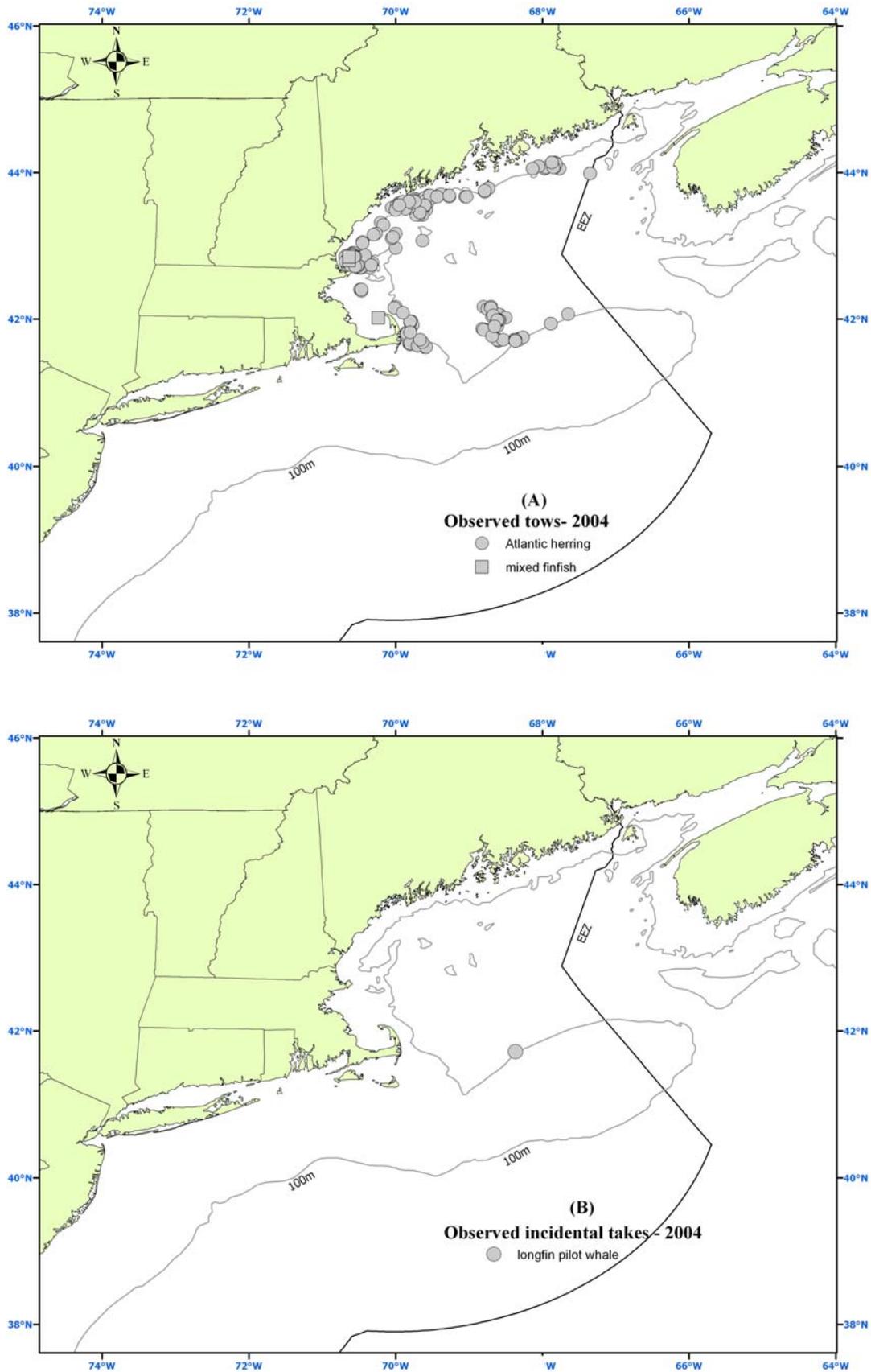
Figure 24. 2005 Northeast mid-water trawl observed tows (A) and observed takes (B).

(A)
Observed tows- 2005
○ Herring, n.k.
□ Atlantic herring
▲ Sea Scallop

(B)
Observed incidental takes- 2005
○ white-sided dolphin
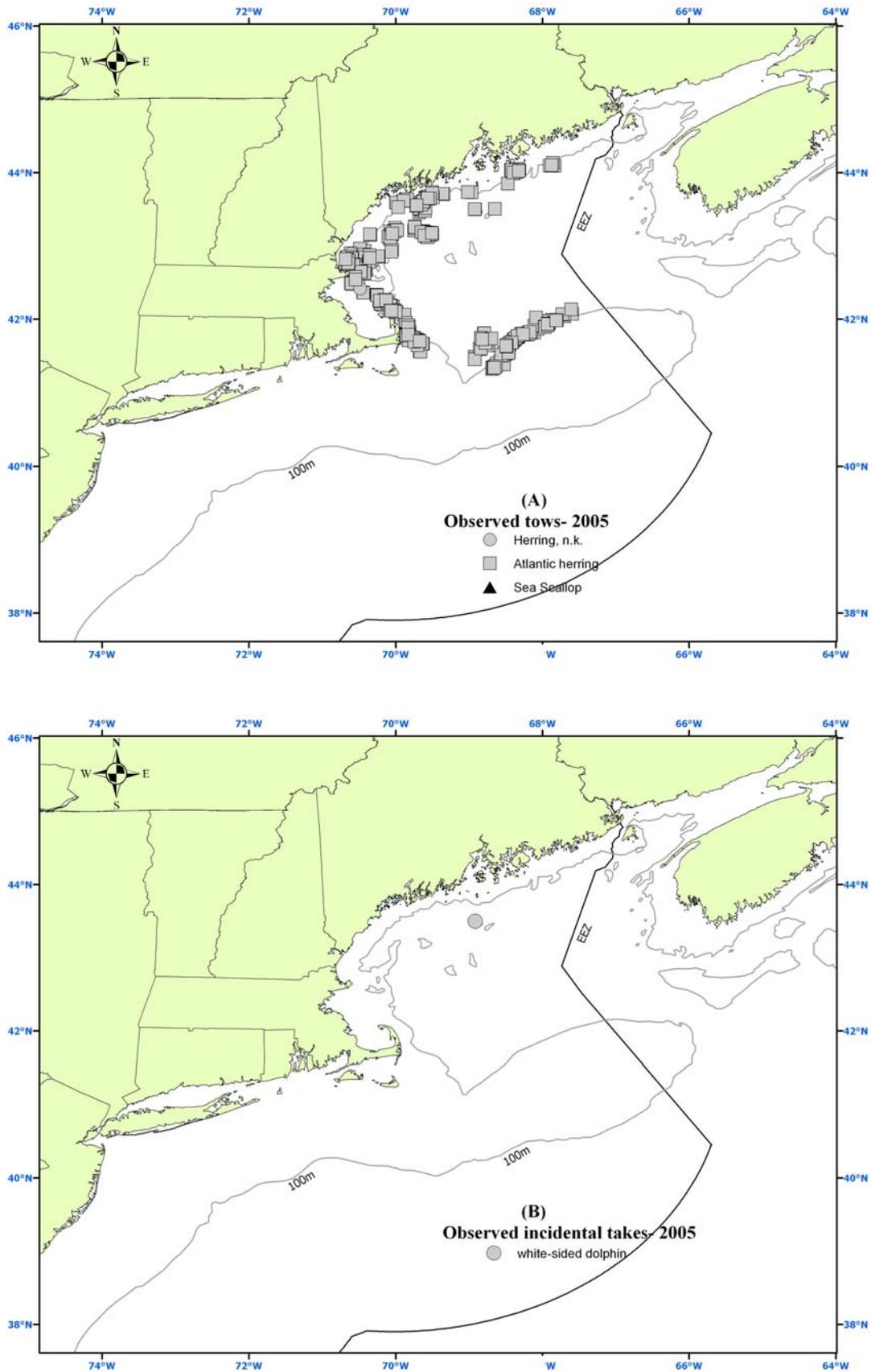
Figure 25. 2006 Northeast mid-water trawl observed tows (A) and observed takes (B).
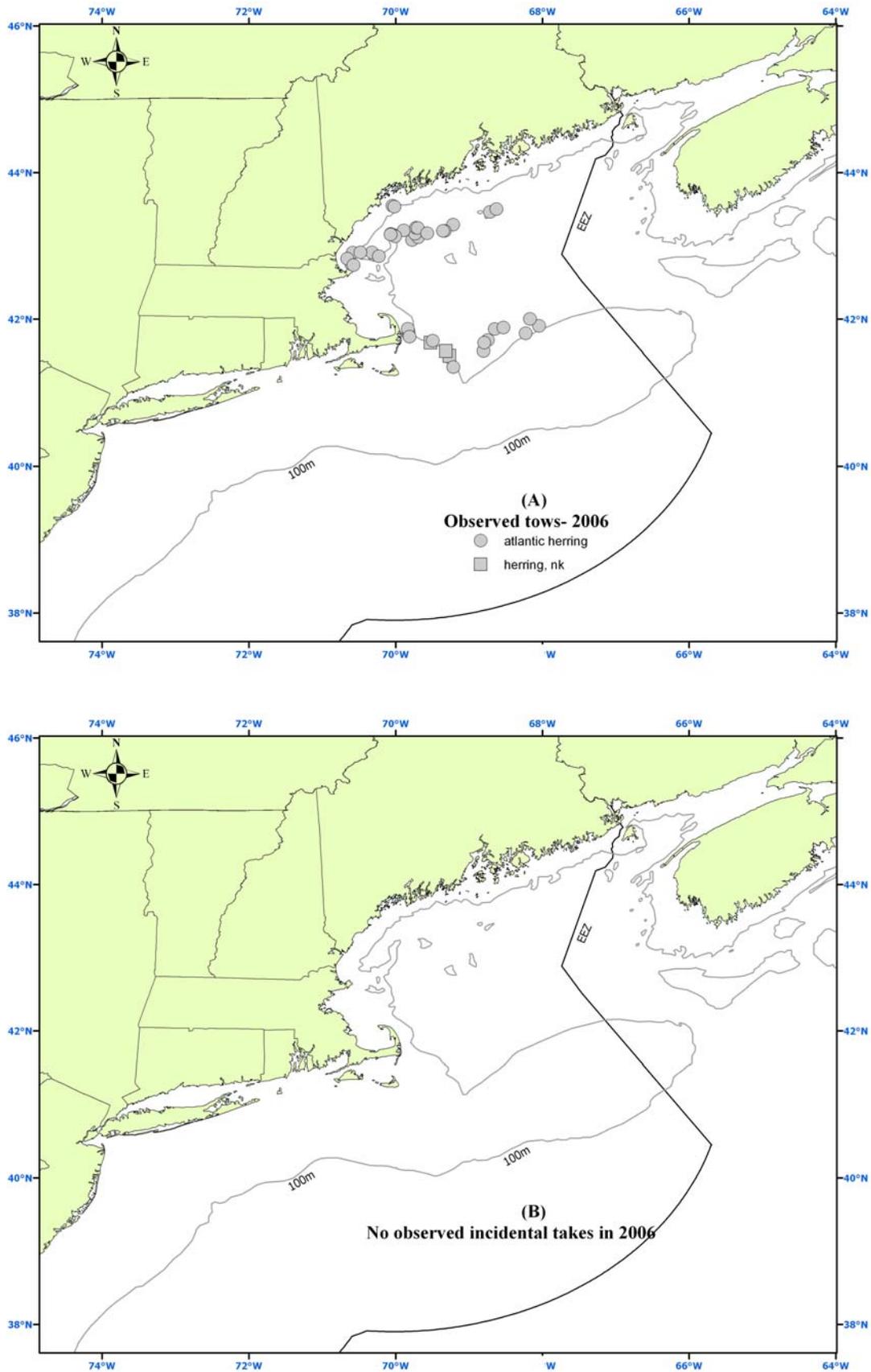
Figure 26. 2002 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

(A)
Observed hauls- 2002
● Atlantic Mackerel

(B)
No observed incidental takes in 2002
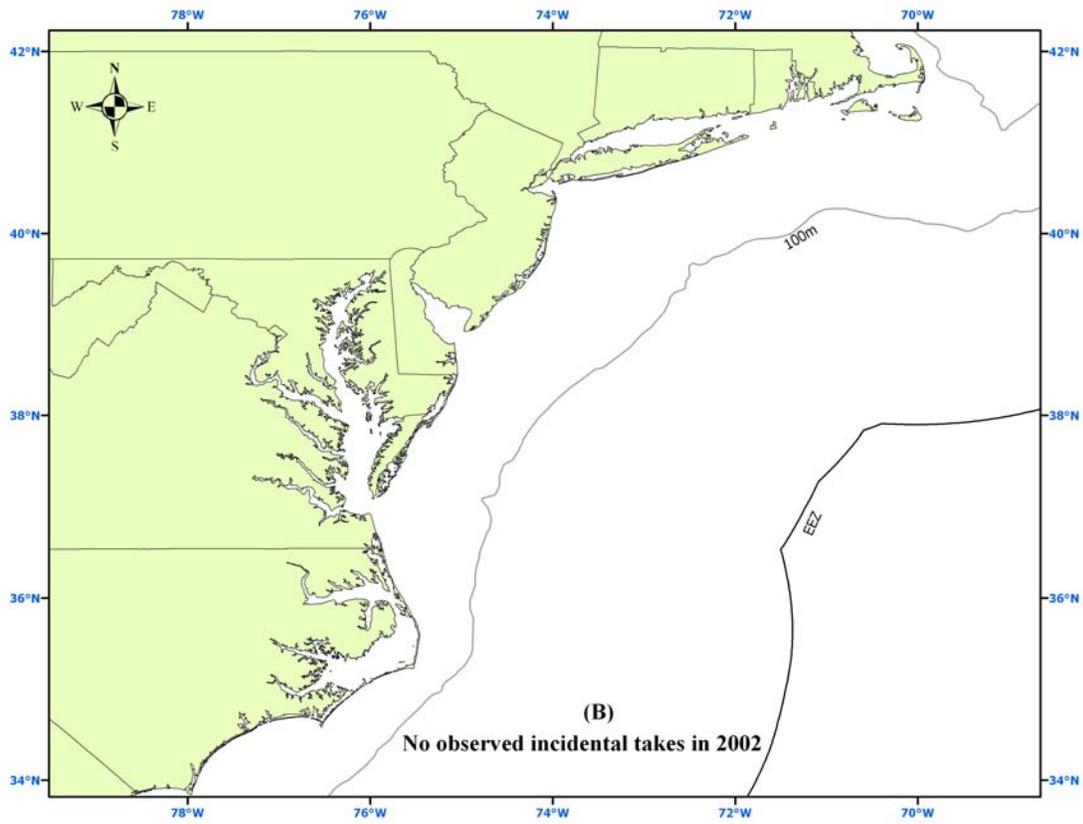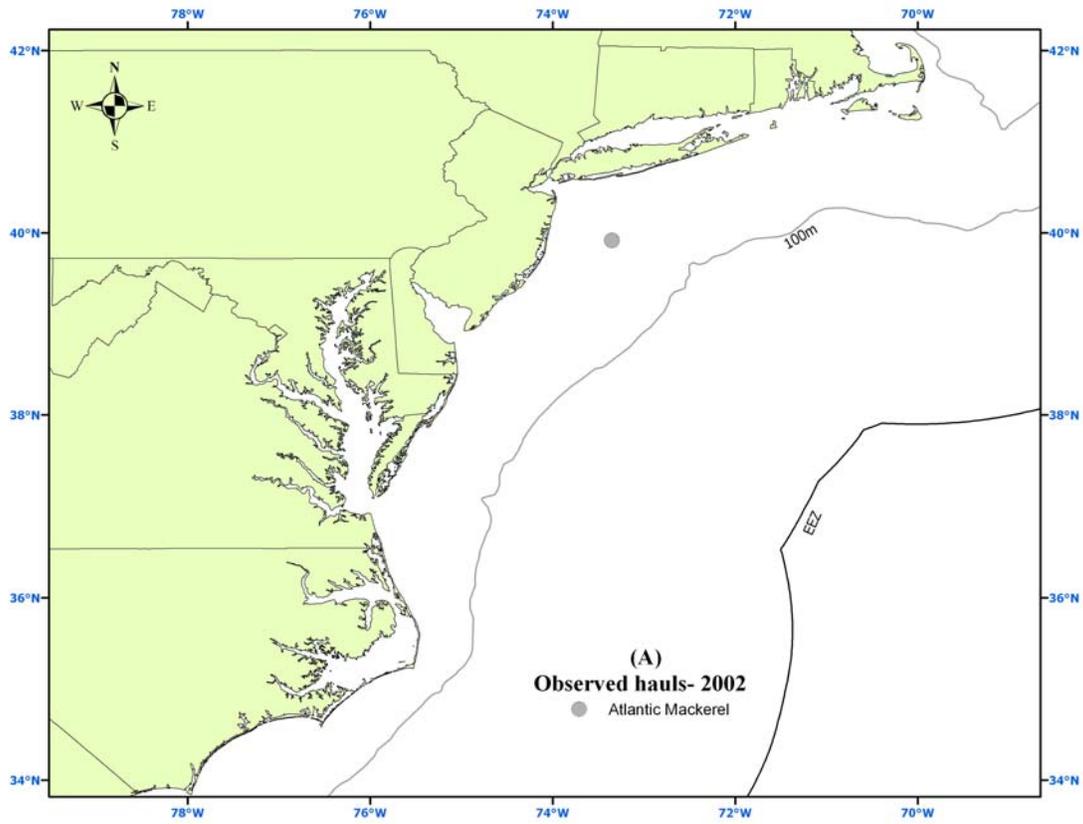
Figure 27. 2003 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

(A)
Observed hauls- 2003
▪ Atlantic Herring
● Atlantic Mackerel
▲ Mixed Finfish

(B)
No observed incidental takes in 2003
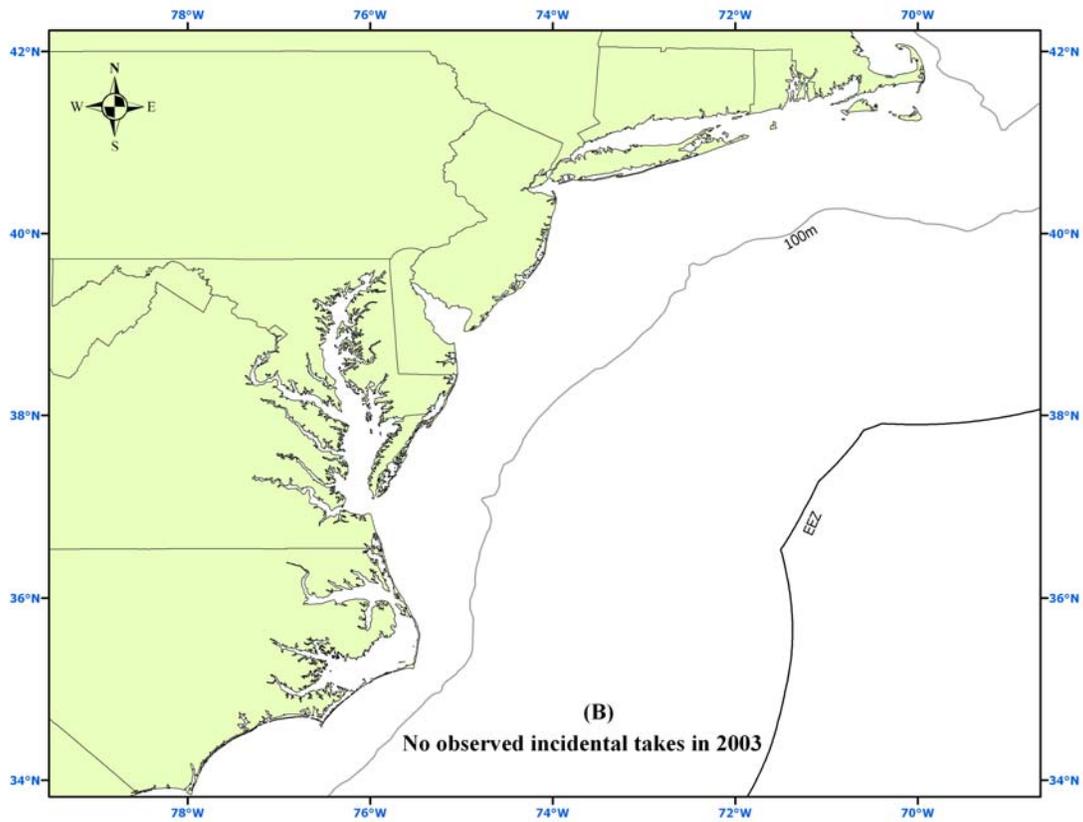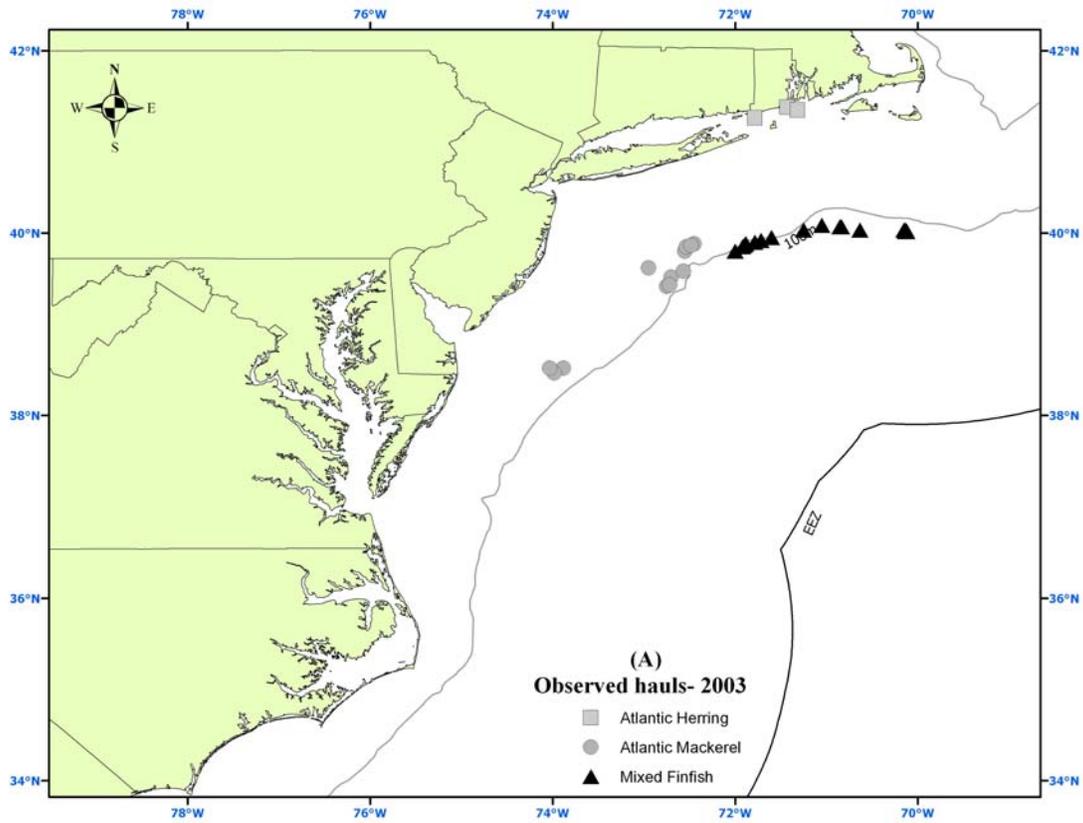
Figure 28. 2004 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

(A)
Observed hauls- 2004
- ■ Atlantic Herring
- ● Atlantic Mackerel
- ▲ Long-finned Squid
- △ Short-finned Squid

(B)
Observed incidental takes - 2004
- ● unknown dolphin
- ■ white-sided dolphin
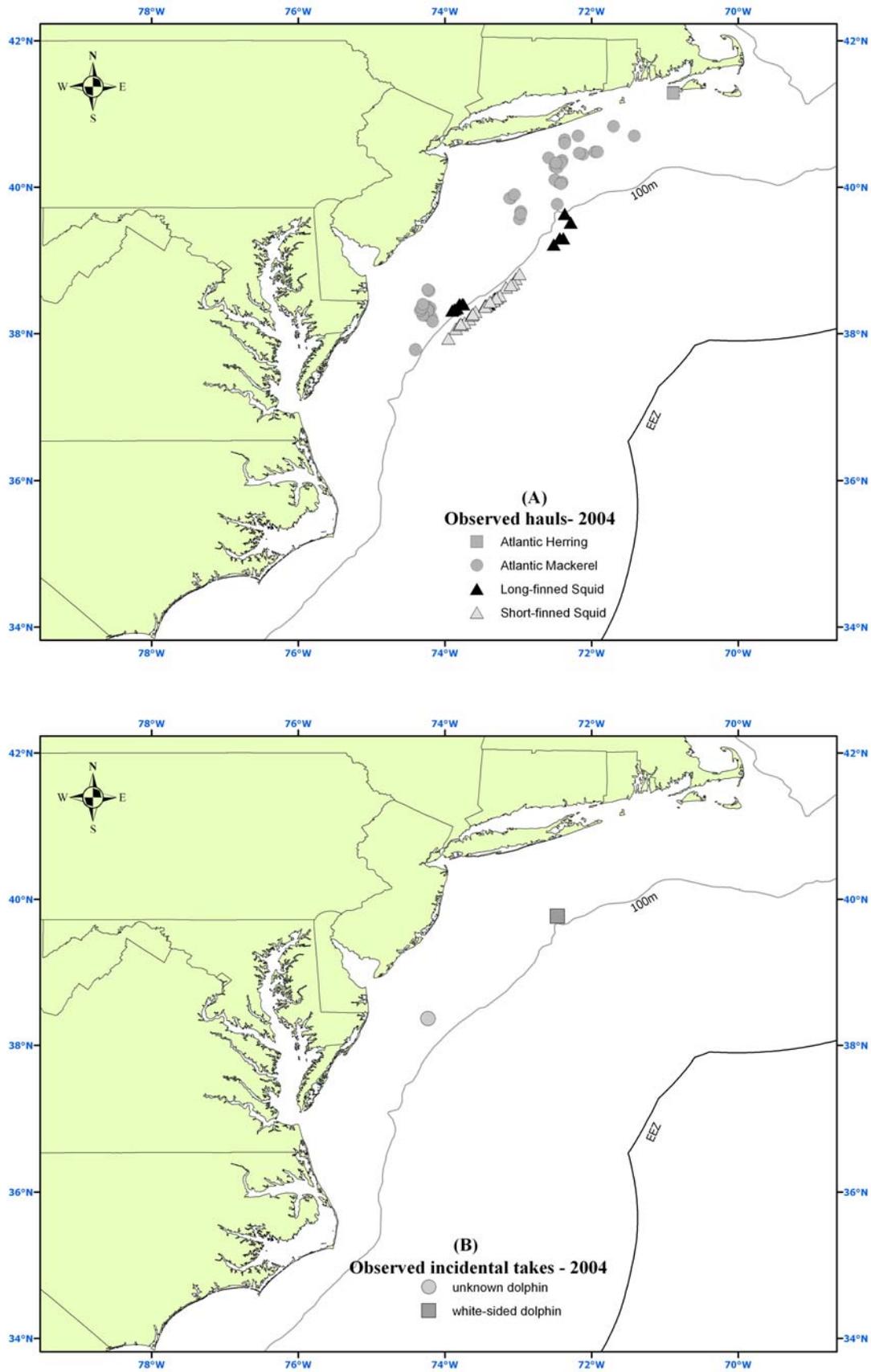
Figure 29. 2005 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

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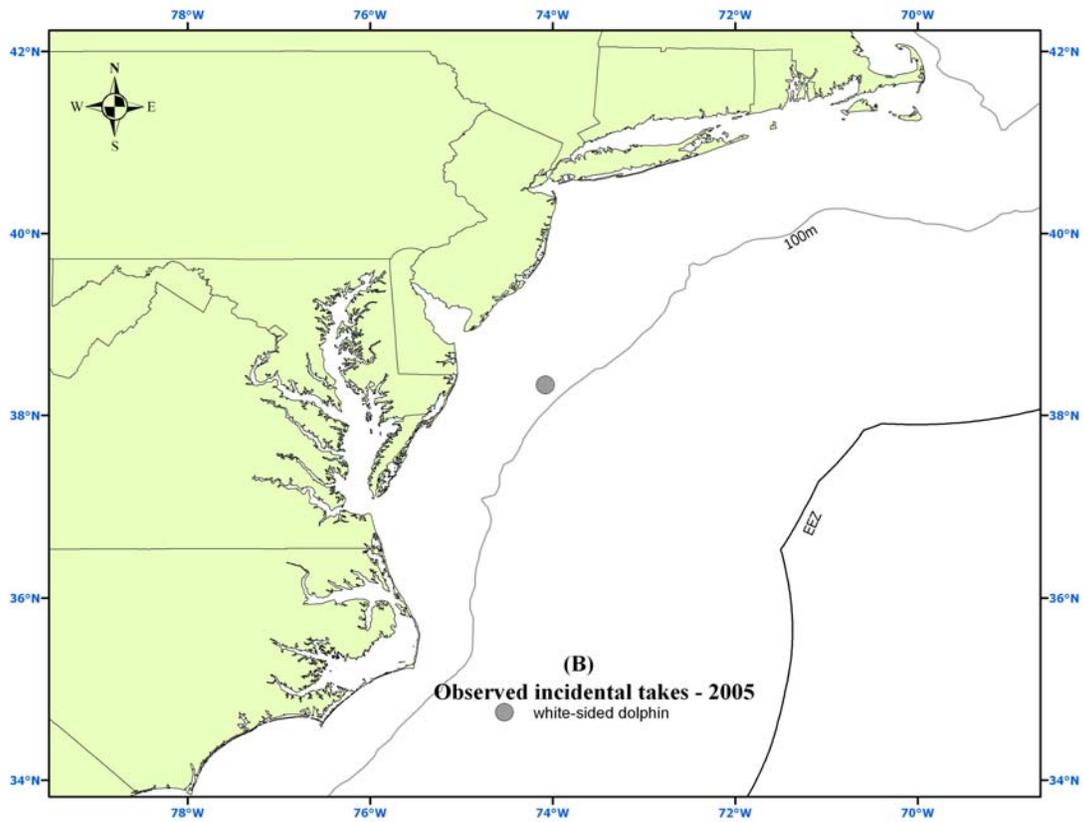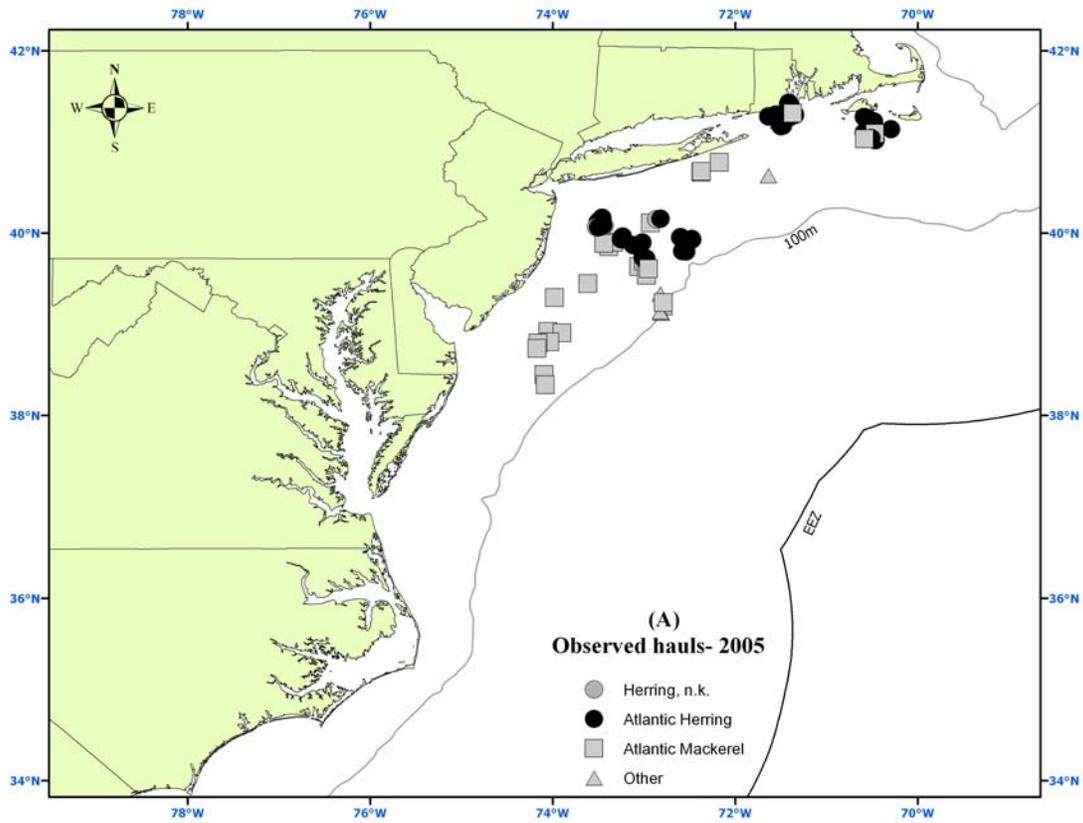
Figure 30. 2006 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).
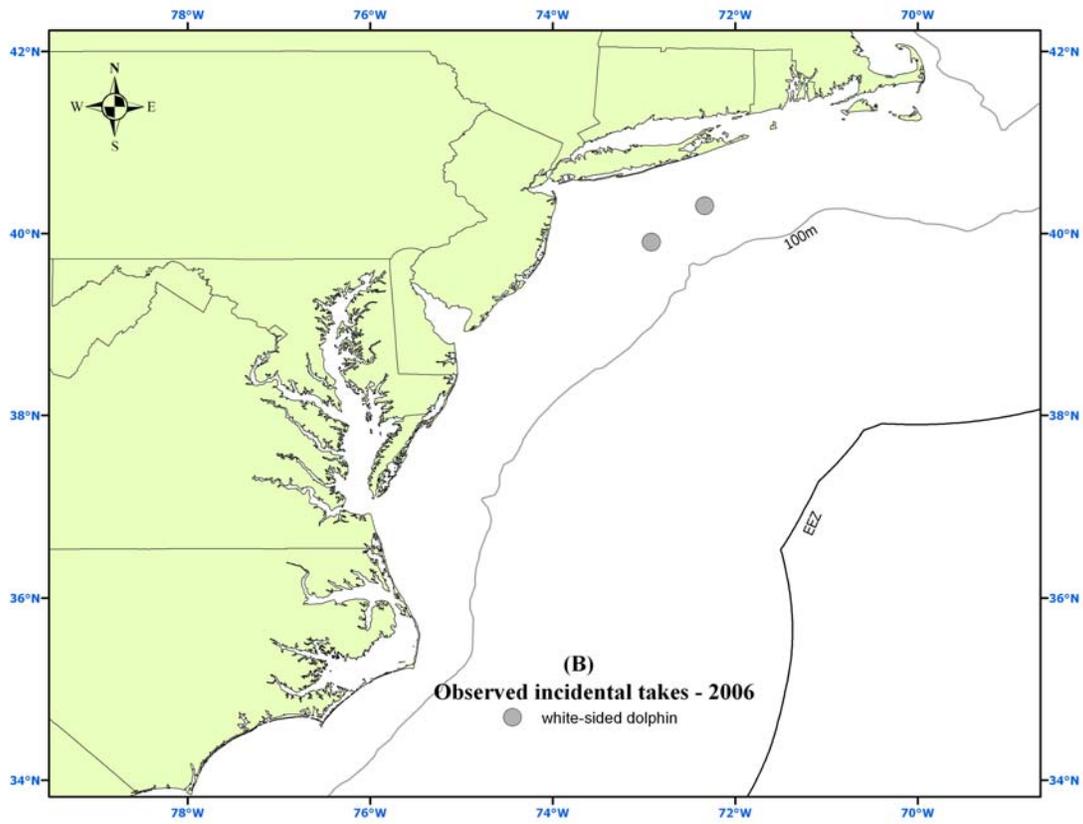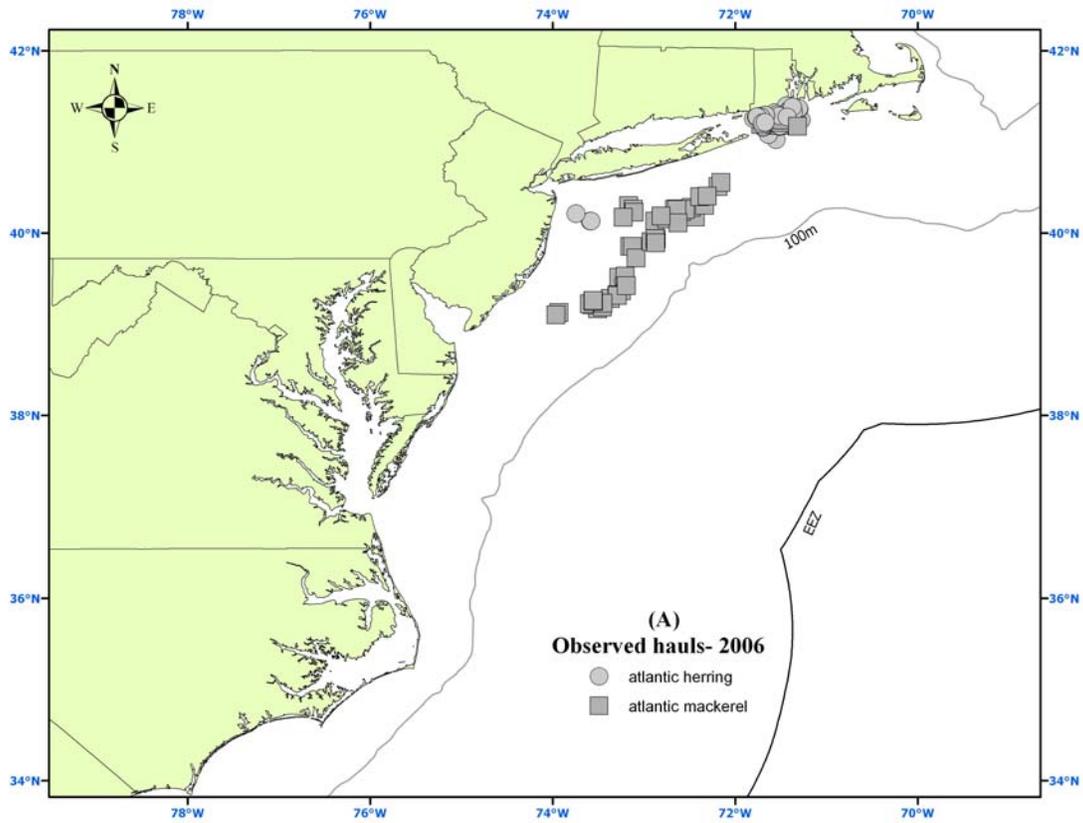
Figure 31. 2002 Herring Purse Seine observed hauls (A) and observed takes (B).

(A)
No observed hauls - 2002

(B)
No observed incidental takes - 2002
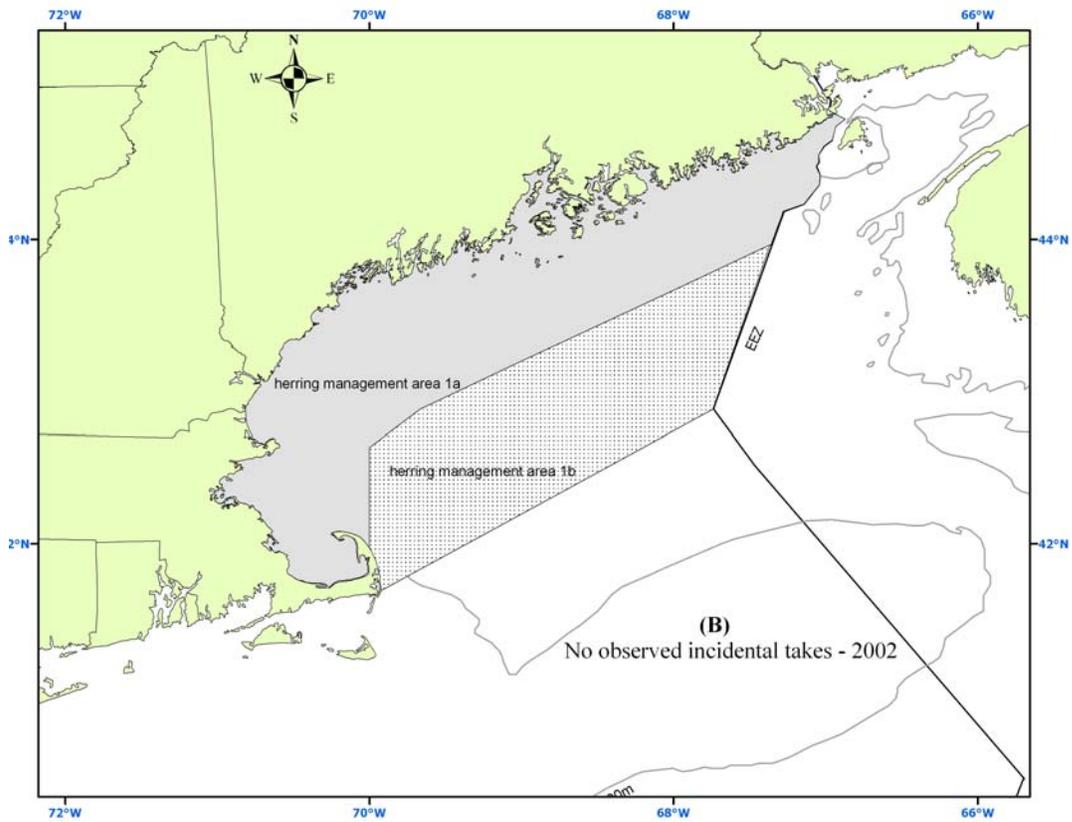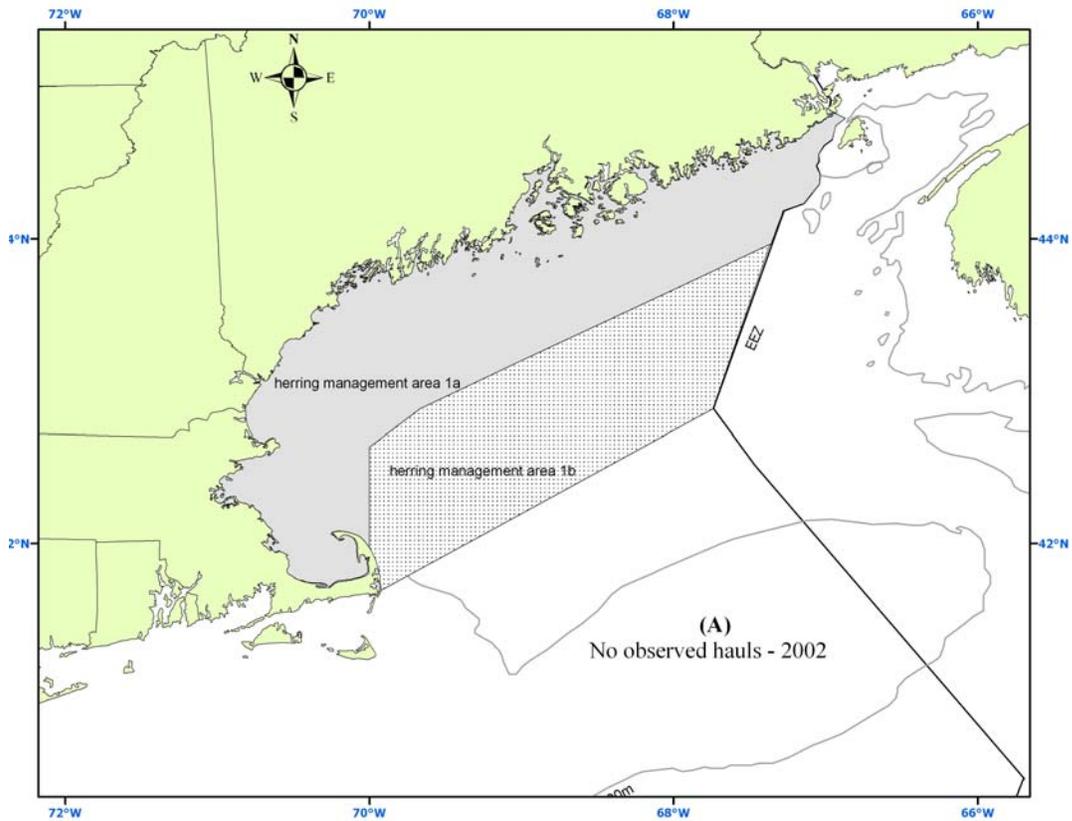
Figure 32. 2003 Herring Purse Seine observed hauls (A) and observed takes (B).

(A)
Observed hauls - 2003

(B)
No observed incidental takes - 2003
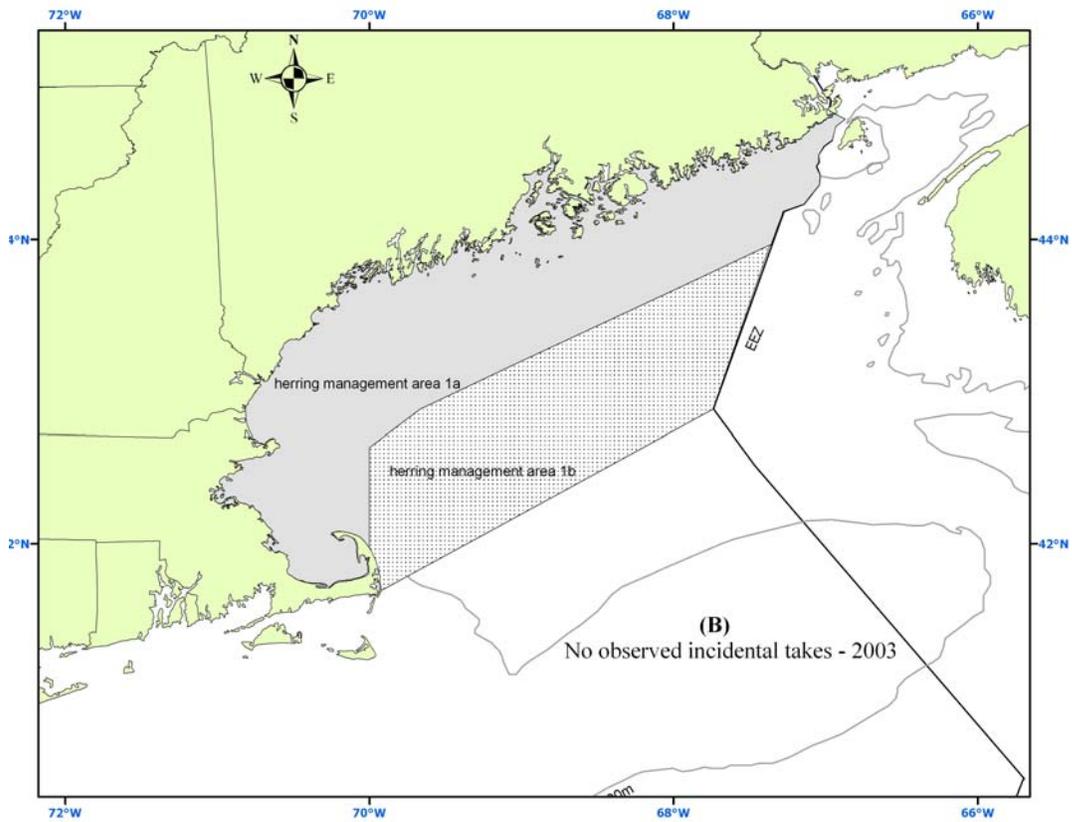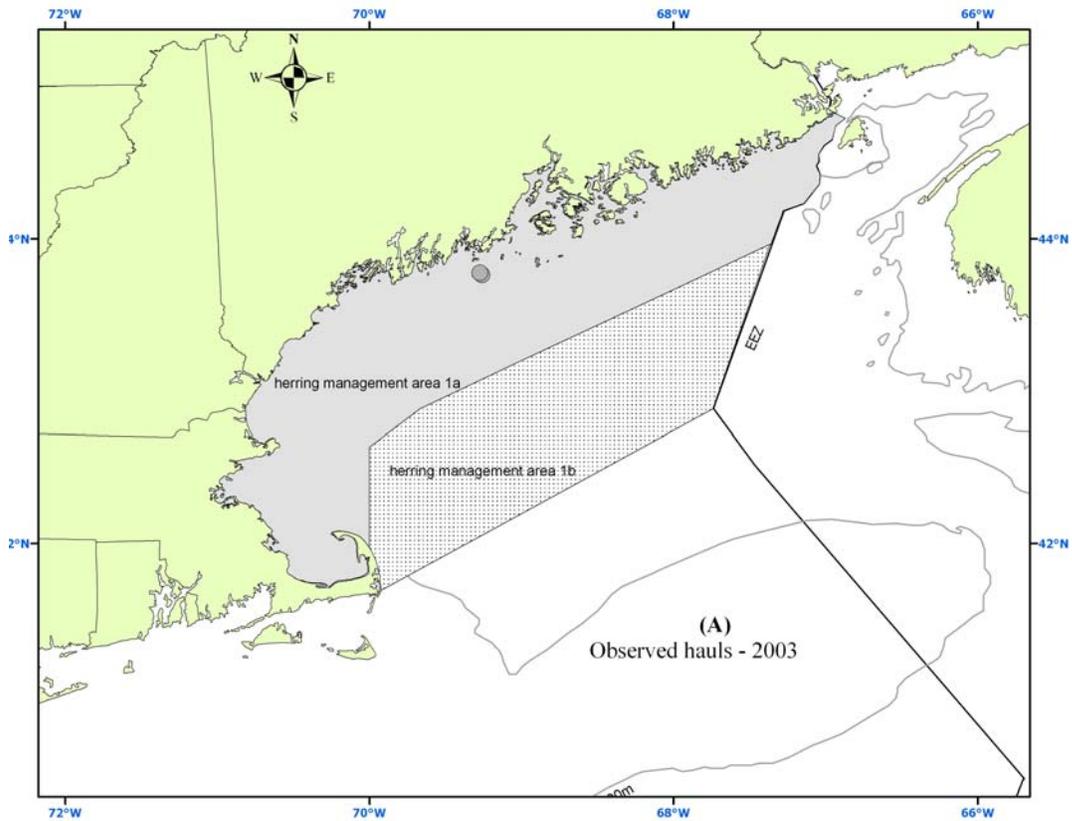
Figure 33. 2004 Herring Purse Seine observed hauls (A) and observed takes (B).

(A)
Observed hauls - 2004

(B)
Observed incidental takes - 2004
● Unknown Seal
■ Harbor Seal
☆ Gray Seal
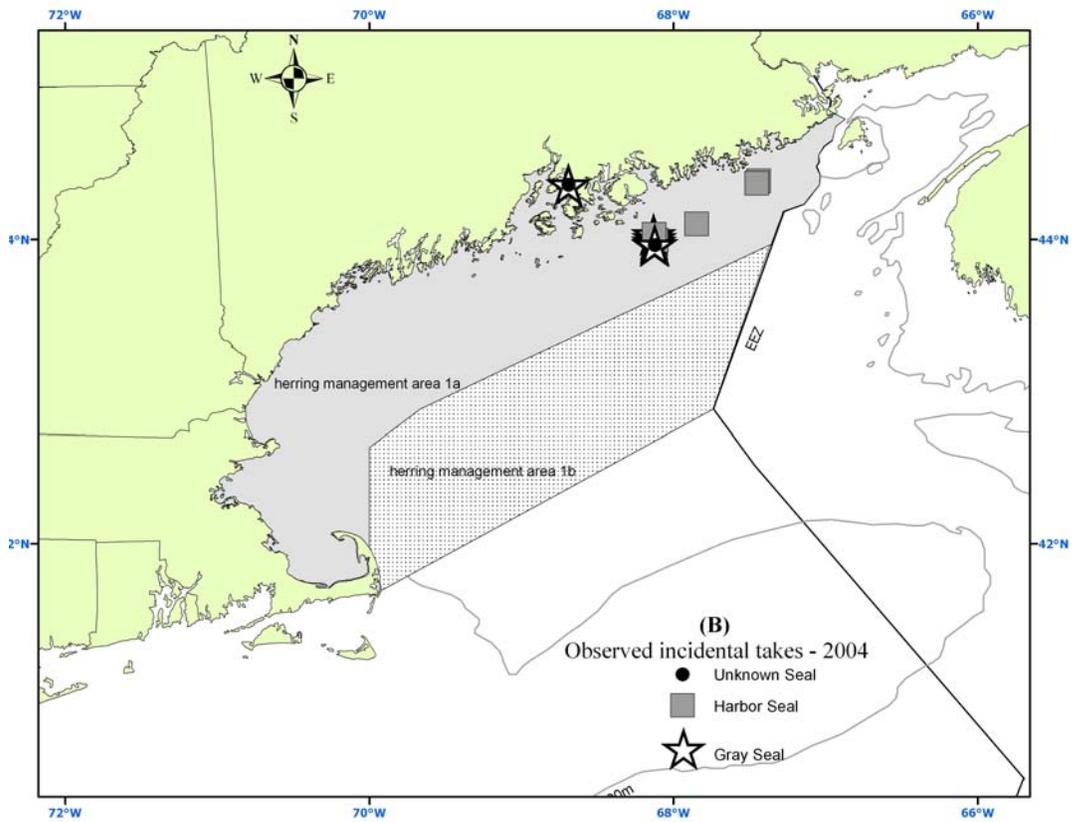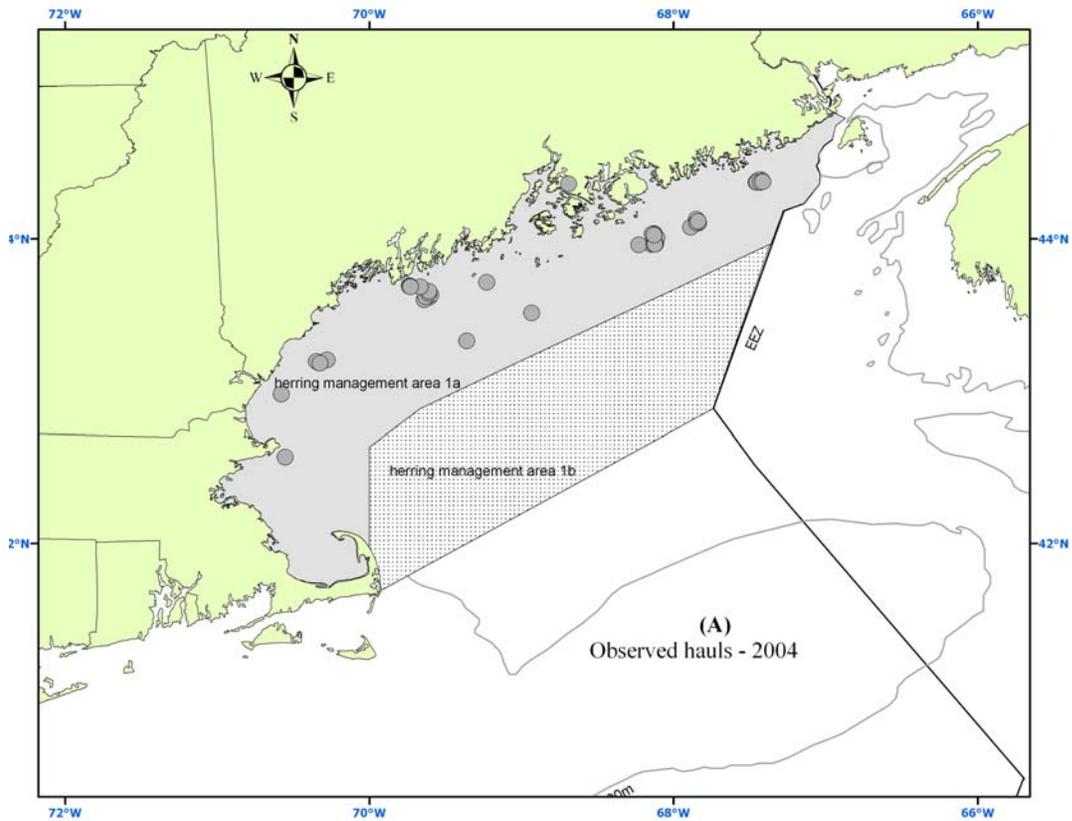
Figure 34. 2005 Herring Purse Seine observed hauls (A) and observed takes (B).

(A)
Observed hauls - 2005

(B)
Observed incidental takes - 2005

- ● Unknown Seal
- ■ Harbor Seal
- ☆ Gray Seal
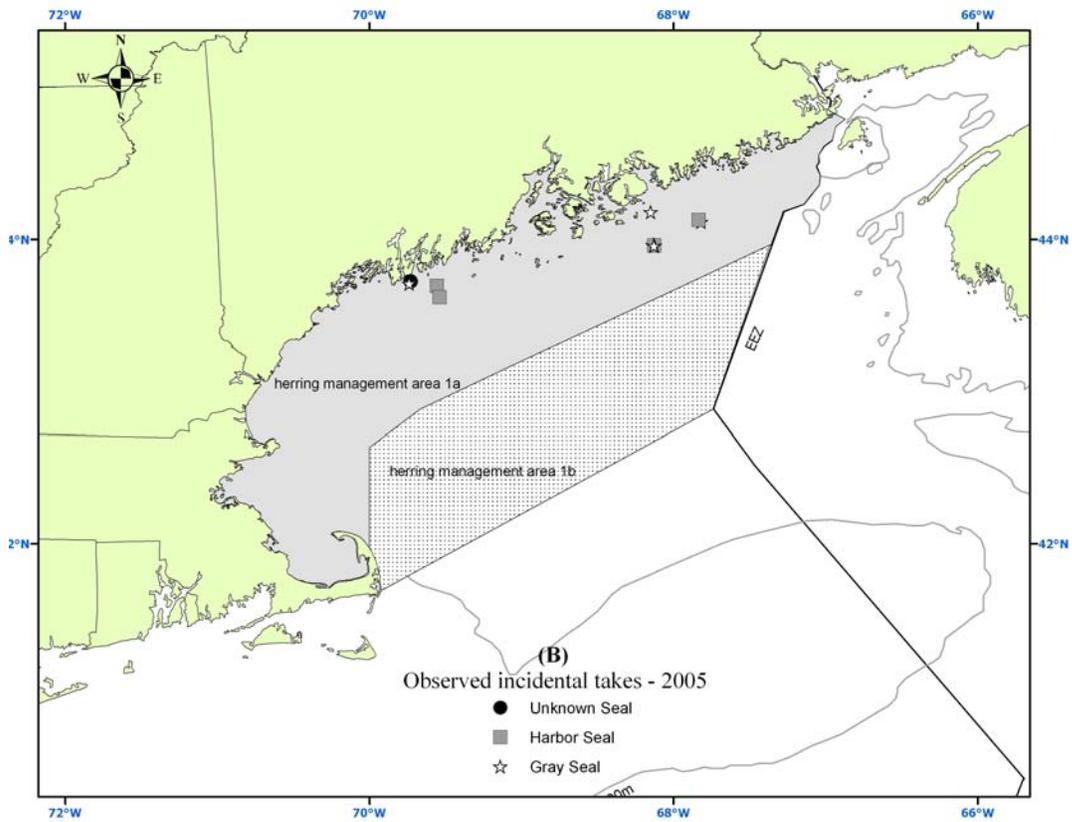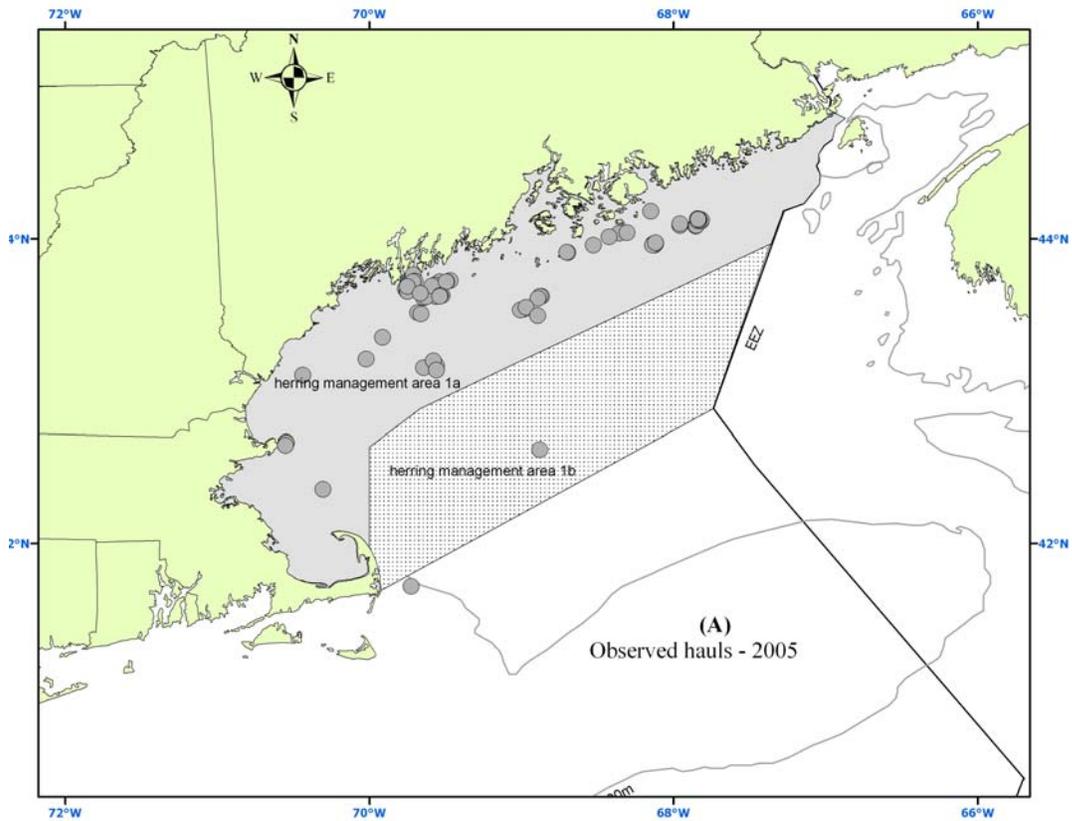
Figure 35. 2006 Herring Purse Seine observed hauls (A) and observed takes (B).
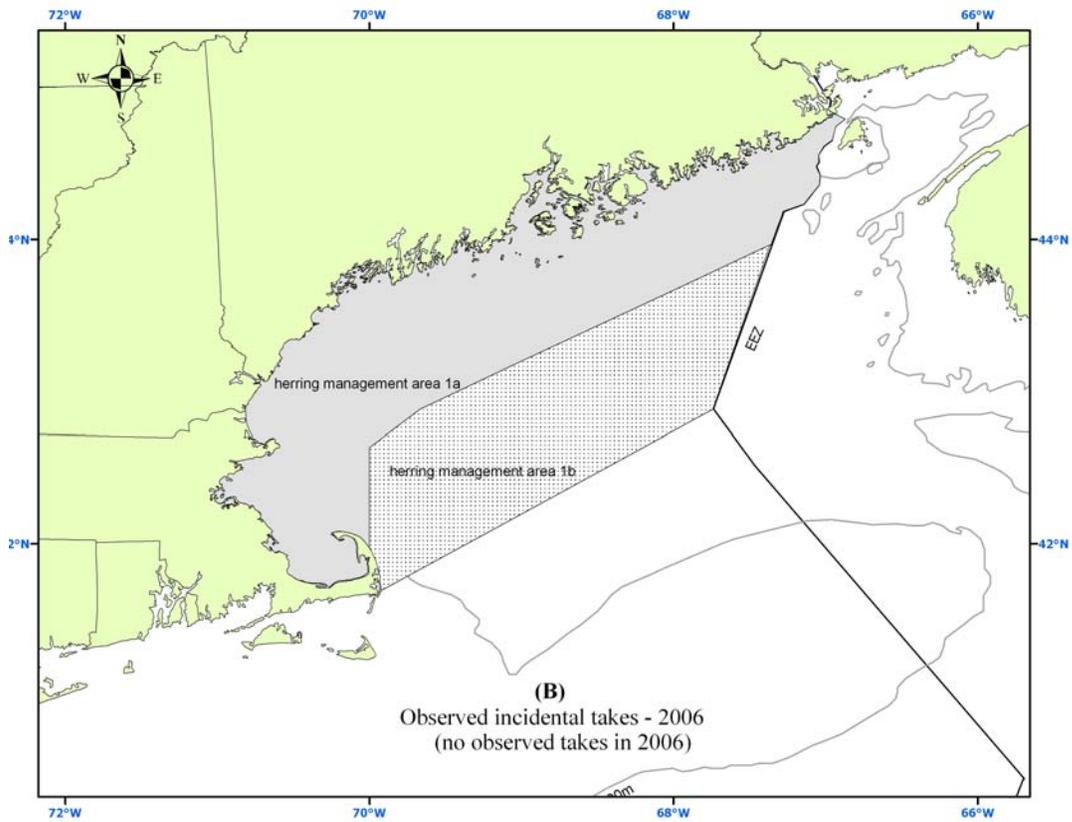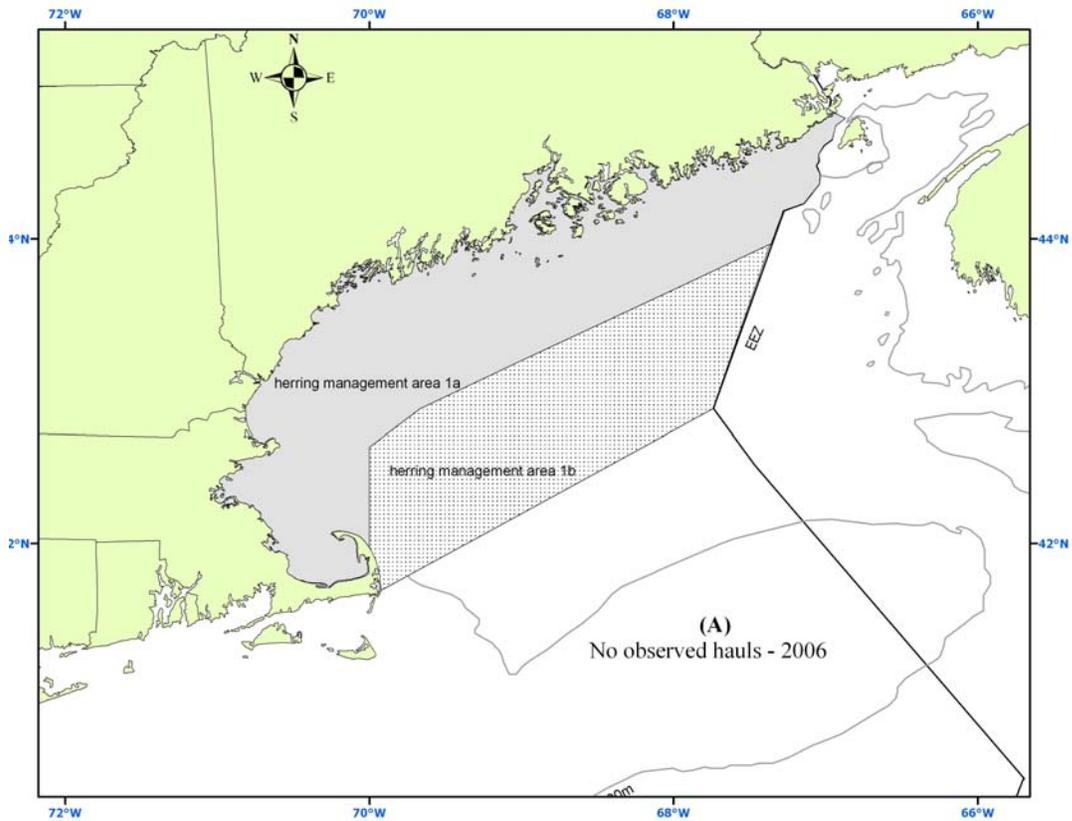
Figure 36. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2002. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.
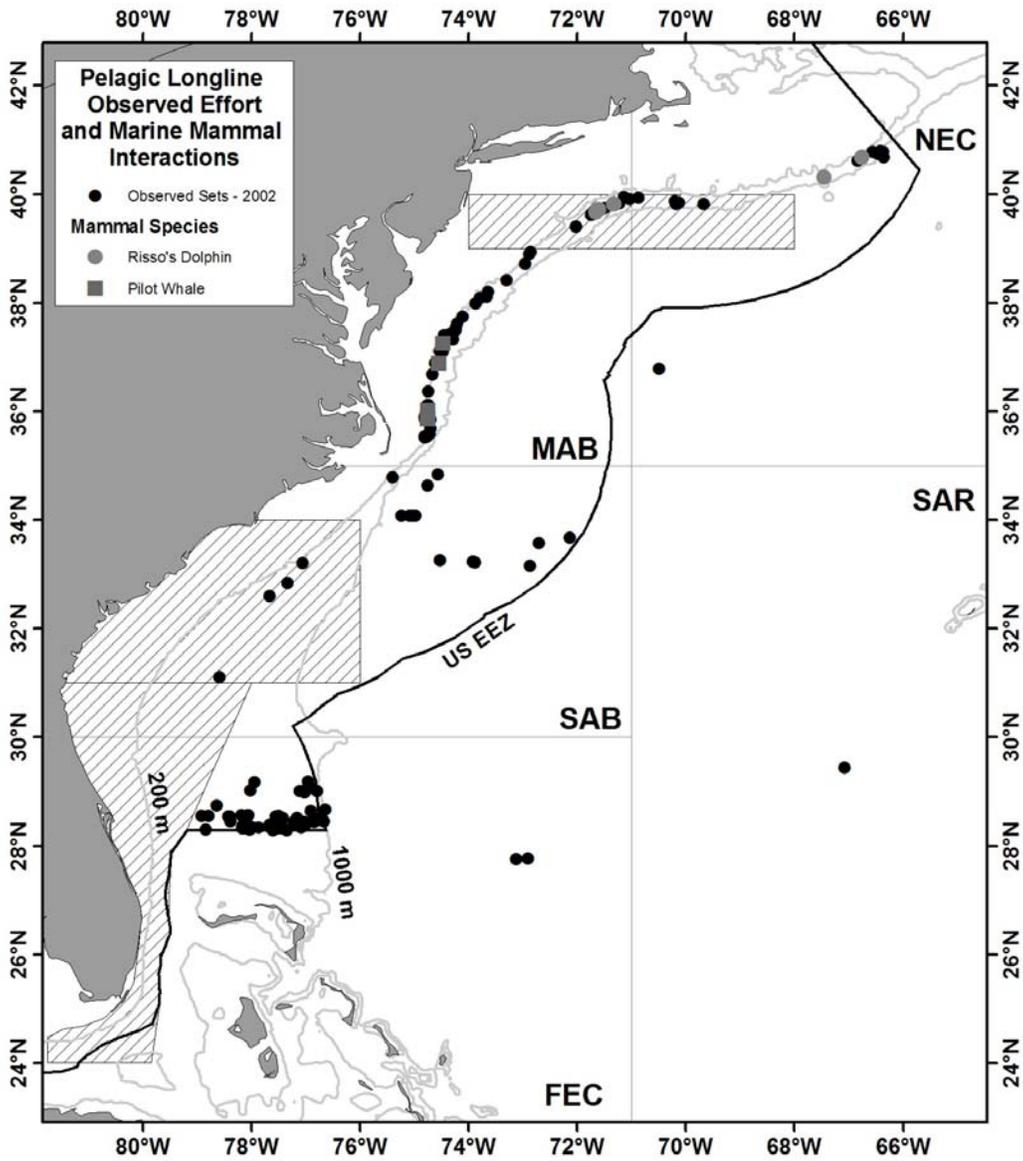
Figure 37. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2003. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.
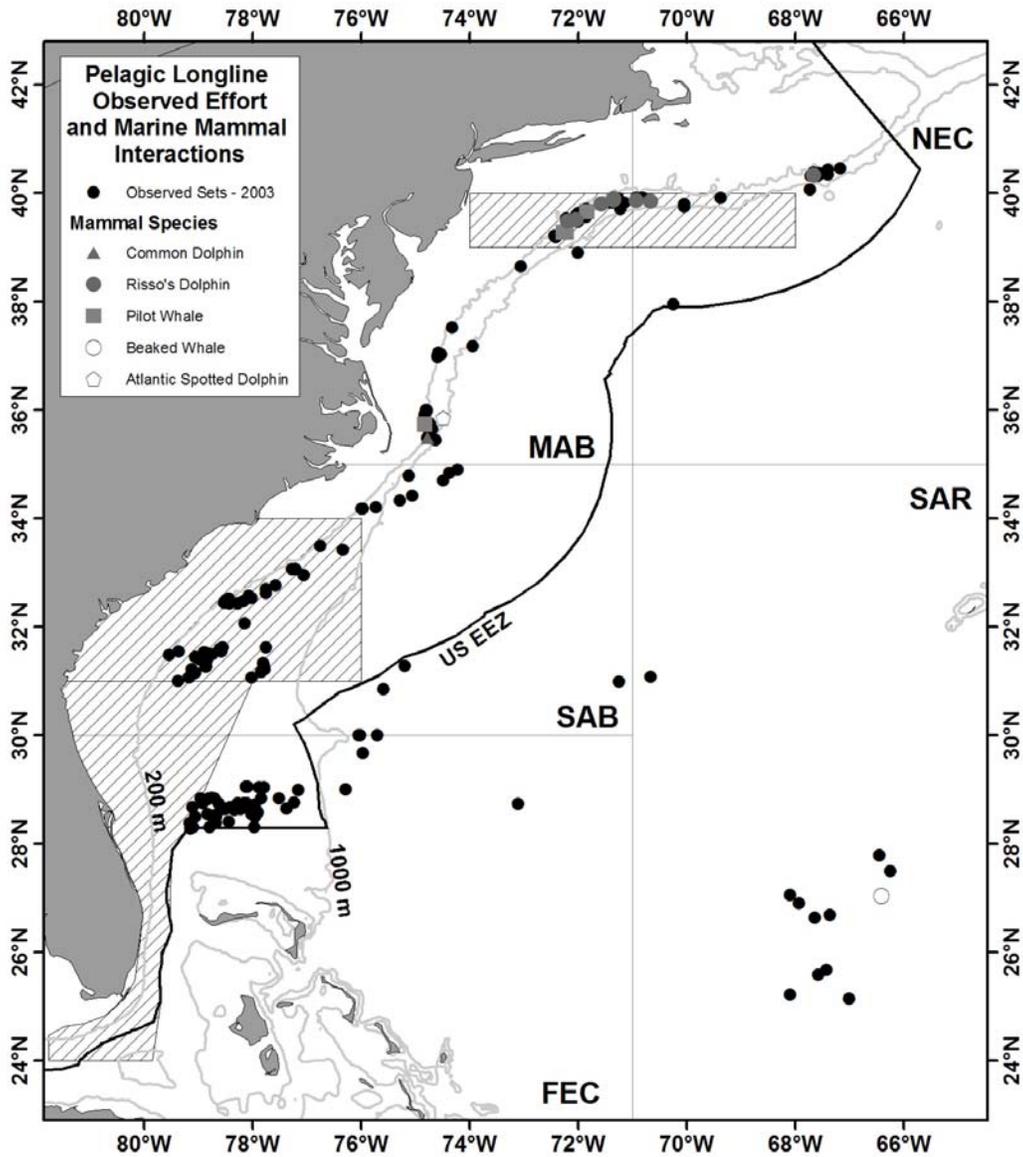
Figure 38. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2004. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.
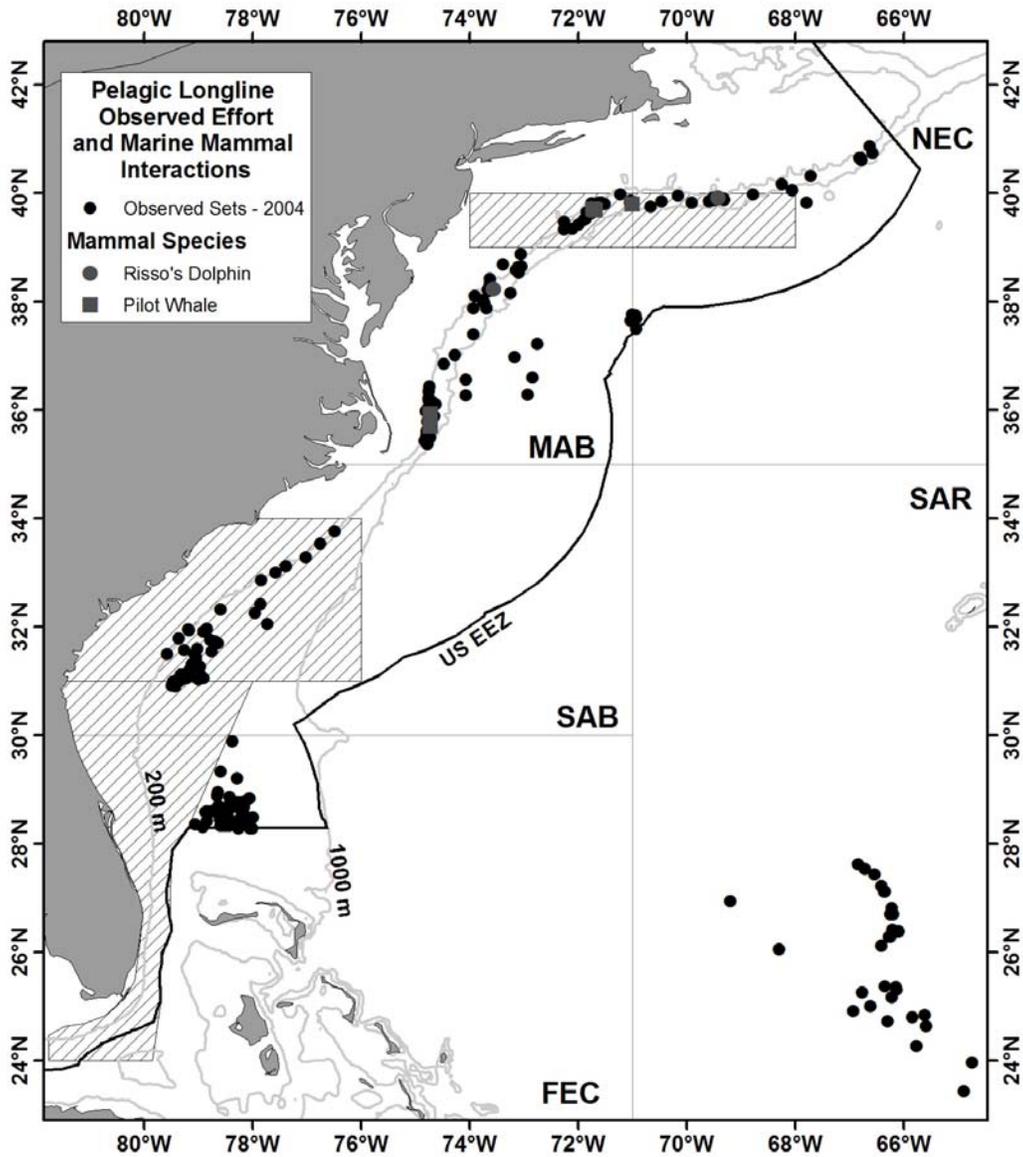
Figure 39. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2005. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.
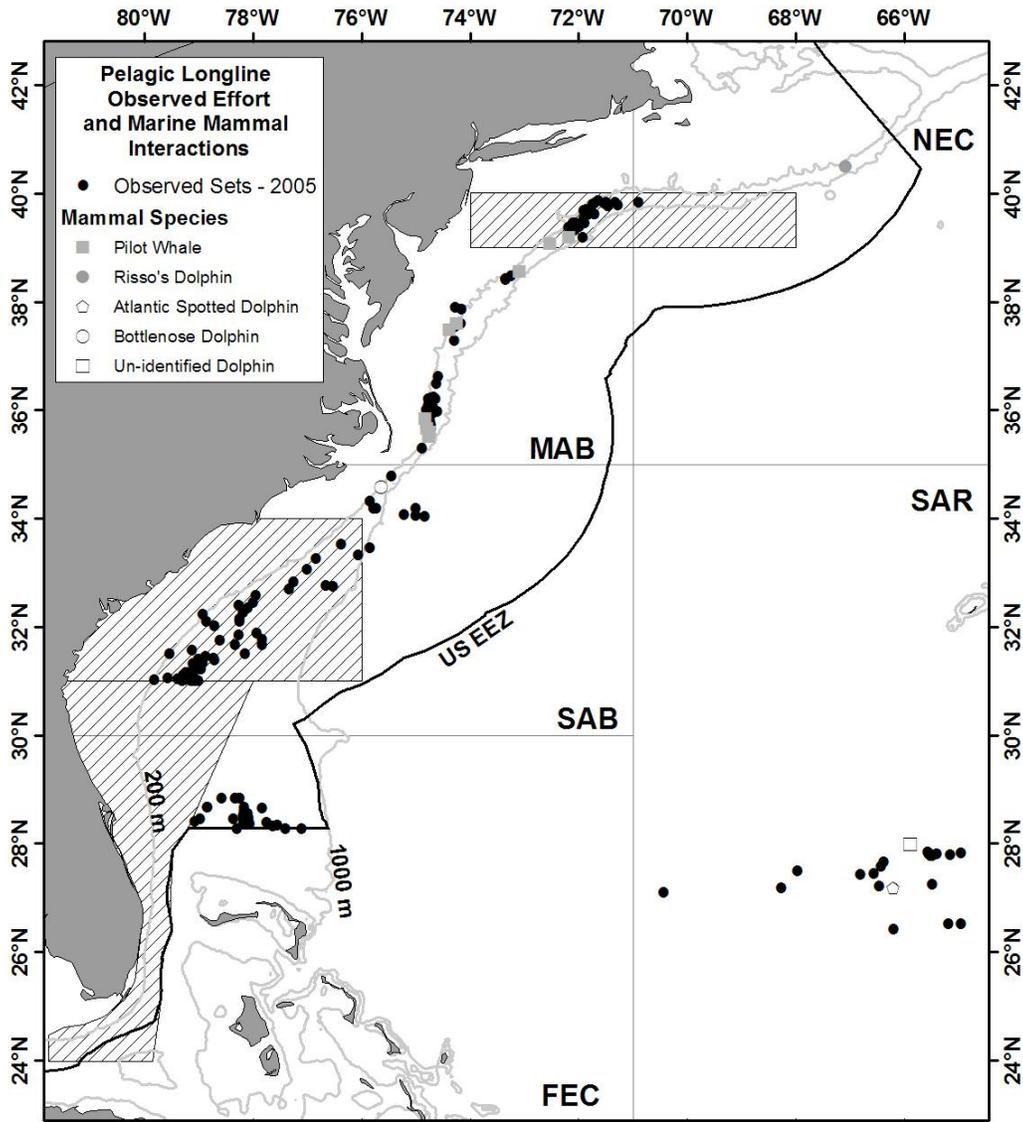
Figure 40. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2006. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.
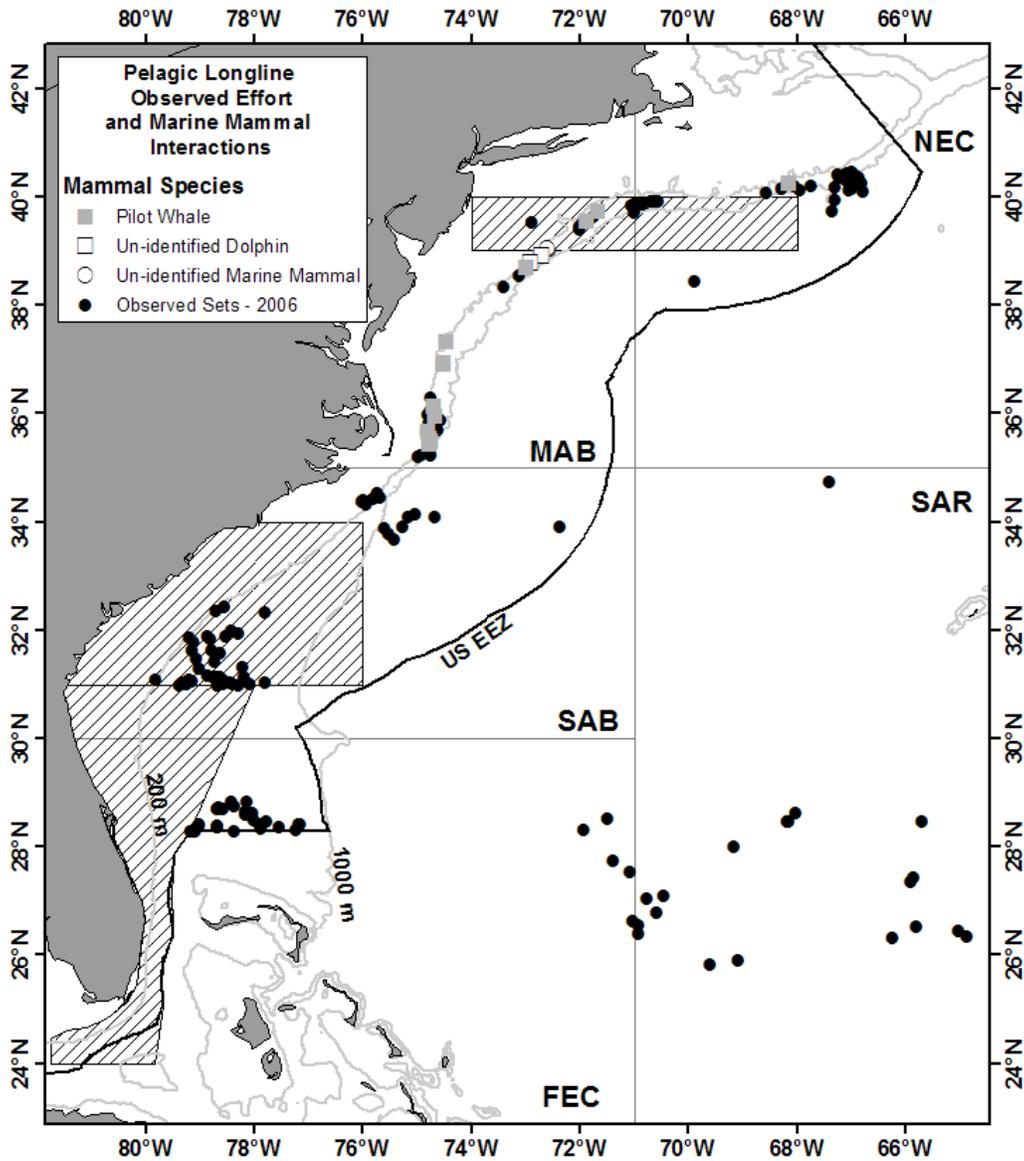
Figure 41. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2002. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown.
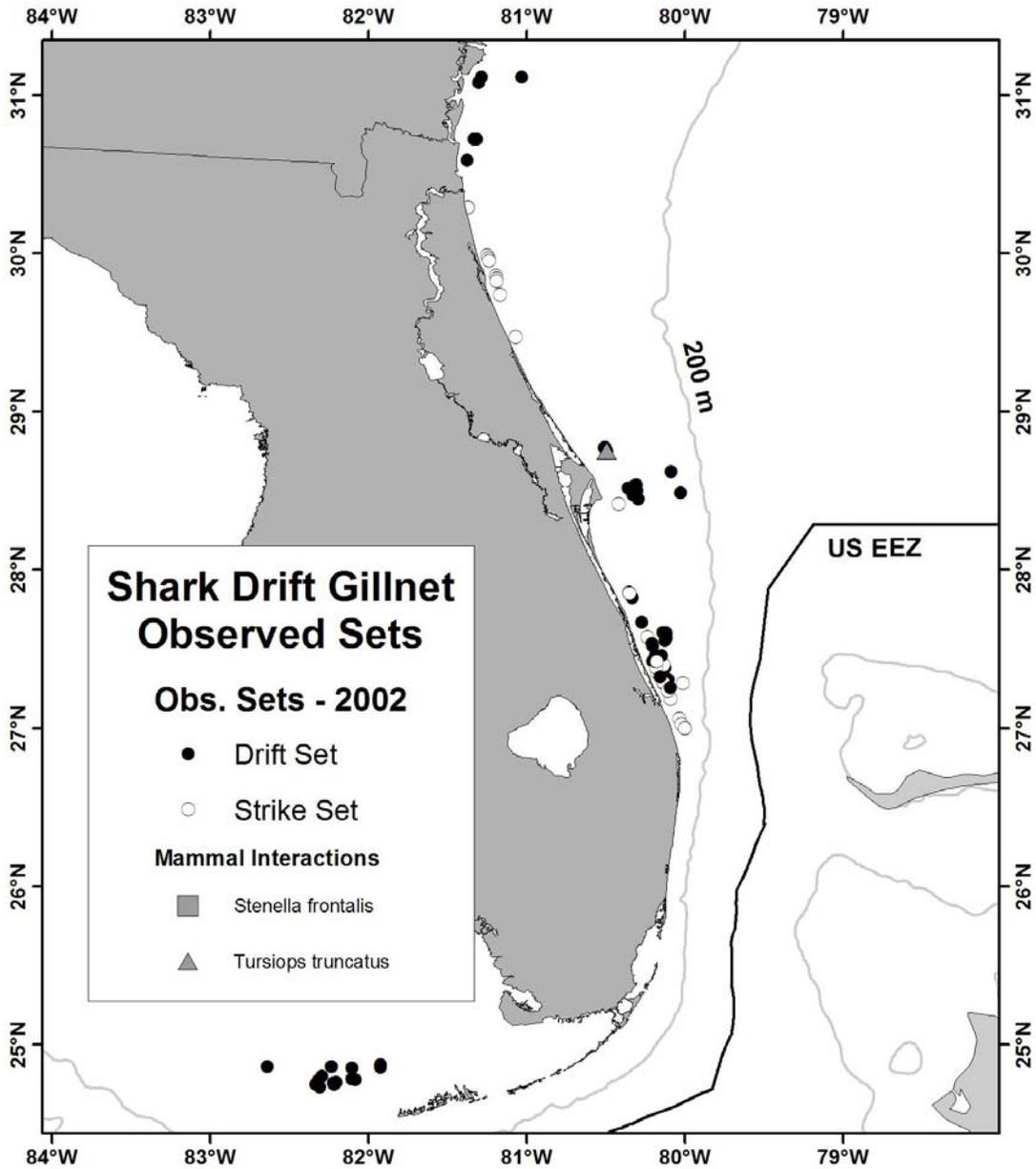
Figure 42. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2003. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown.
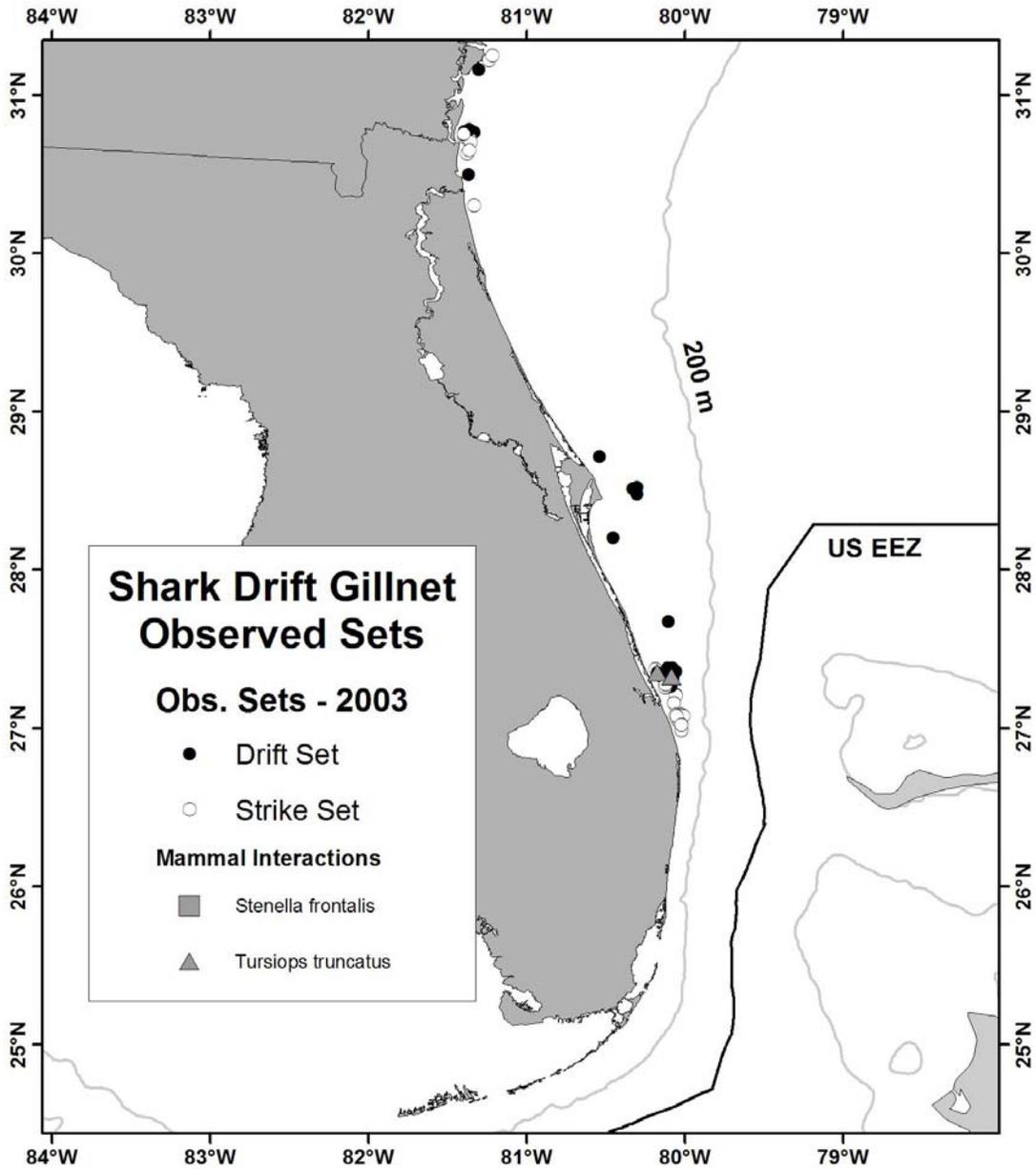
Figure 43. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2004. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown. No interactions with marine mammals were observed.
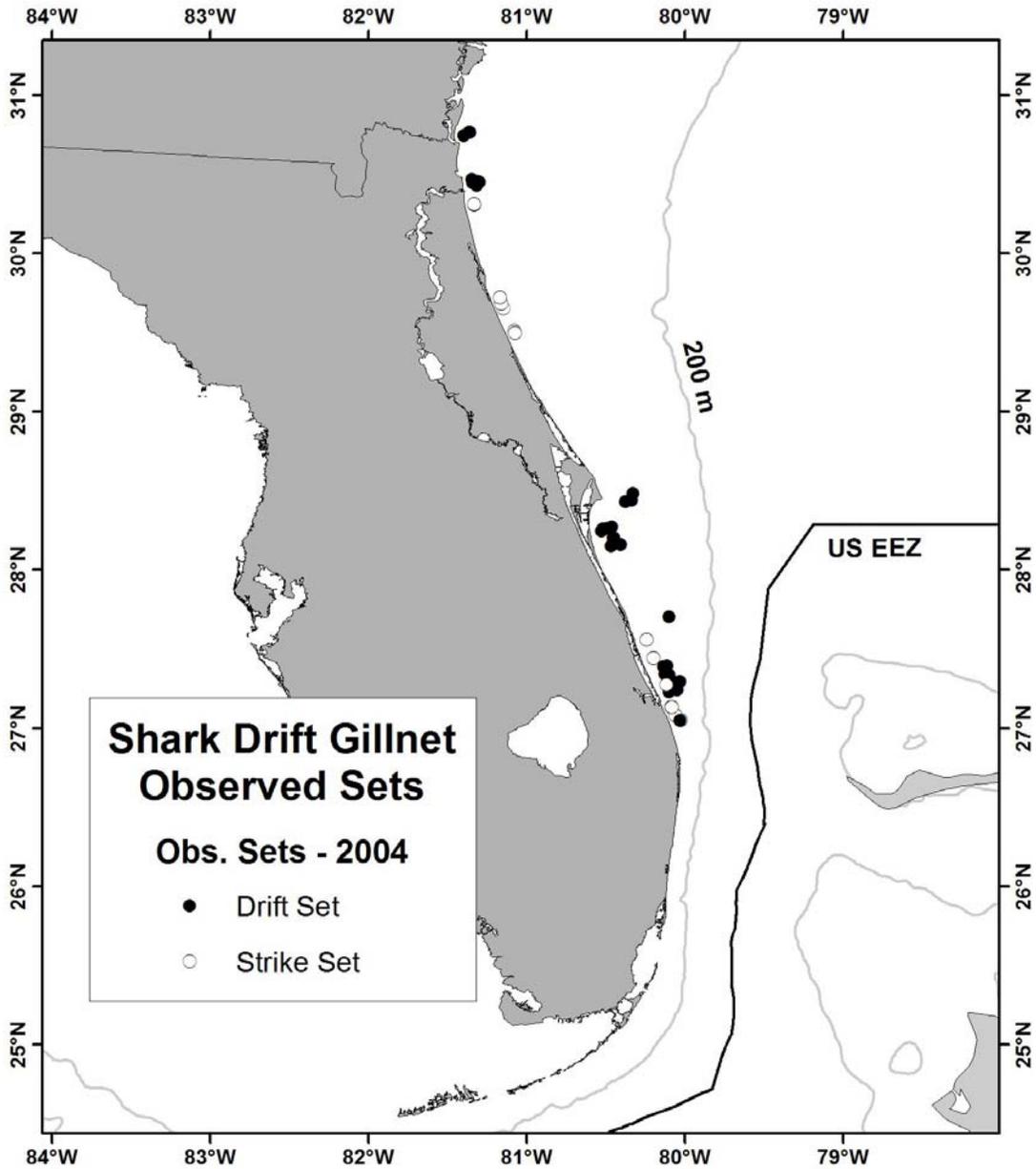
Figure 44. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2005. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown. No interactions with marine mammals were observed.
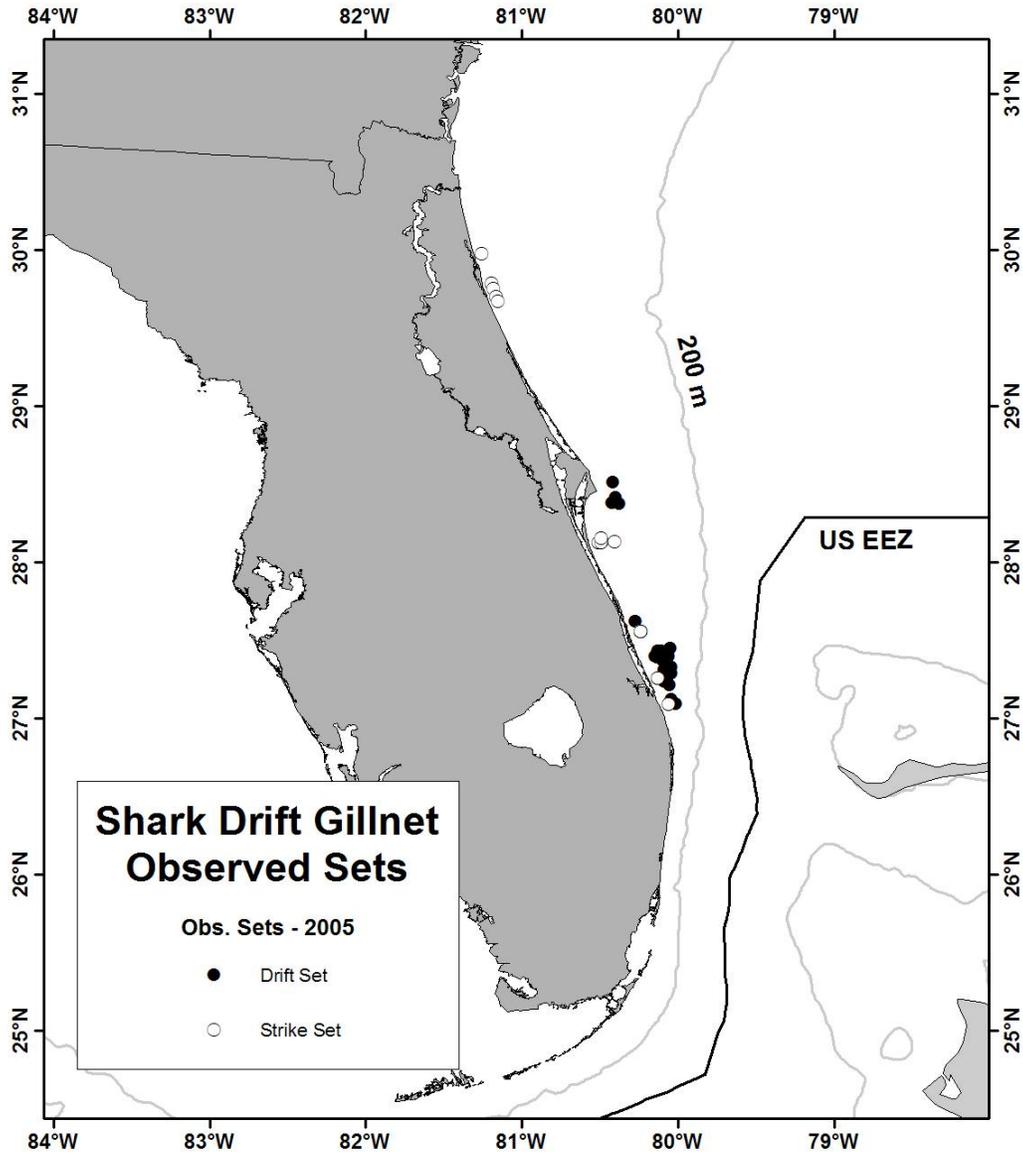
Figure 45. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2006. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Drift, strike, and sink gillnet sets by observed vessels are shown. No interactions with marine mammals were observed.
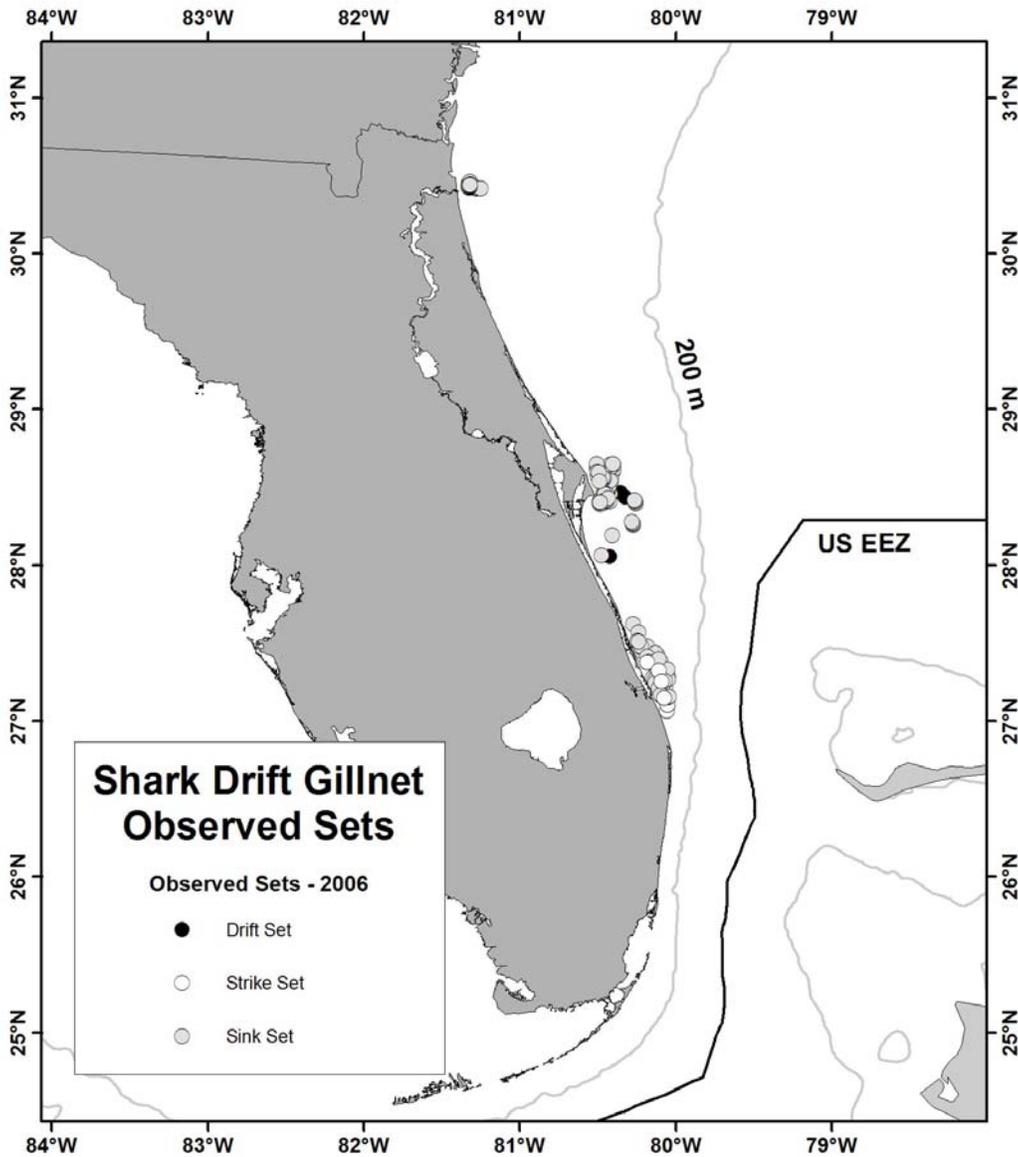
Figure 46. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2002. No marine mammal interactions were observed. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.
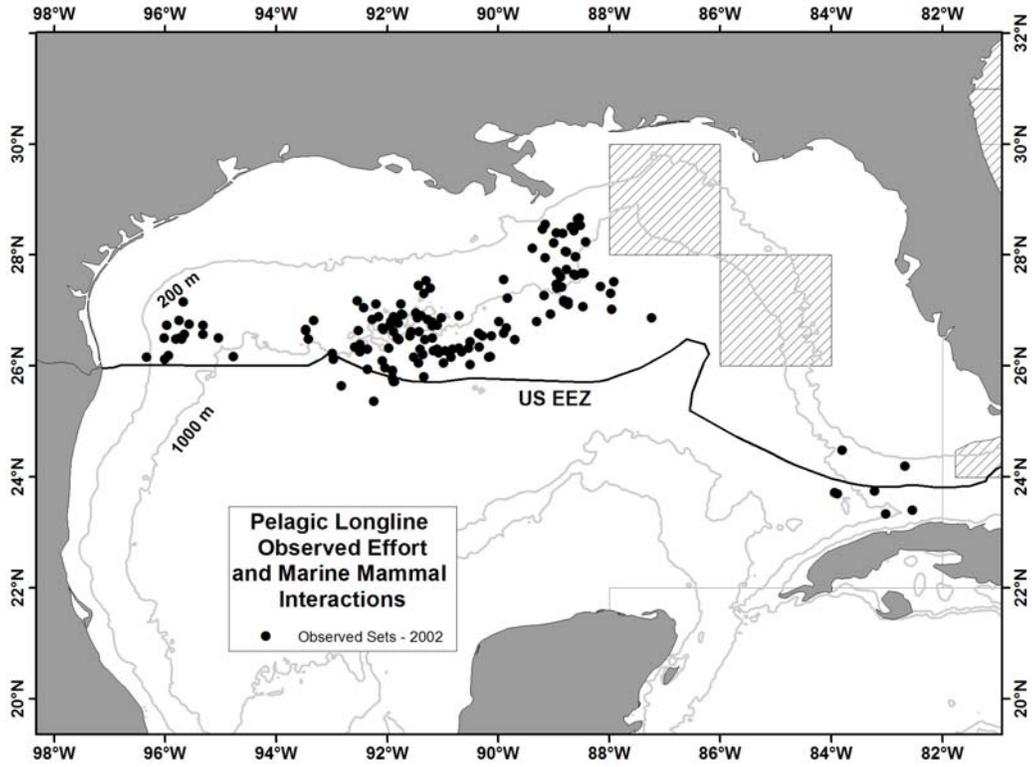
Figure 47. Observed sets and marine mammal interactions in the Pelagic longline fishery in the Gulf of Mexico during 2003. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.
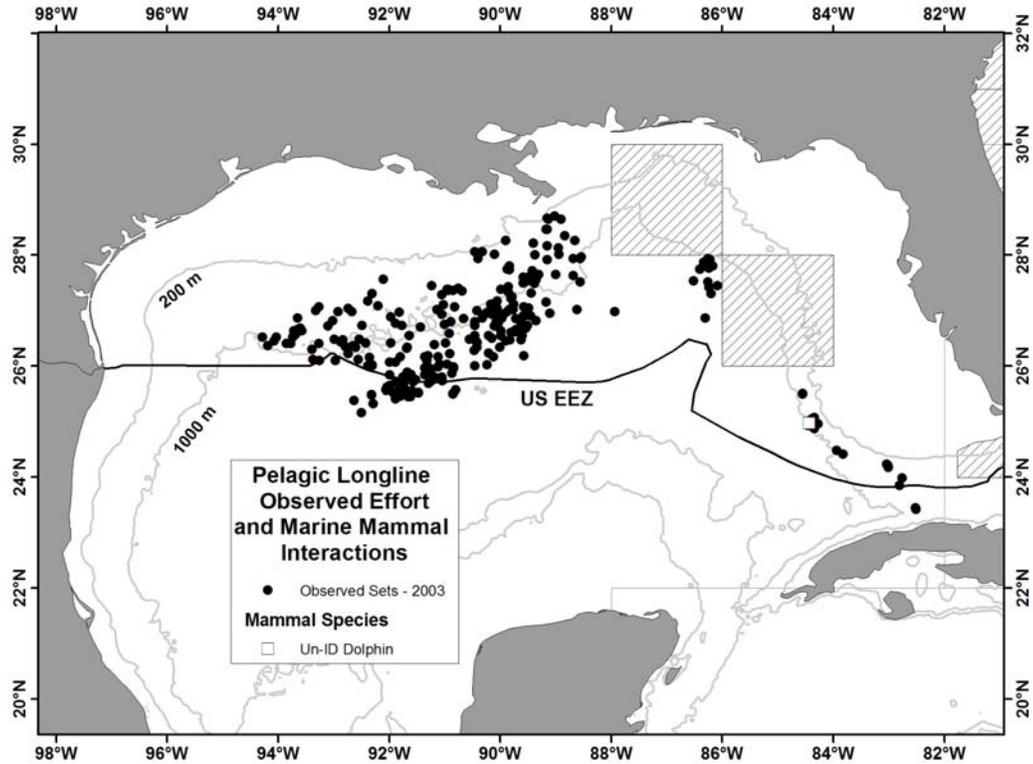
Figure 48. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2004. No marine mammal interactions were observed. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.
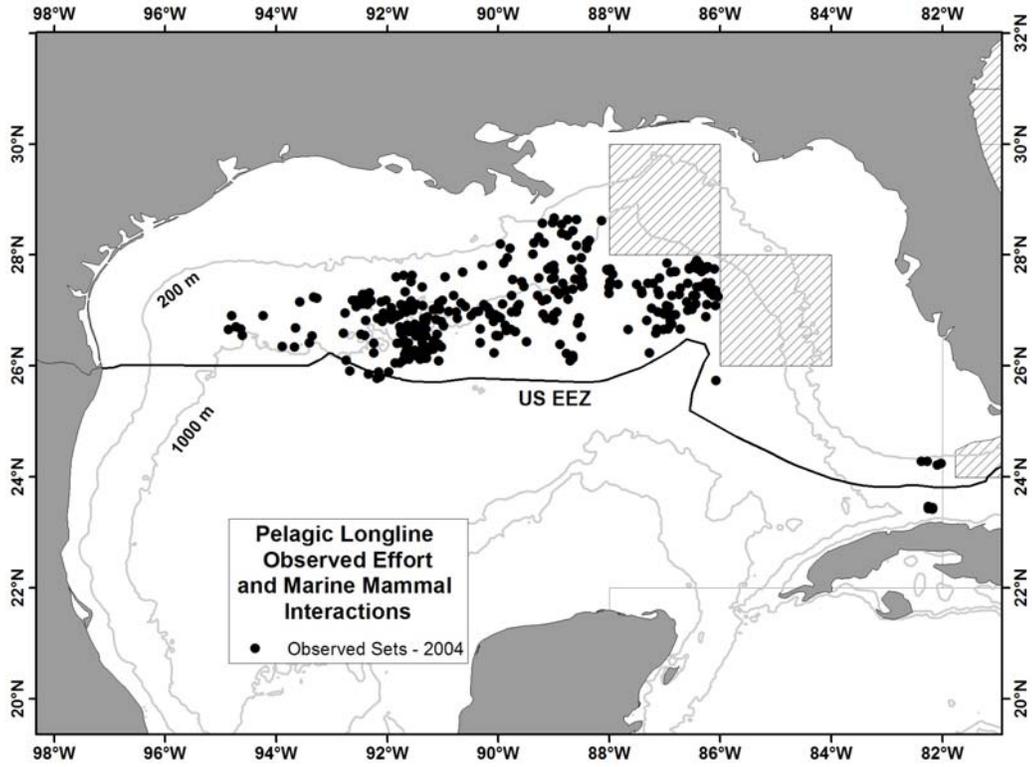
Figure 49. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2005. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.
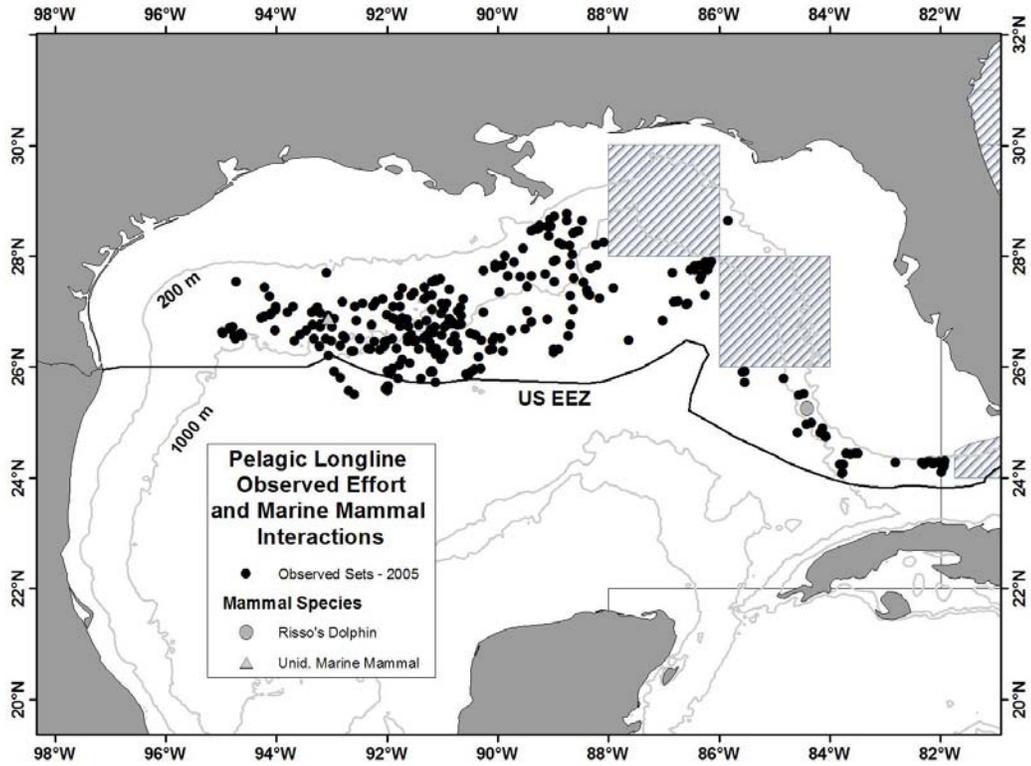
Figure 50. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2006. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.
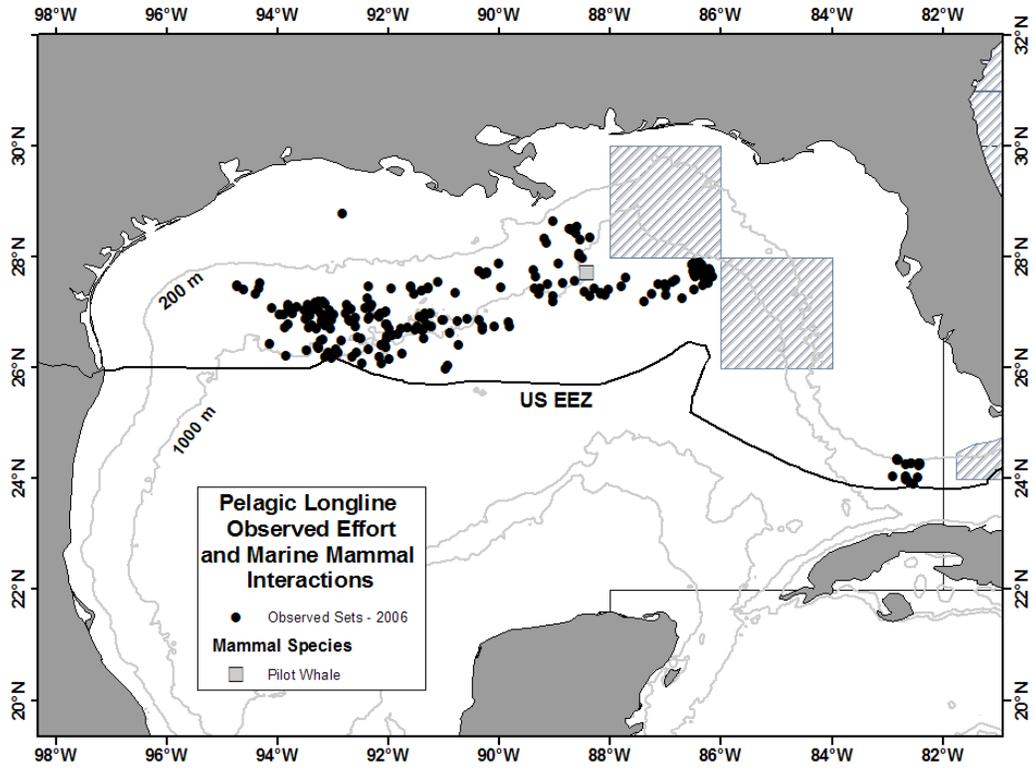
APPENDIX IV: Reports not updated in 2008

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-latitude waters. Blue whales are most frequently sighted in the waters off eastern Canada, with the majority of recent records from the Gulf of St. Lawrence (Sears *et al.* 1987). The species was hunted around Newfoundland in the first half of the 20th century (Sergeant 1966). The present Canadian distribution, broadly described, is spring, summer, and fall in the Gulf of St. Lawrence, especially along the north shore from the St. Lawrence River estuary to the Strait of Belle Isle and off eastern Nova Scotia. The species occurs in winter off southern Newfoundland and also in summer in Davis Strait (Mansfield 1985). Individual identification has confirmed the movement of a blue whale between the Gulf of St. Lawrence and western Greenland (R. Sears and F. Larsen, unpublished data), although the extent of exchange between these two areas remains unknown. Similarly, a blue whale photographed by a NMFS large whale survey in August 1999 had previously been observed in the Gulf of St. Lawrence in 1985 (R. Sears and P. Clapham, unpublished data).

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

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

POPULATION SIZE

Little is known about the population size of blue whales except for in the Gulf of St. Lawrence area. Here, 308 individuals have been catalogued (Sears *et al.* 1987), but the data were deemed to be unusable for abundance estimation (Hammond *et al.* 1990). Mitchell (1974) estimated that the blue whale population in the western North Atlantic may number only in the low hundreds. R. Sears (pers. comm.) suggests that no present evidence exists to refute this estimate.

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 308. 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). However, the minimum population size figure given

above is now 14 years old and thus is not usable for the calculation of PBR (see Wade and Angliss 1997). Consequently, no PBR can be calculated for this stock because of lack of any data on current minimum population size.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
There are no confirmed records of mortality or serious injury to blue whales in the US Atlantic EEZ. However, in March 1998 a dead 20 m (66ft) male blue whale was brought into Rhode Island waters on the bow of a tanker. The cause of death was determined to be ship strike. Although it appears likely that the vessel concerned was responsible, the necropsy revealed some injuries that were difficult to explain in this context. The location of the strike was not determined; given the known rarity of blue whales in US Atlantic waters, and the vessel's port of origin (Antwerp), it seems reasonable to suppose that the whale died somewhere to the north of the US Atlantic EEZ.
However, this incident was used in calculating the total annual mortality rate of 0.2 used in the summary table on page 2.

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 US 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. This is a strategic stock because the blue whale is listed as an endangered species under the ESA. A Recovery Plan has been published (Reeves *et al.* 1998) and is in effect.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the sperm whale in the U.S. Exclusive Economic Zone (EEZ) occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Figure 1). Waring *et al.* (1993, 2001) 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. Atlantic 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 waters. 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 northwestern Atlantic population is discrete from northeastern Atlantic is currently unresolved. The International Whaling Commission recognizes one stock for the North Atlantic. Based on reviews of many types of stock studies, (i.e., tagging, genetics, catch data, mark-recapture, biochemical markers, etc.) Reeves and Whitehead (1997) and Dufault *et al.* (1999) suggest that sperm whale populations have no clear geographic structure. Recent ocean wide genetic studies (Lyrholm and Gyllensten 1998; Lyrholm *et al.* 1999) indicate low genetic diversity, but strong differentiation between potential social (matrilineally related) groups. Further, the ocean-wide findings, combined with observations from other studies, indicate stable social groups, site fidelity, and latitudinal range limitations in groups of females and juveniles (Whitehead 2002). In contrast, males migrate to polar regions to feed and return to more tropical waters to breed. There exists one tag return of a male tagged off Browns Bank (Nova Scotia) in 1966 and returned from Spain in 1973 (Mitchell 1975). Another male taken off northern Denmark in August 1981 had been wounded the previous summer by whalers off the Azores (Reeves and Whitehead 1997). In the U.S. Atlantic 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

Figure 1. *Distribution of sperm whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1,000m, and 4,000m depth contours.*

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 100 m 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 (<200 m) observations have been made on the southwestern (Kenney, pers. comm) and 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; Christal *et al.* 1998). These groupings have a distinct geographical distribution, with females and juveniles generally based in tropical and subtropical waters, and males more wide-ranging and occurring in higher latitudes. Male sperm whales are present off and sometimes on the continental shelf along the entire east coast of Canada south of Hudson Strait, whereas, females rarely migrate north of the southern limit of the Canadian EEZ (Reeves and Whitehead 1997; Whitehead 2002). Off the northeast U.S., CETAP and NMFS/NEFSC sightings in shelf-edge and off-shelf waters included
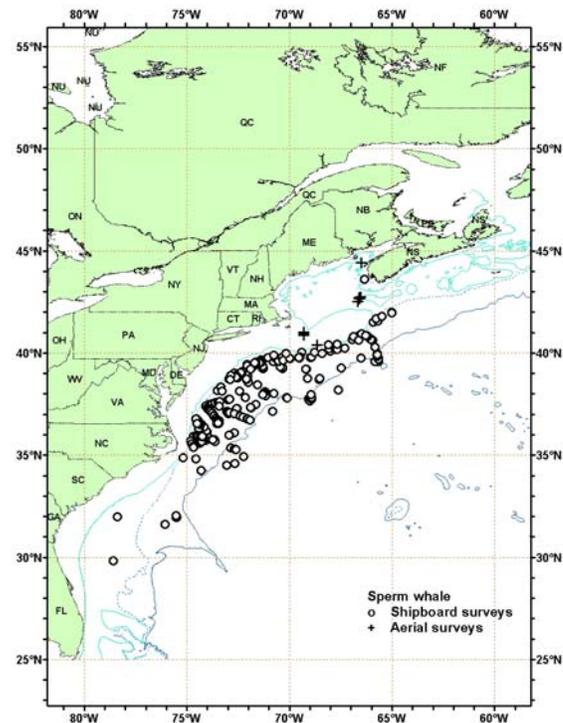
many social groups with calves/juveniles (CETAP 1982; Waring *et al.* 1992, 1993). The basic social unit of the sperm whale appears to be the mixed school of adult females plus their calves and some juveniles of both sexes, normally numbering 20-40 animals in all. There is evidence that some social bonds persist for many years (Christal *et al.* 1998).

POPULATION SIZE

Total numbers of sperm whales off the U.S. or Canadian Atlantic coast are unknown, although several estimates from selected regions of the habitat do exist for select time periods. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best recent abundance estimate for sperm whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 4,804 (CV=0.38), where the estimate from the northern U.S. Atlantic is 2,607 (CV=0.57), and from the southern U.S. Atlantic is 2,197 (CV=0.47). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat. 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. The average dive-time of sperm whales is approximately 30 - 60 min (Whitehead *et al.* 1991; Watkins *et al.* 1993; Amano and Yoshioka 2003; Watwood *et al.* 2006), therefore, the proportion of time that they are at the surface and available to visual observers is assumed to be low.

Although the stratification schemes used in the 1990-2004 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- 2004 data suggest that, seasonally, at least several thousand sperm whales are occupying these waters. 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.

Earlier abundance estimates

An abundance of 219 (CV=0.36) sperm whales was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance of 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 (NMFS 1990; Waring *et al.* 1992). An abundance of 736 (CV=0.33) sperm whales was estimated from a June and July 1991 shipboard line- transect sighting survey conducted primarily between the 200 and 2,000-m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). An abundance 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 (NMFS 1991). An abundance 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 2,000-m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance 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 (NMFS 1994). An abundance 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 (Palka 1996). An abundance of 2,848 (CV=0.49) sperm whales was estimated from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN). An abundance of 1,181 (CV=0.51) sperm whales was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

Recent surveys and abundance estimates

An abundance of 2,607 (CV=0.57) for sperm whales was estimated from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (about 38ºN) to the Bay of Fundy (about 45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths>50 m) between Florida and

Maryland (27.5 and 38ºN) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias ($g(0)$) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka 1995; Buckland *et al.*, 2001). The resulting abundance estimate for sperm whales between Florida and Maryland was 2,197 (CV=0.47*)*(Table 1).

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
Jun-Aug 2004	Maryland to the Bay of Fundy	2,607	0.57
Jun-Aug 2004	Florida to Maryland	2,197	0.47
Jun-Aug 2004	Bay of Fundy to Florida (COMBINED)	4,804	0.38

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 4,804 (CV=0.38). The minimum population estimate for the western North Atlantic sperm whale is 3,539.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. While more is probably known about sperm whale life history in other areas, some life history and vital rates information is available for the northwest Atlantic. These include: calving interval is 4-6 years; lactation period is 24 months; gestation period is 14.5-16.5 months; births occur mainly in July to November; length at birth is 4.0 m; length at sexual maturity 11.0-12.5 m for males and 8.3-9.2 m for females; mean age at sexual maturity is 19 years for males and 9 years for females; and mean age at physical maturity is 45 years for males and 30 years for females (Best 1974; Best *et al.* 1984; Lockyer 1981; Rice 1989).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 3,539. 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 7.1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

During 2001-2005, human caused mortality was 0.2 sperm whales per year (CV=unknown). This is derived from two components: 0 sperm whales per year (CV=unknown) from U.S. fisheries using observer data and 0.2 sperm whales per year from ship strikes.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Several sperm whale entanglements have been documented. In July 1990, a sperm whale was entangled and subsequently released (injured) from the now prohibited pelagic drift gillnet near the continental shelf edge on southern Georges Bank. This resulted in an estimated annual fishery-related mortality and serious injury of 4.4 (CV=1.77) for 1990. In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating about 20 miles off Mt Desert Rock. In October 1994, a sperm whale was successfully disentangled from a fine- mesh gillnet in Birch Harbor, Maine. 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. In May 1997, a sperm whale entangled in net with three buoys trailing was sighted 130 nm northwest of Bermuda. No information on the status of the animal was provided.

Other Mortality

Four hundred twenty-four sperm whales were harvested in the Newfoundland-Labrador area between 1904 and 1972 and 109 male and no female sperm whales were taken near Nova Scotia in 1964-1972 (Mitchell and Kozicki 1984) in a Canadian whaling fishery. There was also a well-documented sperm whale fishery based on the west coast of Iceland. Other sperm whale catches occurred near West Greenland, the Azores, Madeira, Spain, Spanish Morocco, Norway (coastal and pelagic), the Faroes, and Britain. 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.

During 1994-2000, eighteen sperm whale strandings have been documented along the U.S. Atlantic coast between Maine and Miami, Florida (NMFS unpublished data). One 1998 and one 2000 stranding off Florida showed signs of human interactions. The 1998 animal's head was severed, but it is unknown if it occurred pre- or post-mortem. The 2000 animal had fishing gear in the blowhole. In October 1999, a live sperm whale calf stranded on eastern Long Island, and was subsequently euthanized. Also, a dead calf was found in the surf off Florida in 2000.

During 2001 to 2005, fifteen sperm whale strandings were documented along the U.S. Atlantic coast and in Puerto Rico and the EEZ according the NER and SER strandings databases (Table 2). Except for the sperm whale struck by a naval vessel in the EEZ in 2001, there were no confirmed documented signs of human interactions on the other animals.

STATE	2001	2002	2003	2004	2005	TOTAL
Massachusetts	1	1				2
North Carolina			2	1		3
South Carolina		1				1
Florida		2	2	1	1	6
EEZ	1[1]					1
Puerto Rico				1	1	2
TOTAL	**2**	**4**	**4**	**3**	**2**	**15**

Table 2. Sperm Whale (*Physeter macrocephalus*) reported strandings along the U.S. Atlantic coast, 2001-2005.

[1] U.S. Navy reported ship strike

In eastern Canada, 6 dead strandings were reported in Newfoundland/Labrador in 1987-2005; 20 dead strandings along Nova Scotia in 1988-2005; 9 dead strandings on Prince Edward Island in 1988-2005; 2 dead strandings in Quebec in 1992; 5 dead strandings in New Brunswick in 2005; and 13 animals in 8 stranding events on Sable Island, Nova Scotia in 1970-1998 (Reeves and Whitehead 1997; Hooker *et al.* 1997; Lucas and Hooker 2000). Sex was recorded for 11 of the 13 Sable island animals, and all were male, which is consistent with sperm whale distribution patterns (Lucas and Hooker 2000).

Recent mass strandings have been reported in the North Sea, including; winter 1994/1995 (21); winter 1995/1996 (16); and winter 1997/1998 (20). Reasons for the strandings are unknown, although multiple causes (e.g., unfavorable North Sea topography, ship strikes, global changes in water temperature and prey distribution, and pollution) have been suggested (Holsbeek *et al.* 1999).

Ship strikes are another source of human- induced mortality. In May 1994 a ship-struck sperm whale was observed

south of Nova Scotia (Reeves and Whitehead 1997) and in May 2000 a merchant ship reported a strike in Block Canyon (NMFS, unpublished data). In spring, Block Canyon is a major pathway for sperm whales entering southern New England continental shelf waters in pursuit of migrating squid (CETAP 1982; Scott and Sadove 1997).

A potential human-caused source of mortality is from accumulation of stable pollutants (e.g., polychlorobiphenyls (PCBs), chlorinated pesticides (DDT, DDE, dieldrin, etc.), polycyclic aromatic hydrocarbons (PAHs), and heavy metals) in long lived, high -trophic level animals. Analysis of tissue samples obtained from 21 sperm whales that mass -stranded in the North Sea in 1994/1995 indicated that mercury, PCB, DDE, and PAH levels were low and similar to levels reported for other marine mammals (Holsbeek *et al.* 1999). Cadmium levels were high and double reported levels in North Pacific sperm whales. Although the 1994/1995 strandings were not attributable to contaminant burdens, Holsbeek *et al.* (1999) suggest that the stable pollutants might affect the health or behavior of North Atlantic sperm whales.

Using stranding and entanglement data, during 2001-2005, one sperm whale was confirmed struck by a ship, thus, there is an annual average of 0.2 sperm whales per year struck by ships. No sperm whale stranding mortalitiesduring this period were confirmed fishery interactions.

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 U.S. 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 a zero mortality and serious injury rate. This is a strategic stock because the species is listed as endangered under the ESA. A Draft Recovery Plan for sperm whales has been prepared and is available for review (NMFS 2006).

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia sima*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2002). Sightings of these animals in the western North Atlantic occur in oceanic waters (Mullin and Fulling 2003; NMFS unpublished data), although there are no stranding records for the east Canadian coast (Willis and Baird 1998). Dwarf sperm whales and pygmy sperm whales (*K. breviceps*) are difficult to differentiate at sea (Caldwell and Caldwell 1989, Wursig *et al.* 2000), and sightings of either species are often categorized as *Kogia* sp. Diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species when such measurements are obtainable (Barros and Duffield 2003; Handley 1966) Duffield *et al.* (2003) propose using the molecular weights of myoglobin and hemoglobin, as determined by blood or muscle tissues of stranded animals, as a quick and robust way to provide species confirmation.

Using hematological as well as stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. This may result in differential exposure to marine debris, collision with vessels and other anthropogenic activities between the two *Kogia* species.

The western North Atlantic *Kogia* sp. population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

Figure 1. *Distribution of Kogia sp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 2004. Isobaths are at 100 m, 1,000 m and 4,000 m.*

POPULATION SIZE

Total numbers of dwarf sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. Because *Kogia sima* and *Kogia breviceps* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia*. The best abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 animals (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because these two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 695 (CV=0.49) *Kogia* sp. was obtained from the sum of the estimate of 115 (CV=0.61) *Kogia* sp. from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of trackline in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 580 (CV=0.57) *Kogia* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).

Recent surveys and abundance estimates

An abundance estimate of 358 (CV= 0.44) for *Kogia* sp. was obtained from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (about 38° N) to the Bay of Fundy (about 45° N) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ≥ 50 m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al*. 2001). The resulting abundance estimate for *Kogia* sp. between Florida and Maryland was 37 animals (CV=0.75).

1. Summary of abundance estimates for the western North Atlantic *Kogia* sp. Month, year, and covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation			
Month/Year		N_{best}	**CV**
Jun-Aug 2004	Maryland to Bay of Fundy	358	0.44
Jun-Aug 2004	Florida to Maryland	37	0.75
Jun-Aug 2004	Bay of Fundy to Florida (COMBINED)	395	0.40

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 *Kogia* sp. is 395 (CV=0.40). The minimum population estimate for *Kogia* sp. is 285 animals.

Current Population Trend

The available information is insufficient to evaluate population trends for this species in the western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Kogia* sp. is 285. 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 *Kogia* sp. is 2.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information
Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to these stocks during 2001-2005 was zero for *Kogia* sp. , as there were no reports of mortality or serious injury to these species.

Earlier Interactions
No *Kogia* sp. mortalities were observed in 1977-1991 foreign fishing activities.

Pelagic Longline
Between 1992 and 2005, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in 2000 (in the Florida East coast fishing area) (Yeung 2001).

Other Mortality
No dwarf sperm whales were reported to strand in Nova Scotia from 1990-2005 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). From 2001-2005, 30 dwarf sperm whales were reported stranded along the U.S. Atlantic coast and 2 were reported stranded in Puerto Rico (Table 2). In addition to the above strandings of *Kogia sima,* there were 11 strandings reported as *Kogia* sp. There were no documented strandings of dwarf sperm whales along the U.S. Atlantic coast during 2001-2005 which were classified as likely caused by fishery or human interactions.

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

STATE	2001			2002			2003			2004			2005			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Massachusetts	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
New York	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Carolina	1	0	1	0	0	1	4	0	0	2	5	0	4	5	0	11	10	2
South Carolina	1	0	0	0	0	0	2	0	0	0	8	0	0	8	0	3	16	0
Georgia	0	0	0	0	0	1	2	0	1	1	10	0	2	3	0	5	13	2
Florida	2	0	0	3	0	2	2	0	3	3	8	1	0	3	1	10	11	7
Puerto Rico	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
TOTALS	4	0	1	5	0	4	10	0	4	6	31	1	7	20	1	32	51	11

Historical stranding records (1883-1988) of dwarf sperm whales in the southeastern U.S. (Credle 1988), and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 17% of all *Kogia* strandings in the entire southeastern U.S. waters. During the period 1990-October 1998, 3 dwarf sperm whale strandings occurred in the northeastern U.S. (Maryland, Massachusetts, and Rhode Island), whereas 43 strandings were documented along the U.S. Atlantic coast between North Carolina and the Florida Keys in the same period. A pair of latex examination gloves was retrieved from the stomach of a dwarf sperm whale stranded in Miami in 1987 (Barros *et al.* 1990). In the period 1987-1994, 1 animal had possible propeller cuts on or near the flukes.
A Mid-Atlantic Offshore Small Cetacean Unusual Mortality Event (UME), was declared when 33 small cetaceans stranded from Maryland to Georgia between July and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. Fifteen pygmy sperm whales (*Kogia breviceps*) and one dwarf sperm whale (*Kogia sima*) were involved in this UME. Two pygmy sperm whales were involved in a multispecies UME in North Carolina in January of 2005 (Hohn *et al.* 2006). Although anthropogenic

noise was not definitively implicated, the January 2005 event was associated in time and space with naval sonar activity. Potential risk to this species and others from anthropogenic noise is of concern.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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.

Rehabilitation challenges for *Kogia* sp. are numerous due to limited knowledge regarding even the basic biology of these species. Advances in recent rehabilitation success has potential implications for future release and tracking of animals at sea to potentially provide information on distribution, movements and habitat use of these species (Manire *et al.* 2004).

STATUS OF STOCK

The status of *Kogia* sp. relative to OSP in the western U.S. Atlantic EEZ is unknown. These species are not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Total U.S. fishery-related mortality and serious injury for these stocks is less than 10% of the calculated PBR and therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual human-related mortality and serious injury rate does not exceed the PBR, therefore *Kogia* sp. are not strategic stocks.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale (*Kogia breviceps*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2002). Sightings of these animals in the western North Atlantic occur in oceanic waters (Mullin and Fulling 2003; SEFSC unpublished data), although there are no stranding records

for the east Canadian coast (Willis and Baird 1998). Pygmy sperm whales and dwarf sperm whales (*K. sima*) are difficult to differentiate at sea (Caldwell and Caldwell 1989, Wursig *et al.* 2000), and sightings of either species are often categorized as *Kogia* sp. Diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Barros and Duffield 2003; Handley 1966), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species when such measurements are obtainable (Barros and Duffield 2003). Duffield *et al.* (2003) propose using the molecular weights of myoglobin and hemoglobin, as determined by blood or muscle tissues of stranded animals, as a quick and robust way to provide species confirmation.

Using hematological as well as stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. This may result in differential exposure to marine debris, collision with vessels and other anthropogenic activities between the two *Kogia* species.

The western North Atlantic *Kogia* sp. population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

Figure 1. *Distribution of Kogia sp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 2004. Isobaths are at 100 m, 1,000 m and 4,000 m.*

POPULATION SIZE

Total numbers of pygmy sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. Because *Kogia breviceps* and *Kogia sima* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia*. The best abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 animals (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because these two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 695 (CV=0.49) *Kogia* sp. was obtained from the sum of the estimate of 115 (CV=0.61) *Kogia* sp. from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 580 (CV=0.57) *Kogia* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and

17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).

Recent surveys and abundance estimates

An abundance estimate of 358 (CV= 0.44) *Kogia* sp. was obtained from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38° N) to the Bay of Fundy (45° N) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths $\geq$ 50 m) between 27.5 and 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al*. 2001). The resulting abundance estimate for *Kogia* sp. between Florida and Maryland was 37 animals (CV=0.75).

Table 1. Summary of abundance estimates for the western North Atlantic *Kogia* sp. Month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).			
Month/Year	**Area**	**N_{best}**	**CV**
Jun-Aug 2004	Maryland to Bay of Fundy	358	0.44
Jun-Aug 2004	Florida to Maryland	37	0.75
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	395	0.40

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 *Kogia* sp. is 395 animals (CV=0.40). The minimum population estimate for *Kogia* sp. is 285 animals.

Current Population Trend

The available information is insufficient to evaluate population trends for this species in the western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Kogia* sp. is 285. 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 *Kogia* sp. is 2.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information
    Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to these stocks during 2001-2005 was zero for *Kogia* sp., as there were no reports of mortality or serious injury to these species.

Earlier Interactions
    No *Kogia* sp. mortalities were observed in 1977-1991 foreign fishing activities.

Pelagic Longline
    Between 1992 and 2005, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in 2000 (Yeung 2001).

Other Mortality
    No pygmy sperm whales were reported to strand in Nova Scotia from 1990-2005 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). From 2001-2005, 51 pygmy sperm whales were reported stranded along the U.S. Atlantic coast (Table 2).

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

STATE	2001			2002			2003			2004			2005			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Massachusetts	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
New York	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Jersey	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
North Carolina	1	0	1	0	0	1	4	0	0	2	5	0	4	5	0	11	10	2
South Carolina	1	0	0	0	0	0	2	0	0	0	8	0	0	8	0	3	16	0
Georgia	0	0	0	0	0	1	2	0	1	1	10	0	2	3	0	5	13	2
Florida	2	0	0	3	0	2	2	0	3	3	8	1	0	3	1	10	11	7
Puerto Rico	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
TOTALS	4	0	1	5	0	4	10	0	4	6	31	1	7	20	1	32	51	11

A Mid-Atlantic Offshore Small Cetacean UME, was declared when 33 small cetaceans stranded from Maryland to Georgia between July 2004 and September 2004. The species involved are generally found offshore and are not expected to strand along the coast. Fifteen pygmy sperm whales (Kogia breviceps) and one dwarf sperm whale (Kogia sima) were involved in this UME. Two pygmy sperm whales were involved in a multispecies UME in North Carolina in January of 2005 (Hohn *et al.* 2006). Although anthropogenic noise was not definitively implicated, the January 2005 event was associated in time and space with naval sonar activity. Potential risk to this species and others from anthropogenic noise is of concern.
    There were 4 documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 1999- 2005 which were classified as involving fishery or human interactions - 1 in Florida in 1999, 1 in Puerto Rico in 2000, 1 in North Carolina in 2001, and 1 in Massachusetts in 2005. In one of the strandings in 2002 of a pygmy sperm whale, red plastic debris was found in the stomach along with squid beaks.

Historical stranding records (1883-1988) of pygmy sperm whales in the southeastern U.S. (Credle 1988) and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 83% of all *Kogia* sp. strandings in this area. During the period 1990-October 1998, 21 pygmy sperm whale strandings occurred in the northeastern U.S. (Delaware, New Jersey, New York and Virginia), whereas 194 strandings were documented along the U.S. Atlantic coast between North Carolina and the Florida Keys in the same period. Remains of plastic bags and other marine debris have been retrieved from the stomachs of 13 stranded pygmy sperm whales in the southeastern U.S. (Barros *et al.* 1990, 1998), and at least on one occasion the ingestion of plastic debris is believed to have been the cause of death. During the period 1987-1994, 1 animal had possible propeller cuts on its flukes.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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.

Rehabilitation challenges for *Kogia* sp. are numerous due to limited knowledge regarding even the basic biology of these species. Advances in recent rehabilitation success has potential implications for future release and tracking of animals at sea to potentially provide information on distribution, movements and habitat use of these species (Manire *et al.* 2004).

STATUS OF STOCK

The status of *Kogia* sp. relative to OSP in the western U.S. Atlantic EEZ is unknown. These species are not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Total U.S. fishery-related mortality and serious injury for these stocks is less than 10% of the calculated PBR and therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual human-related mortality and serious injury rate does not exceed the PBR, therefore *Kogia* sp. are not strategic stocks.

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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 status. 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 fishery information system for large pelagic fisheries. Data files are maintained at the Southeast Fisheries Science Center (SEFSC). The Northeast Fisheries Science Center (NEFSC) Fisheries Observer 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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PYGMY KILLER WHALE (*Feresa attenuata*):
Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy killer whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994). Pygmy killer whales are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The paucity of sightings is probably due to a naturally low number of groups compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico occur in oceanic waters (Mullin *et al.* 1994; Mullin and Fulling 2004). Sightings of pygmy killer whales were documented in all seasons during aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The western North Atlantic population is provisionally being considered one stock for management purposes. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of 6 pygmy killer whales was sighted during a 1992 vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina, in waters >1500 m deep (Hansen *et al.* 1994), but this species was not sighted during subsequent surveys (NMFS 1999; NMFS 2002; Mullin and Fulling 2003). Abundance was not estimated for pygmy killer whales from the 1992 vessel survey because the sighting was not made during line-transect sampling effort; therefore, the population size of pygmy killer whales is unknown.

Minimum Population Estimate

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

Current Population Trend

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

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal level (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic stock of pygmy killer whales is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during 2001-2005 was zero pygmy killer whales, as there were no reports of mortality or serious injury to pygmy killer whales (Yeung 2001; Garrison 2003; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006).

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and Caldwell 1971).

Other Mortality

From 2001-2005, 3 pygmy killer whales were reported stranded between Maine and Puerto Rico (Table 1). The total includes 1 animal stranded in South Carolina, 1 in Georgia in 2003, and 1 animal stranded in Georgia in 2004,

though there were no indications of human interactions for these stranded animals.

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

Table 1. Pygmy killer whale (Feresa attenuata) reported strandings along the U.S. Atlantic coast, 2001-2005.						
STATE	**2001**	**2002**	**2003**	**2004**	**2005**	**TOTALS**
South Carolina	0	0	1	0	0	1
Georgia	0	0	1	1	0	2
TOTALS	0	0	2	1	0	3

STATUS OF STOCK

The status of pygmy killer whales, relative to OSP, in the U.S. western North 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 size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total U.S. fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

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MELON-HEADED WHALE (*Peponocephala electra*):
Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The melon-headed whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994) and is assumed to be part of the cetacean fauna of the tropical western North Atlantic.

The paucity of sightings is probably due to a naturally low number of groups compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico occur in oceanic waters (Mullin *et al.* 1994; Mullin and Fulling 2004). Sightings of melon-headed whales in the northern Gulf of Mexico were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of melon-headed whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of melon-headed whales was sighted during both a 1999 (20 whales) and 2002 (80 whales) vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina in waters >2500 m deep (Figure 1; NMFS 1999, 2002). Abundances have not

Figure 1. *Distribution of melon-headed whales from SEFSC vessel surveys during 1998-2002. All sightings are shown. Solid lines indicate the 100 m, 1,000 m, and 4,000 m isobaths.*

been estimated from the 1999 and 2002 vessel surveys in western North Atlantic because the sighting was not made during line-transect sampling effort; therefore the population size of melon-headed whales is unknown. No melon-headed whales have been observed in any other surveys.

Minimum Population Estimate

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

Current Population Trend

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

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal level (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic stock of melon-headed whales is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during 2001-2005 was zero, as there were no reports of mortality or serious injury to melon-headed whales.

Other Mortality

From 2001-2005, 1 melon-headed whale stranded in New Jersey and one in Georgia in 2004. Prior to this time, 1 melon-headed whale was reported stranded in Puerto Rico in 1999. No evidence of human interaction was apparent for any of the stranded animals.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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 or human interaction.

STATUS OF STOCK

The status of melon-headed whales, relative to OSP, in the western North 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 size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total U.S. fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

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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 to southern Greenland and Davis Straits (Leatherwood *et al.*1976; CETAP 1982), across the Atlantic to the Barents Sea and south to at least Portugal (Reeves *et al.* 1999). 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 analyses have been conducted to corroborate this stock structure.

In waters off the northeastern U.S. coast, white-beaked dolphin sightings are 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 1970s, 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 1970s, 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; Kenney *et al.* 1996).

In late March 2001, one group of 18 animals was seen about 60 nautical miles east of Provincetown, Massachusetts during a NMFS aerial marine mammal survey (NMFS unpublished data). In addition, during spring 2001 and 2002, white-beaked dolphins stranded on beaches in New York and Massachusetts (see Other Mortality section below).

Figure 1. *Distribution of white-beaked dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

POPULATION SIZE

The total number of white-beaked dolphins in U.S. and Canadian waters is unknown, although one old abundance estimate is available for part of the known habitat in U.S. waters, two other estimates are available from Canadian waters, and one estimate is available from August 2006 from waters in the Gulf of Maine and Scotian shelf (Table 1). The best and only recent abundance estimate for the western North Atlantic white-beaked dolphin is 2,003 (CV=0.94), an estimate derived aerial survey data collected in August 2006. It is assumed this estimate is negatively biased because the survey only covered part of the species' habitat.

Earlier abundance estimates

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 (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, according to the CETAP data. This estimate does not include a correction for dive-time, or to 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), and its dated nature. A population size of 5,500 white-beaked dolphins was estimated based on an aerial survey off eastern Newfoundland and southeastern Labrador (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 (Alling and Whitehead 1987). A CV was not given, but assuming a symmetric CI, it would be 0.22. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An estimate of abundance from an August 2006 survey was 2,003 white-beaked dolphins (CV=0.94). Three aerial line transect abundance surveys were conducted in the summers of 2002, 2004 and 2006 on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of *g(0)* (Palka 2005).   The estimate of *g(0)* was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000 m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000-m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100-m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed. No white-beaked dolphins were observed in the 2002 and 2004 abundance surveys.

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).			
Month/Year	Area	N_{best}	CV
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,003	0.94

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 western North Atlantic stock of white-beaked dolphins is 2,003 (CV=0.94). The minimum population estimate for these white-beaked dolphins is 1,023.

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 1,023. 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 10.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

White-beaked dolphins have been incidentally captured in cod traps and in 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. Of three bycaught white-beaked dolphins reported off Newfoundland during 1987-1988, 1 died in a groundfish gillnet, 1 in a herring gillnet, and 1 in a cod trap (Reeves *et al.*1999).

There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. EEZ. A white-beaked dolphin was captured by a Northeast bottom trawl in March 2003. However, since the animal was moderately decomposed and the trawl duration was short, the animal could not have died in this trawl.

Fishery Information

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

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. Hunting that now occurs in Canadian waters is believed to be opportunistic and in remote regions of Labrador where enforcement of regulations is minimal (Lien *et al.*2001).

White-beaked dolphins regularly become caught in ice off the coast of Newfoundland during years of heavy pack ice. A total of 21 ice entrapments involving approximately 350 animals were reported in Newfoundland from 1979 to 1990; known mortality as a result of entrapment was about 55% (Lien *et al.*2001).

Mass strandings of white-beaked dolphins are less common than for white-sided dolphins. White-beaked dolphins more commonly strand as individuals or in small groups (Reeves *et al.*1999). In Newfoundland, 5 strandings of white-beaked dolphins occurred between 1979 and 1990 involving groups of 2 to 7 animals. On three occasions live dolphins came ashore, including groups of 3 and 4 (Reeves *et al.*1999).

White-beaked dolphin stranding records from 1997 onward that are part of the US NE Regional Office/NMFS strandings and entanglement database include six records that clearly identify the species to be the white-beaked dolphin (Table 2). Three of these strandings were collected from Cape Cod, Massachusetts beaches, where 1 animal stranded during May 1997, and 2 animals stranded during March 2001. A white-beaked dolphin also stranded in New York in February 2002. No white-beaked dolphins stranded during 2003. One white-beaked dolphin stranded in Maine during May 2004 and another stranded in Maine in June of 2005. It was not possible to determine the cause of death for any of the stranded animals.

Whales and dolphins stranded between 1997 and 2005 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows: 1 white-beaked dolphin stranded in May 1997, 0 documented strandings in 1998 to 2001, 2 in 2002 (1 in July (released alive) and 1 in August), and 0 in 2003, 2004 and 2005 (Table 2).

Table 2. Summary of number of stranded white-beaked dolphins during January 1, 2001 to December 31, 2005, by year and area within U.S. and Canada.

Area	Year					Total
	2001	2002	2003	2004	2005	
Maine				1	1	2
Massachusetts	2					2
New York		1				1
TOTAL US	**2**	**1**	**0**	**1**	**1**	**5**
Nova Scotia[a]		2				
GRAND TOTAL	**2**	**3**	**0**	**1**	**1**	**7**

a. One animal that stranded in July 2002 was released alive.

STATUS OF STOCK

The status of white-beaked dolphins, relative to OSP, in U.S. Atlantic coast waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. The total documented U.S. fishery-related mortality and serious injury for this stock (0) is less than 10% of the calculated PBR (10.0) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. This is a non-strategic stock because the 2001-2005 estimated average annual human related mortality does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood *et al.* 1976). Their distribution ranges from southern New England, south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood *et al.* 1976; Perrin *et al.* 1994). 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; Mullin and Fulling 2003). Sightings have also been made along the north wall of the Gulf Stream and warm-core ring features (Waring *et al.* 1992).

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin, *Stenella frontalis,* formerly *S. plagiodon*, and the pantropical spotted dolphin, *S. attenuata* (Perrin *et al.* 1987). The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al.* 1987, 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 200 m isobath; and the smaller, less spotted island and offshore form which occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling *et al.* 2003; Mullin and Fulling 2003; Mullin and Fulling 2004). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea.

A genetic analysis of mtDNA and microsatellite DNA data from samples collected in the Gulf of Mexico and the western North Atlantic reveal significant genetic differentiation between these areas (Adams and Rosel 2006). The western North Atlantic population is provisionally being considered a separate stock from the Gulf of Mexico stock(s) for management purposes. Adams and Rosel (2006) also provide evidence for genetic separation of dolphins within the western North Atlantic into two stocks with a provisional point of differentiation near Cape Hatteras, NC. These two Atlantic stocks, however, are not currently recognized as distinct management units, and thus will be treated as one western North Atlantic stock for the remainder of this assessment.

Figure 1. *Distribution of Atlantic spotted dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998 and 2004. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

POPULATION SIZE

Total numbers of Atlantic spotted dolphins off the U.S. or Canadian Atlantic coast are unknown, although estimates are available from selected regions for select time periods. Sightings have been concentrated in the slope waters north of Cape Hatteras, but in the shelf waters south of Cape Hatteras sightings extend into the deeper slope and offshore waters of the mid-Atlantic (Fig. 1). The best recent abundance estimate for Atlantic spotted dolphins is the sum of the estimates from the two 2004 western U.S. Atlantic surveys. This joint estimate (3,578+47,400=50,978) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Because *S. frontalis* and *S. attenuata* are difficult to differentiate at sea, the reported abundance estimates, prior to 1998, are for both species of spotted dolphins combined. At their November 1999 meeting, the Atlantic SRG recommended that without a genetic determination of stock structure, the abundance estimates for the coastal and offshore forms should be combined. There remains debate over how distinguishable both species are at sea, though in the waters south of Cape Hatteras identification to species is made with very high certainty. This does not, however, account for the potential for a mixed species herd, as has been recorded for several dolphin assemblages. Pending further genetic studies for clarification of this problem, a single species abundance estimate will be used as

the best estimate of abundance, combining species specific data from the northern as well as southern portions of the species' ranges.

Earlier abundance estimates

An abundance estimate of 6,107 undifferentiated spotted dolphins (CV=0.27) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental, shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 4,772 (CV=1.27) undifferentiated spotted dolphins was obtained 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 (NMFS unpublished data). An abundance estimate of 32,043 (CV=1.39) Atlantic spotted dolphins was derived from a line-transect sighting survey conducted during July 6 to September 6, 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N). An abundance estimate of 14,438 (CV=0.63) Atlantic spotted dolphins was generated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of 3,578 (CV= 0.48) Atlantic spotted dolphins was obtained from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38°N) to the Bay of Fundy (45°N) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths $\geq$50 m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias $g(0)$ and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for Atlantic spotted dolphins between Florida and Maryland was 47,400 animals (CV=0.45)(Table 1).

Table 1. Summary of abundance estimates for the western North Atlantic spotted dolphins, *Stenella frontalis*, by 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
Jun-Aug 2004	Maryland to the Bay of Fundy	3,578	0.48
Jun-Aug 2004	Florida to Maryland	47,400	0.45
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	50,978	0.42

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 abundance estimate is 50,978 (CV=0. 42). The minimum population estimates based on the combined abundance estimates is 36,235.

Current Population Trend

There are insufficient data to determine the population trends for this species, because prior to 1998, species of spotted dolphins were not differentiated during surveys.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Atlantic spotted dolphin is 36,235. 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 combined offshore and coastal forms of Atlantic spotted dolphins is 362.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins 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 annual estimated average fishery-related mortality or serious injury to this stock during 2001-2005 was 6 (CV=1) undifferentiated spotted dolphins.

Earlier Interactions

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Bycatch had been observed in the pelagic drift gillnet and pelagic longline fisheries, but no mortalities or serious injuries have been documented in the pelagic pair trawl, Northeast sink gillnet, Mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries. No takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Forty-nine undifferentiated spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1998 and occurred northeast of Cape Hatteras within the 183m isobath in February-April and near Lydonia Canyon in October. Six whole animal carcasses sent to the Smithsonian were identified as pantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 25 in 1989 (.65), 51 in 1990 (.49), 11 in 1991 (.41), 20 in 1992 (0.18), 8.4 in 1993 (0.40), 29 in 1994 (0.01), 0 in 1995, 2 in 1996 (0.06), no fishery in 1997 and 0 in 1998.

Pelagic Longline

Between 1992 and 2005, 2 spotted dolphins (recorded as Atlantic spotted dolphins) were hooked and released alive in the Atlantic, including one dolphin hooked and released alive with serious injuries in 2003 (in the Mid-Atlantic Bight fishing area), and one dolphin was released alive without serious injuries in 2005 (in the Sargasso fishing area) (Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006.). The estimated fishery-related mortality to Atlantic spotted dolphins in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery between 2001-2005 was 6 (CV=1) (Table 2) (Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006).

Table 2. Summary of the incidental mortality and serious injury of undifferentiated spotted dolphins (*Stenella frontalis* and *Stenelal attenuata*) 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 observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E)[h]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 1, 0, 0	6 (1)
TOTAL											6 (1)

a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
b. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

Other Mortality

From 2001-2005, 16 Atlantic spotted dolphins were stranded between Massachusetts and Puerto Rico (NMFS unpublished data). Two animals stranded in North Carolina and 3 in Florida in 2001; 2 animals stranded in North Carolina and 2 in Florida in 2002; 1 animal stranded in 2003 in Massachusetts, North Carolina, and Florida;, one dolphin stranded in Florida and one in Puerto Rico in 2004; and one dolphin stranded in North Carolina and one in Georgia in 2005. None of these strandings had documented signs of fishery or human interactions.

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

Table 2. Atlantic spotted dolphin (Stenella frontalis) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
Massachusetts	0	0	1	0	0	1
North Carolina	2	2	1	0	1	6
Georgia	0	0	0	0	1	1
Florida	3	2	1	1	0	7
Puerto Rico	0	0	0	1	0	1
TOTALS	5	4	3	2	2	16

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. There are insufficient data to determine the population trends for this species. Total U.S. fishery-related mortality and serious injury for the western North Atlantic stock of Atlantic spotted dolphins is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

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PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata*):
Western North Atlantic 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). There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin, *Stenella frontalis,* formerly *S. plagiodon*, and the pantropical spotted dolphin, *S. attenuata* (Perrin *et al.* 1987).

The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al.* 1987, Perrin and Hohn 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 200-m isobath; and the smaller, less spotted island and offshore form which occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling *et al.* 2003; Mullin and Fulling 2003; Mullin and Fulling 2004). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate at sea

Sightings of pantropical spotted dolphins 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 seasonal aerial surveys of the northern Gulf of Mexico, and during 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 1987; Perrin and Hohn 1994).

The western North Atlantic pantropical spotted dolphin population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

Figure 1. *Distribution of pantropical spotted dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998 and 2004. Isobaths are at 100 m, 1,000 m, and 4,000 m isobaths.*

POPULATION SIZE

Total numbers of pantropical spotted dolphins off the U.S. or Canadian Atlantic coast are unknown, although estimates are available from selected regions for select time periods. Sightings have been concentrated in the slope waters north of Cape Hatteras, but in the shelf waters south of Cape Hatteras sightings extend into the deeper slope and offshore waters of the mid-Atlantic (Fig. 1). The best recent abundance estimate for pantropical spotted dolphins is the sum of the estimates from the two 2004 western U.S. Atlantic surveys. This joint estimate (0+4,439=4,439) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Because *S. frontalis* and *S. attenuata* are difficult to differentiate at sea, the reported abundance estimates, prior to 1998, are for both species of spotted dolphins combined. At their November 1999 meeting, the Atlantic SRG recommended that without a genetic determination of stock structure, the abundance estimates for the coastal and offshore forms should be combined. There remains debate over how distinguishable both species are at sea, though in the waters south of Cape Hatteras identification to species is made with very high certainty. This does not, however, account for the potential for a mixed species herd, as has been recorded for several dolphin assemblages. Pending further genetic studies for clarification of this problem, a single species abundance estimate will be used as the best estimate of abundance, combining species specific data from the northern as well as southern portions of the species'

ranges.

Earlier abundance estimates

An abundance estimate of 6,107 undifferentiated spotted dolphins (CV=0.27) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental, shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 4,772 (CV=1.27) undifferentiated spotted dolphins was obtained 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 (NMFS unpublished data). An abundance estimate of 343 (CV=1.03) pantropical spotted dolphins was derived from a line-transect sighting survey conducted during July 6 to September 6, 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N). An abundance estimate of 12,747 (CV=0.56) pantropical spotted dolphins was generated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An abundance estimate of zero pantropical spotted dolphins was obtained from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38°N) to the Bay of Fundy (45°N) (Table 1; Palka 2006), as no dolphins of this species were observed. Shipboard data were collected using the two independent team line-transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths $\geq$50 m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias $g(0)$ and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for pantropical spotted dolphins between Florida and Maryland was 4,439 animals (CV=0.49)(Table 1).

Table 1. Summary of abundance estimates for the western North Atlantic pantropical spotted *dolphin (Stenella attenuata)* by 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
Jun-Aug 2004	Maryland to the Bay of Fundy	0	0
Jun-Aug 2004	Florida to Maryland	4,439	0.49
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	4,439	0.49

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 pantropical spotted dolphins is 4,439 (CV=0. 49) The minimum population estimate for pantropical spotted dolphins is 3,010.

Current Population Trend

There are insufficient data to determine population trends for this species, because prior to 1998 spotted dolphins were not differentiated during surveys.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for pantropical spotted dolphins is 3,010 . 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 pantropical spotted dolphins is 30.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of spotted dolphins 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 annual estimated average fishery-related mortality or serious injury to this stock during 2001-2005 was 6 (CV=1) undifferentiated spotted dolphins.

Earlier Interactions

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. No mortalities or serious injuries have been documented in the pelagic pair trawl, Northeast sink gillnet, Mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries. No takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Bycatch has been observed in the pelagic longline fisheries (two dolphins hooked and released alive without serious injuries - one in the Mid-Atlantic Bight area in 1993, and one in the Gulf of Mexico in 1994) (Yeung 1999) Forty-nine undifferentiated spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1998 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Six whole animal carcasses sent to the Smithsonian were identified as pantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 25 in 1989 (.65), 51 in 1990 (.49), 11 in 1991 (.41), 20 in 1992 (0.18), 8.4 in 1993 (0.40), 29 in 1994 (0.01), 0 in 1995, 2 in 1996 (0.06), no fishery in 1997 and 0 in 1998.

Pelagic Longline

Between 1992 and 2005, 2 spotted dolphins (recorded as Atlantic spotted dolphins) were hooked and released alive in the Atlantic, including one dolphin hooked and released alive with serious injuries in 2003 (in the Mid-Atlantic Bight fishing area), and one dolphin was released alive without serious injuries in 2005 (in the Sargasso fishing area) (Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006.). The estimated fishery-related mortality to spotted dolphins in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery between 2001-2005 was 6 (CV=1) (Table 2) (Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006).

Table 2.	Summary of the incidental mortality and serious injury of undifferentiated spotted dolphins (*Stenella frontalis* and *Stenella attenuata*) 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 observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E)[h]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 1, 0, 0	6 (1)
TOTAL											6 (1)

a.   Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
b.   Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

Other Mortality

From 2001-2005, 3 pantropical spotted dolphins were stranded between South Carolina and Florida (Table 3) (NMFS unpublished data). These include one animal stranded in Florida in both 2002 and 2003, and one animal stranded in South Carolina in 2004 as part of an Unusual Mortality Event (UME). A Mid-Atlantic Offshore Small Cetacean UME, was declared when 85 small cetaceans stranded from Maryland to Georgia between 3 July 2004 and 16 January 2005. The species involved are generally found offshore and are not expected to strand along the coast. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn et al. 2006), though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings". Prior to this, 4 animals stranded in Florida in 1999. There were no documented signs of fishery or human interactions in any of these strandings.

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

Table 3. Pantropical spotted dolphin (*Stenella attenuata*) reported strandings along the U.S. Atlantic coast, 2001-2005.						
STATE	**2001**	**2002**	**2003**	**2004**	**2005**	**TOTALS**
South Carolina	0	0	0	1[a]	0	1
Florida	1	1	0	0	0	2
TOTALS	1	1	0	1	0	3
[a]One pantropical spotted dolphin stranded in September in South Carolina and was considered part of the North Carolina Unusual Mortality Event.						

STATUS OF STOCK

The status of pantropical spotted dolphins, relative to OSP in the western 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. Total U.S.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. Average annual human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock

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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 warm-temperate to tropical seas (Archer and Perrin 1997). 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 very little information concerning striped dolphin stock structure in the western North Atlantic (Archer and Perrin 1997).

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; Mullin and Fulling 2003; Figure 1). 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). Striped dolphins seen in a survey of the New England Sea Mounts (Palka 1997) were in waters that were between 20˚ and 27˚C and deeper than 900 m.

Although striped dolphins are considered to be uncommon in Canadian Atlantic waters (Baird *et al.* 1997), recent summer sightings (2-125 individuals) in the deeper and warmer waters of the Gully (submarine canyon off eastern Nova Scotia shelf) suggest that this region may be an important part of their range (Gowans and Whitehead 1995; Baird *et al.* 1997).

POPULATION SIZE

Total numbers of striped dolphins off the U.S. or Canadian Atlantic coast are unknown, although several estimates from selected regions are available for select time periods. Sightings are almost exclusively in the continental shelf edge and

Figure 1. *Distribution of striped dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer 1998, 1999, and 2004. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

continental slope areas west of Georges Bank (Figure 1). The best abundance estimate for striped dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 94,462 (CV=0.40), where the estimate from the northern U.S. Atlantic is 52,055 (CV=0.57), and from the southern U.S. Atlantic is 42,407 (CV=0.53). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 36,780 striped dolphins (CV=0.27) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental, shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). Abundance estimates of 25,939 (CV=0.36) and 13,157 (CV=0.45) striped dolphins were obtained from line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11aircraft (NMFS 1991). An abundance estimate of 31,669 (CV=0.73) striped dolphins was obtained 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. An abundance estimate of 49,945 (CV=0.40) striped dolphins was obtained from the sum of the estimate of 39,720 (CV=0.45) striped dolphins from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 10,225 (CV=0.91) striped dolphins, estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMS Workshop Report (Wade and Angliss 1997),
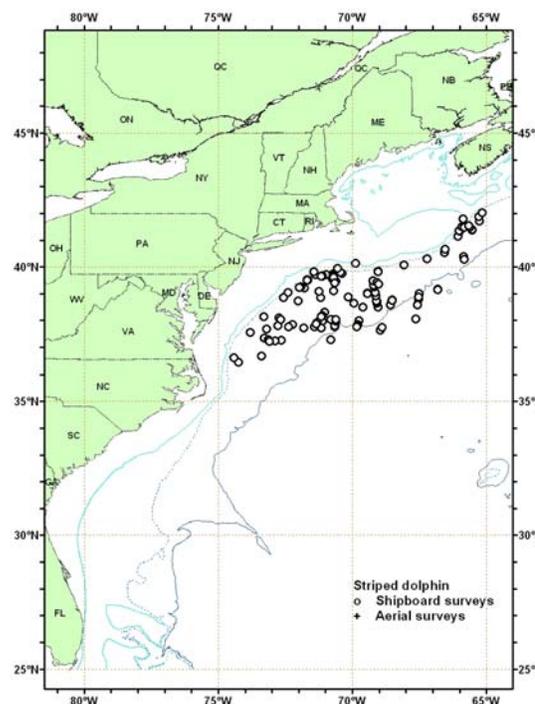
estimates older than eight years are deemed unreliable, and should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates

Recent surveys and abundance estimates

An abundance estimate of 52,055 (CV=0.57) striped dolphins was obtained from a line-transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Table 1; Palka 2006). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and $g(0)$, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line-transect method (Hiby 1999) and analyzed accounting for $g(0)$ and biases due to school size and other potential covariates (Palka 2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5 and 38ºN) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 25x bigeye binocluars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream Front in the Mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were corrected for visibility bias ($g(0)$) and group-size bias and analyzed using line-transect distance analysis (Palka 1995, 2006; Buckland *et al.* 2001). The resulting abundance estimate for striped dolphins between Florida and Maryland was 42,407 animals (CV=0.53).

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
Jun-Aug 2004	Maryland to the Bay of Fundy	52,055	0.57
Jun-Aug 2004	Florida to Maryland	42,407	0.53
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	94,462	0.40

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 94,462 (CV=0.40) obtained from the 2004 surveys. The minimum population estimate for the western North Atlantic striped dolphin is 68,558.

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 1995).
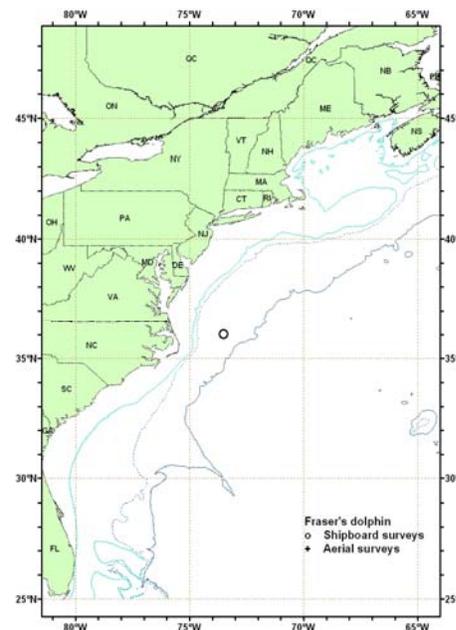
POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 68,558. 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 0.5 because this stock is of unknown status. PBR for the western North Atlantic striped dolphin is 686.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality to this stock during 2001-2005 was zero striped dolphins.

Fishery Information
    Detailed fishery information is reported in Appendix III.

Earlier Interactions
    The pelagic drift gillnet fishery is now closed. Forty striped dolphin mortalities were observed between 1989 and 1998 and occurred east of Cape Hatteras in January and February, and along the southern margin of Georges Bank in summer and autumn (Northridge 1996).   Estimated annual mortality and serious injury (CV in parentheses) attributable to the pelagic drift gillnet fishery were 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), 2 in 1995 (0), 7 in 1996 (CV=0.22), no fishery in 1997 and 4 in 1998 (CV=0).
    In the North Atlantic bottom trawl fishery the only reported fishery-related mortalities (two) occurred in 1991, where the total estimated mortality and serious injury attributable to this fishery for 1991 was 181 (CV=0.97).

USA
    Bycatch has previously been observed by NMFS Fisheries Observer Program in the pelagic drift gillnet and North Atlantic bottom trawl fisheries (see above) but no mortalities or serious injuries have recently been documented in any U.S. fishery.

CANADA
    No mortalities were documented in review of Canadian gillnet and trap fisheries (Read 1994). However, in a recent review of striped dolphins in Atlantic Canada two records of incidental mortality have been reported (Baird *et al.* 1997) In the late 1960s and early 1970s two mortalities each, were reported in trawl and salmon net fisheries.
    Between January 1993 and December 1994, 36 Spanish deep-water trawlers, covering 74 fishing trips (4,726 fishing days and 14,211sets), were observed in NAFO Fishing Area 3 (off the Grand Bank) (Lens 1997). A total of 47 incidental catches were recorded, which included two striped dolphins. The incidental mortality rate for striped dolphins was 0.014/set.

Other Mortality
    From 1995-1998, 7 striped dolphins were stranded between Massachusetts and Florida (NMFS unpublished data). From 1999-2003, fifty-nine dolphins were reported stranded from Maine to Florida (NMFS unpublished data). There were no signs of human interactions or mass strandings. The number of reported strandings per year were 2005 (16, including 12 from a mass stranding in North Carolina), 2004 (2), 2003 (19), 2002 (5), 2001 (9), 2000 (5), and 1999 (5).
    In eastern Canada, 10 strandings were reported off eastern Canada from 1926-1971, and 19 from 1991-1996 (Sergeant *et al.* 1970; Baird *et al.* 1997; Lucas and Hooker 1997). In both time periods, most of the strandings were on Sable Island, Nova Scotia. Two stranding mortalities were reported in Nova Scotia in 2004 and two in 2005.

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 U.S. fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR, therefore can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

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FRASER'S DOLPHIN (*Lagenodelphis hosei*):
Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphins are distributed worldwide in tropical waters (Perrin *et al.* 1994) and are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The paucity of sightings is probably due to naturally low abundance compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico are uncommon but occur on a regular basis. Fraser's dolphins have been observed in oceanic waters (>200 m) in the northern Gulf of Mexico during all seasons (Leatherwood *et al.* 1993; Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2004). The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of Fraser's dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of an estimated 250 Fraser's dolphins was sighted in waters 3300 m deep in the western North Atlantic off Cape Hatteras during a 1999 vessel survey (Figure 1; NMFS 1999). Abundance has not been estimated from the 1999 vessel survey in western North Atlantic because the sighting was not made during line-transect sampling effort; therefore, the population size of Fraser's dolphins is unknown. No Fraser's dolphins have been observed in any other surveys.

Figure 1. *Distribution of Fraser's dolphins from SEFSC shipboard survey during 1999. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

Minimum Population Estimate

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

Current Population Trend

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

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 history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal level (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997).   The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic Fraser's dolphin stock is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information

Detailed fishery information is reported in Appendix III.   Total annual estimated average fishery-related

mortality and serious injury to this stock during 2001-2005 was zero, as there were no reports of mortality or serious injury to Fraser's dolphins.

Other Mortality

From 2001-2005, 12 Fraser's dolphins were reported stranded between Maine and Puerto Rico (Table 1). The total includes one animal stranded in 2002, 10 mass stranded live animals in April 2003 in Lee, Florida, and one animal stranded in Florida in 2004. Prior to this time period, one animal stranded in Puerto in 1999. There were no indications of fishery or human interactions for these stranded animals.

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

Table 1. Fraser's dolphin (*Lagenodelphis hosei*) reported strandings along the U.S. Atlantic coast, 2001-2005.						
STATE	**2001**	**2002**	**2003**	**2004**	**2005**	**TOTALS**
Florida	0	0	10[a]	1	0	11
Puerto Rico	0	1	0	0	0	1
TOTALS	0	1	10	1	0	12
[a] Florida live mass stranding of 10 animals in Lee, Florida on April 4, 2003						

STATUS OF STOCK

The status of Fraser's dolphins relative to OSP in the U.S. western North 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 size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total U.S. fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

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CLYMENE DOLPHIN (*Stenella clymene*):
Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic (Jefferson and Curry 2003). Clymene dolphins have been commonly sighted in the Gulf of Mexico since 1990 (Mullin *et al.* 1994; Fertl *et al.* 2003), and a Gulf of Mexico stock has been designated since 1995. Four Clymene dolphin groups were sighted during summer 1998 in the western North Atlantic (Mullin and Fulling 2003), and two groups were sighted in the same general area during a 1999 bottlenose dolphin survey (NMFS unpublished). These sightings and stranding records (Fertl *et al.* 2003) indicate that this species routinely occurs in the western North Atlantic. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of Clymene dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this species since it was rarely seen in any surveys.

Clymene dolphins were observed during earlier surveys along the U.S. Atlantic coast. Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. Data were collected using standard line-transect techniques conducted from NOAA Ship *Relentless* during July and August 1998 between Maryland (38.00°N) and central Florida (28.00°N) from the 10 m isobath to the seaward boundary of the U.S. EEZ. Transect lines were placed perpendicular to bathymetry in a double saw-tooth pattern. Sightings of Clymene dolphins were primarily on the continental slope east of Cape Hatteras, North Carolina (Fig. 1). The best estimate of abundance for the Clymene dolphin was 6,086 (CV=0.93) (Mullin and Fulling 2003) and represents the first and only estimate to date for this species in the U.S. Atlantic EEZ. No Clymene dolphins have been observed in subsequent surveys. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations.

Figure 1. *Distribution of Clymene dolphin sightings from NEFSC and SEFSC vessel and aerial summer surveys during 1998. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

Minimum Population Estimate

No minimum population estimate is available at this time.

Current Population Trend

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

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 history

(Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL
Potential Biological Removal (PBR) is the product of minimum population size, one half the maximum net productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown; therefore, PBR for the western North Atlantic Clymene dolphin stock is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY
Fishery Information
Detailed fishery information is reported in Appendix III. Total annual estimated fishery-related mortality and serious injury to this stock during 2001-2005 was zero, as there were no reports of mortalities or serious injury to Clymene dolphins.

Other Mortality
There has been one reported stranding of a Clymene dolphin in the western North Atlantic between 2001-2005, which occurred in NC in August 2004. This stranding was part of the Mid-Atlantic Offshore Small Cetacean UME, which was declared when 33 small cetaceans stranded from Maryland to Georgia between July September 2004. One Clymene dolphin was involved in this UME.

Prior to this, one stranding of a Clymene dolphin was recorded in Florida in 1999. No sign of fishery or human interactions were noted. There may be some uncertainty in the identification of this species due to similarities with other *Stenella* species.

Stranding data probably underestimate the extent of fishery-related mortality and serious injury because all of the marine mammals that die or are seriously injured may not 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 Clymene dolphins, relative to OSP, in the EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this stock. Because there are insufficient data to calculate PBR it is not possible to determine if stock is strategic and if the total U.S. fishery-related mortality and serious injury for this stock is significant and approaching zero mortality and serious injury rate. However, because there are no documented takes in U.S. waters, this stock has been designated as not strategic.

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SPINNER DOLPHIN (*Stenella longirostris*):
Western North Atlantic Stoc k

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; NMFS unpublished data) off the northeast U.S. coast. Stranding records exist from North Carolina, South Carolina, Florida and Puerto Rico in the Atlantic and in Texas and Florida in the Gulf of Mexico. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of spinner dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock 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 stock.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during 2001-2005 was zero, as there were no reports of mortalities or serious injury to spinner dolphins.

EARLIER INTERACTIONS

There was no documentation of spinner dolphin mortality or serious injury in distant-water fleet (DWF) activities off the northeast U.S. coast (Waring *et al.* 1990). No takes were documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Bycatch has been observed in the now prohibited pelagic drift gillnet fishery, and in the pelagic longline fishery (one dolphin hooked and released alive without serious injury in 1997) but no mortalities or serious injuries have been documented in the pelagic pair trawl, Northeast sink gillnet, Mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries (Yeung 1999).

Pelagic Drift Gillnet

One spinner dolphin mortality was observed in the pelagic driftnet between 1989 and 1993 and occurred east of Cape Hatteras in March 1993 (Northridge 1996). Estimates of 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 self-reported fisheries information. Variances were estimated using bootstrap re- sampling techniques. Estimated annual 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), 0.5 in 1993 (1.00) and zero from 1994-1996. This fishery is no longer in operation.

Other Mortality

From 2001-2005, 10 spinner dolphins were reported stranded between Maine and Puerto Rico (Table 1). The total includes 2 animals stranded in North Carolina in 2001, 2 animals stranded in Puerto Rico in 2002, 4 mass stranded live animals in December 2003 in Flagler, Florida (all died on the scene), 1 animal stranded in Florida 2003and in 2004. There were no indications of fishery or human interactions for these stranded animals.

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

Table 1. Spinner dolphin (*Stenella longirostris*) strandings along the U.S. Atlantic coast, 1999-2003						
STATE	**2001**	**2002**	**2003**	**2004**	**2005**	**TOTALS**
North Carolina	2	0	0	0	0	2
South Carolina	0	0	0	0	0	0
Georgia	0	0	0	0	0	0
Florida	0	0	5[a]	1	0	6
Puerto Rico	0	2	0	0	0	2
TOTALS	2	2	5	1	0	10
[a] Includes live mass stranding of 4 animals in Flagler, FL in December 2003.						

STATUS OF STOCK

The status of spinner dolphins, relative to OSP, in the U.S. western North 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 size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. 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 (Sergeant 1976a; Campbell 1987; Lavigne and Kovacs 1988; Stenson *et al.* 1996). The world's hooded seal population has been divided by ICES into three separate stocks, each identified with a specific breeding site (Lavigne and Kovacs 1988; Stenson *et al.* 1996): Northwest Atlantic, Greenland Sea ("West Ice"), and White Sea ("East Ice"). The Western North Atlantic stock (synonymous with the ICES Northwest Atlantic stock), whelps off the coast of eastern Canada and is divided into three whelping areas. The Front herd (largest) breeds off the coast of Newfoundland and Labrador, Gulf herd breeds in the Gulf of St. Lawrence, and the third area is in the Davis Strait.

Hooded seals are highly migratory and may wander as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the southeast U.S. coast and in the Caribbean (McAlpine *et al.* 1999; Harris *et al.* 2001; Mignucci-Giannoni and Odell 2001). Although it is not known which stock these seals come from, it is known that during spring, the northwest Atlantic stock of hooded seals are at their southernmost point of migration in the Gulf of St. Lawrence. Hooded seals remain on the Newfoundland continental shelf during winter/spring (Stenson *et al.* 1996). Breeding occurs at about the same time in March for each stock. Three of 4 hooded seals stranded, satellite tagged, and released in the United States in 2004 migrated to the eastern edge of the Scotian Shelf and the two that were monitored until June ended up on the southeast tip of Greenland. The fourth traveled into the Gulf of St. Lawrence. (WHALENET at http://whale.wheelock.edu). Adults from all stocks assemble in the Denmark Strait to molt between late June and August (King 1983; ICES 1995), and following this, the seals disperse widely. Some move south and west around the southern tip of Greenland, and then north along the west coast of Greenland. Others move to the east and north between Greenland and Svalbard during late summer and early fall (Lavigne and Kovacs 1988). Little else is known about the activities of hooded seals during the rest of the year until they assemble again in February for breeding.

POPULATION SIZE

The number of hooded seals in the western North Atlantic is relatively well known and is derived from pup production estimates produced from whelping pack surveys. Several estimates of pup production at the Front are available. Hooded seal pup production between 1966 and 1977 was estimated at 25,000 - 32,000 annually (Benjaminsen and Oritsland 1975; Sergeant 1976b; Lett 1977; Winters and Bergflodt 1978; Stenson *et al.* 1996). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters and Bergflodt 1978). Pup production estimates began to increase after 1978, reaching 62,400 (95% CI. 43,700 - 89,400) by 1984 (Bowen *et al.* 1987, ICES 2006). Bowen *et al.* (1987) also estimated pup production in the Davis Strait at 19,000 (95% C.I. 14,000 - 23,000). A 1985 survey at the Front (Hay *et al.* 1985) produced an estimate of 61,400 (95% C.I. 16,500 - 119,450). Hammill *et al.* (1992) estimated the Front pup production to be 83,100 (SE=12,700) in 1990. Assuming a ratio of pups to total population of 1:5, pup production in the Gulf and Front herds would represent a total population of approximately 400,000-450,000 hooded seals (Stenson 1993). Based on the 1990 survey, Stenson *et al.* (1996) suggested that pup production may have increased at about 5% per year since 1984. However, because of exchange between the Front and the Davis Strait stocks, the possibility of a stable or slightly declining level of pup production was also likely (Stenson 1993; Stenson *et al.* 1996). In 1998 and 1999, surveys were conducted to estimate pup production in the southern Gulf of St. Lawrence, which is the smallest component of the northwest Atlantic stock (ICES 2001). The estimate of 2,000 was similar to the previous published 1990 estimate (Hammill *et al.* 1992; ICES 2001). Surveys of all three whelping areas in the Northwest Atlantic were carried out in 2005. Pup production at the Front was estimated to be 107,013 (SE=7,558, CV=7.1%) while 6,620 (SE=1,700, CV=25.8%) pups were estimated to have been born in the Gulf and 3,346 (SE=2,237, CV=66.8%) in Davis Strait. Total pup production in the northwest Atlantic was 116,900 (SE=7,918, CV=6.8%). Fitting pup production estimates from all herds and making assumptions about numbers of hooded seals in the Davis Strait herd for years when this area was not included in the survey program, results in an estimate of total population in 2005 of 592,100 (SE=94,800; 95% C.I.= 404,400-779,800).

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 hooded seals is 592,100 (SE=94,800). The minimum population estimate based on the 2005 pup survey results is 512,000. Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current population trend

Comparison with previous estimates suggests that pup production (and total population size) may have increased since the mid 1980s but the considerable uncertainty about the relationship among whelping areas makes it difficult to reliably assess the population trend.

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, which assume the maximum net productivity rate to be 0.12 (ICES 2006). This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 512,000. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is set at 0.75, the value for populations which are thought to be increasing. PBR for the western North Atlantic hooded seal stock is 15,360 but for U.S. waters is unknown. The Joint NAFO/ICES Harp and Hooded Seal Working Group applied the PBR formula to Canadian population estimates to obtain a harvest reference level of 19,650 and 23,025 hooded seals from the Front Only and All Areas, respectively (ICES 2006).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2001-2005, the total estimated human caused mortality and serious injury to hooded seals was 5,199. This is derived from three components: 1) an average catch of 5,173 seals from 2001-2005 (2001= 3,960; 2002 = 7,341; 2003 = 5,446, 2004 = 5,270, and 2005 = 3,846) average catches of Northwest Atlantic population of hooded seals by Canada and Greenland (ICES 2006); 2) 25 hooded seals (CV=0.82) from the observed U.S. fisheries (Table 1); and 3) one hooded seal from average 2001-2005 non-fishery related, human interaction stranding mortalities (NMFS unpublished data). Note that there is considerable intermixing between the Northwest Atlantic and West Ice stocks, so it is possible that Northwest Atlantic seals are taken by Greenland sealers.

Fishery Information

Detailed fishery information is reported in Appendix III.

U.S.

Northeast Sink Gillnet

The fishery has been observed in the Gulf of Maine and in southern New England. There were 2 hooded seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2005. The bycatch in 2001 occurred in summer (July-September). All bycatch was in waters between Cape Ann and New Hampshire. Annual estimates of hooded seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). Estimated annual mortalities (CV in parentheses) from this fishery during 1990-2003 were 0 in 1990-1994, 28 in 1995 (0.96), 0 in 1996-2000, 82 in 2001 (1.14), 0 in 2002-2003, 43 (0.95) in 2004, and 0 in 2005. The 1995 bycatch includes 5 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of bycatch of harbor seals, gray seals, harp seals, and hooded seals. There were 8, 2, 2, 9, and 14 unidentified seals observed during 2001-2005, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2001-

2005 was 25 hooded seals (CV=0.82) (Table 1).

CANADA

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994).

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

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	01-05	unk	Obs. Data, Weighout, Logbooks	.04, 02, .03, .06, .07	1, 0, 0, 1, 0	82, 0, 0, 43, 0	1.14, 0, 0, .95, 0	25 (0.82)
TOTAL								25 (0.82)

[a.] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Science Center Observer Program. NEFSC collects Weighout (Weighout) landings data, and total landings are used as a measure of total effort for the sink gillnet fishery. Mandatory logbook (Logbook) data are used to determine the spatial distribution of some fishing effort in the Northeast sink gillnet fishery.

[b.] The observer coverages for the Northeast sink gillnet fishery are ratios based on tons of fish landed.

[c.] Only mortalities observed on marine mammal trips were used to estimate total hooded seal bycatch. See Bisack (1997) for "trip" type definitions. The one hooded seal mortality observed in 2001 was taken in a net equipped with pingers. The one hooded seal mortality observed in 2004 was taken in a net not equipped with pingers.

Other Mortality

In Atlantic Canada, hooded seals have been commercially hunted at the Front since the late 1800s. In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984 (Stenson 1993; Anonymous 1998). From 1991 to 1992 the TAC was increased to 15,000. A TAC of 8,000 was set for 1993, and held at that level through 1997. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,425 in 1991, with a mean catch of 1,001 between 1983 and 1995. Catches peaked in 1996 (25,754) due to good ice conditions and strong market demand (ICES 1998). Since 1996 catches have fallen markedly and during 2000-2004 averaged 170 animals per year (ICES 2006). A series of management regulations have been implemented for the Canadian harvest since 1960. For example, the taking of bluecoats was prohibited in 1993 and the TAC has been set at 10,000 seals per year since 1998 (ICES 2006).

In 1988-1993, strandings were fewer than 20 per year, and from 1994 to 1996 they increased to about 50 per year (Rubinstein 1994; Rubinstein, pers. comm.). From 2001 to 2005, 138 hooded seal stranding mortalities were reported in most states from Maine to North Carolina (Table 3; NMFS unpublished data). Six (4.3%) of the mortalities during this five year period showed signs of human interaction (2 in 2001, 1 in 2004 and 3 in 2005), with one animal having some indication of fishery interaction (1 in 2004). Extralimital strandings have also been reported off the southeast U.S., North Carolina to Florida, and in the Caribbean (McAlpine *et al.* 1999; Mignucci-Giannoni and Odell 2001; NMFS, unpublished data). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of hooded seal stranding in the Gulf of Maine is consistent with the species seasonal migratory patterns in this region.

Table 3. Hooded seal (*Cystophora cristata*)stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004[a]	2005[b]	Total
ME	21	8	5	6	3	43
NH		1	1	1		3
MA	22	8	3	9	11	53
RI	2					2
CT	1					1
NY	10	1		1	4	16
NJ	5	1	1	1		8
DE	1	1		2		4
MD				1		1
VA	1				1	2
NC	5					5
Total	68	20	10	21	19	138
Unspecified seals (all states)	37	35	27	33	59	191

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated

STATUS OF STOCK

The status of hooded seals relative to OSP in U.S. Atlantic EEZ is unknown, but the stock's abundance appears to be increasing. The species not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is very low relative to the stock's size and can be considered insignificant and approaching zero mortality and serious injury rate. Because the level of human-caused mortality and serious injury is also low relative to overall stock size, this is not a strategic stock.

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APPENDIX V: West Indian manatees stock assessments - Florida and Antilles stocks

APPENDIX V: WEST INDIAN MANATEE *(Trichechus manatus latirostris):* FLORIDA STOCK

U.S. Fish and Wildlife Service, Jacksonville, Florida

STOCK DEFINITION AND GEOGRAPHIC RANGE

Manatees are typically found in the temperate and equatorial waters of the southeastern U.S., the Caribbean basin, northern and northeastern South America, and equatorial West Africa. Their near relative, the dugong (*Dugong dugon*), is found in the Indo-Pacific region. At present, manatees of the genus *Trichechus* are represented by three allopatric species: *T. senegalensis*, the West African manatee, *T. inunguis*, the Amazonian manatee, and *T. manatus*, the West Indian manatee. The West Indian species is subdivided into two subspecies, the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*) (U.S. Fish and Wildlife Service, 1989). Such subspeciation may reflect reproductive isolation brought on by the intemperate northern coast of the Gulf of Mexico and characteristically strong currents found in the Straits of Florida (Domning and Hayek, 1986).

Historically, the winter range of the Florida manatee (*Trichechus manatus latirostris*) was thought to focus on south Florida, with some animals ranging north of Charlotte Harbor on Florida's west coast and north of Sebastian on Florida's east coast. Extralimital movements occurred and were typically seasonal, with animals travelling north during warmer periods and travelling south as temperatures declined. While most manatees wintered in south Florida, some were known to winter in natural spring areas to the north (Hartman, 1974). With the advent of artificial warm water refugia, the spread of exotic submerged aquatic vegetation, and increased protective measures, the manatee's winter range has expanded significantly (Beeler and O'Shea, 1988). On the east coast, manatees are now known to winter as far north as southeastern Georgia and, on the west coast, as far north as Crystal River, Florida. Documentation of manatee movements between Gulf and Atlantic coast populations in far south Florida is lacking, presumably because lack of suitable habitat in Florida Bay is not conducive to such movements, but significant genetic variation between coastal populations has not been demonstrated (McClenaghan and O'Shea 1988). Range extremes extend north to Virginia on the Atlantic coast and west to Louisiana on the Gulf coast. The number of sighting reports outside of Florida has increased in recent years.

POPULATION SIZE
Minimum Population Estimate

The exact population size for Florida manatees is unknown but the minimum population is estimated at 1,822 animals, based on intensive statewide winter aerial surveys at warm-water refuges coordinated by the Florida Department of Environmental Protection in early February of 1995 (FDEP 1995). A previous high count of 1856 manatees was obtained in a survey conducted in 1992 (Ackerman, 1992). While not a statistical estimate, this count provides the best available data on the minimum size of the population.

Population Trends

Manatee population trends are poorly known but, based on the results of a carcass recovery program, deaths have increased by an average of 5.9 percent per year in Florida from 1976 through 1992 (Ackerman et al. In press). Garrott et al.'s (1994) analysis of trends at winter aggregation sites suggest a mean annual increase of 7-12 percent in adjusted counts at sites on the east coast from 1978-1992, noting that this figure exceeds Packard's conservative estimate of maximum potential rate of increase for manatees of 2-7 percent annually (Packard 1985). Reynolds and Wilcox (1994) reported a decline in the percentage and number of calves seen at power plant aggregation sites during recent winter aerial surveys. It is not clear at this time whether this is related to increases in perinatal mortality or to some other factor.

Marmontel (1994) conducted a population viability analysis through computer simulations using 16 years of data and material collected by the carcass recovery program. This study yielded information on age-related aspects of mortality and reproduction for the Florida manatee population. A scenario, calculated from the data, having an initial population size of 2,000 individuals resulted in a gradually declining population (r = -0.003), a probability of persistence of 44 percent in 1,000 years, and a mean final population size of less than 10 percent of the original value. When adult mortality was reduced by 10 percent in the model, population growth improved considerably, but when adult mortality was increased by 10 percent the population quickly dwindled. These results clearly indicate that the Florida manatee population is still at high risk of extinction in the long term. Any negative change in the population parameters, caused by environmental changes or a catastrophe, might tip the balance towards greater risk of extinction.

ANNUAL HUMAN-CAUSED MORTALITY

Manatee deaths resulting from human activities are well documented through a carcass recovery program, initiated in 1974. Causes of death include collisions with large and small boats, crushing by barges and man made water control structures (flood gates/canal locks), entanglement in nets and lines, entrapment in culverts, poaching, entanglement in, and ingestion of marine debris (e.g., monofilament), and others (Ackerman et al., In press).

From 1974 through 1994, 2,456 manatee carcasses were recovered in the southeastern U.S. Eight hundred and two (33 percent) were attributed to human-related causes. Of these, 613 were caused by collisions with watercraft, 111 were flood gate/canal lock-related, and another 78 were categorized as other human-related.

In Florida, human-related mortality accounted for the greatest proportion of deaths with identifiable causes (45 percent, with another 24 percent of deaths resulting from undetermined causes) from 1986-1992. Collisions with watercraft accounted for 83 percent of human-related causes of death during this period (Ackerman et al. 1994, Wright et al. 1994). Watercraft-related deaths increased by an average of 9.3 percent per year from 1974 to 1992, increasing as a percentage of total deaths from 21 percent in 1976-1980 to 28 percent from 1986-1992 (Ackerman et al., In press). Overall, watercraft collisions account for approximately 25% of all manatee deaths.

The highest known annual mortality for the Florida manatee in any given year occurred in 1990 when 214 deaths (206 of which occurred in Florida) were recorded (Ackerman et al. 1994). In 1994, the second highest annual level of mortality on record occurred, when 193 carcasses were recovered (FDEP 1995).

FISHERIES INFORMATION

Manatee deaths have been attributed to inshore and nearshore commercial fishing activity. Fisheries gear involved in these incidents include shrimp nets, crab trap lines, hoop nets, and a trotline (National Marine Fisheries Service, 1992; Beck, C.A. and N.B. Barros, 1991). Recreational fishing activities have also been implicated in manatee deaths; manatees have died as a result of ingesting monofilament line and fishing tackle and from entanglement in monofilament line, crab trap lines, and cast nets. Non-lethal entanglement associated with these gear types, sometimes resulting in the loss of a flipper due to constriction, is also known to occur. Collisions with fishing boats probably occur; however, it is not possible to determine the extent to which this occurs.

While fisheries have been implicated in the deaths of manatees, the number of such incidents is low. The manatee carcass recovery program has identified 17 manatee deaths which are directly attributable to commercial fisheries gear (FDEP Manatee Mortality Database, 1994). Fishing gear is suspected in three additional deaths. "Because total annual manatee mortality is increasing, the population is small, and reproduction is low, incidental mortality from commercial fisheries, when added to other human-related mortality, could be significant if not critical to the manatee population" (Young et al., 1993).

The majority of the manatee deaths attributed to commercial fisheries involve the shrimping industry. Mortalities have occurred in northeast Florida (Duval County), east central Florida (Volusia County), and the Florida Panhandle area (Franklin County), as well as in coastal waters of Georgia and South Carolina where shrimping is permitted. Other fishery interactions have occurred throughout the manatee's range in Florida. No distinct seasonality has been associated with these events (FDEP Manatee Mortality Database, 1994).

STATUS OF STOCK

The Florida manatee is listed as "endangered" under provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), as amended. The manatee is considered a "strategic stock" as defined in Section 12 of the Marine Mammal Protection Act of 1972, as amended. The basis for this designation is the high level of documented mortality (natural and human-related) relative to the estimated population level and continuing, severe threats to critical manatee habitats in the southeastern U.S.

POTENTIAL BIOLOGICAL REMOVAL

Because of its endangered status, the recovery factor for the Florida manatee should be 0.1, the lowest allowable figure. Given a minimum population estimate of 1,822 and an R_{max} (maximum net productivity rate) of 0.04, the Potential Biological Removal (PBR) rate for manatees is as follows:

$$PBR = (1822)(.02, \text{ or } 1/2 \; R_{max})(.1) = 3$$

The calculated PBR level is greatly exceeded by known human-related manatee mortality (primarily watercraft collisions and water control structure deaths) every year in Florida. For this reason, and because current efforts of the Florida Manatee Recovery Team focus intensively on the reduction of these major types of mortality, the determination of the PBR level for manatees is of limited value. The excessive level of documented manatee mortality and the resulting unlikelihood of attaining Optimum Sustainable Population (OSP) make the calculation of meaningful PBR for manatees a difficult exercise. Marmontel's (1994) estimate of

net productivity is essentially zero (-0.003). Substituting this value for the default value for maximum net productivity rate (0.04) in the above equation results in a PBR level of 0.

The U.S. Fish and Wildlife Service has consistently concluded in Section 7 Biological Opinions, pursuant to the Endangered Species Act, that the take of a single manatee would "jeopardize the continued existence" of the species. We therefore believe that designating any level of take for manatees would be inappropriate and inconsistent with the revised Florida Manatee Recovery Plan.

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WEST INDIAN MANATEE ((*Trichechus manatus manatus*)
ANTILLEAN STOCK

U.S. Fish and Wildlife Service, Jacksonville, Florida

STOCK DEFINITION AND GEOGRAPHIC RANGE

Manatees are typically found in the temperate and equatorial waters of the southeastern U.S., the Caribbean basin, northern and northeastern South America, and equatorial West Africa. Their nearest relative, the dugong (*Dugong dugon*), is found in the Indo-Pacific region. At present, manatees of the genus *Trichechus* are represented by three allopatric species: *T. senegalensis*, the West African manatee, *T. inunguis*, the Amazonian manatee, and *T. manatus*, the West Indian manatee (U.S. Fish and Wildlife Service, 1986). The West Indian species is subdivided into two subspecies, the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). Such subspeciation may reflect reproductive isolation brought on by the intemperate northern coast of the Gulf of Mexico and characteristically strong currents found in the Straits of Florida (Domning and Hayek, 1986).

The Antillean manatee is found in eastern Mexico, Central America, northern and eastern South America, and in the Greater Antilles (Lefebvre et al., 1989). In Puerto Rico, the manatee is most abundant along the south and east coasts, particularly in the area of Fajardo and Ceiba (Roosevelt Roads Naval Station) and in the Jobos Bay area between Guayama and Salinas. In general, manatees are not abundant on the north coast although they are infrequently seen in areas immediately to the west of San Juan (Mignucci Giannoni, 1989, Caribbean Stranding Network, unpubl. data). Manatees are rarely seen near Culebra Island and are generally absent from Mona Island and the Virgin Islands (Caribbean Stranding Network, unpubl. data). The U.S. has jurisdictional responsibilities for the Antillean subspecies only in Puerto Rico and the U.S. Virgin Islands.

POPULATION SIZE

The exact number of Antillean manatees known to occur in Puerto Rico is unknown but, based on aerial surveys conducted on July 16 and 17, 1994, this population includes at least 86 individuals (Oland, pers. comm.). Manatees are virtually unknown from the U.S. Virgin Islands (Lefebvre et al., 1989). A rare sighting and stranding was reported here in 1988 (Caribbean Stranding Network, unpubl. data).

Population Trends

Quantitative information is limited regarding trends in the abundance of the Antillean manatee, although "[h]istorical accounts indicate that manatees were once more common and that hunting has been responsible for declining numbers throughout much of their range" (Lefebvre et al., 1989).

In Puerto Rico, efforts have been made to assess the status of the Antillean manatee by conducting aerial surveys and by means of a carcass salvage program. Aerial surveys were initiated in 1978 and have continued sporadically to the present. Carcass salvage efforts were initiated in April 1974, by the U.S. Fish and Wildlife Service (Rathbun et al., 1986). In 1989, the Caribbean Stranding Network initiated a dedicated salvage, rescue, and rehabilitation program and has assumed responsibility for all carcass recovery efforts in Puerto Rico. Despite these assessments, limited information exists by which to determine trends in this population of manatees.

Based largely on historical accounts and increasing human pressures, the Antillean manatee as a subspecies appears to be in decline. However, efforts to quantify population levels and trends are preliminary and there are no conclusive indications as to whether or not the population of Antillean manatees is stable, increasing, or decreasing either in Puerto Rico or throughout its range.

ANNUAL HUMAN-CAUSED MORTALITY

Since the inception of Puerto Rico's manatee carcass salvage program, 70 manatee deaths have been recorded from that area (Caribbean Stranding Network, unpubl. data). Many of the deaths have been attributed to human-related causes. Carcass collection efforts have documented mortalities associated with nets and watercraft (N=37). Many net-related mortalities involve poaching and are not substantiated by the presence of a carcass (Rathbun et al., 1985). From 1974 until 1988, 41.5 percent of the documented mortality was attributed to poaching. Watercraft-related mortalities are increasing. During the period 1988 to 1991, watercraft-related mortalities accounted for 43 percent of the known mortalities (U.S. Fish and Wildlife Service, 1992).

FISHERIES INFORMATION

In Puerto Rico, fisheries interactions have been documented through the carcass recovery program and in numerous anecdotal reports. Manatees are captured primarily in gill and/or turtle nets either intentionally or inadvertently during fishing activities. Reports indicate that manatee meat is sold to ready buyers, although the extent to which this occurs is unknown (Mignucci et al., 1993). Given the scarcity of detailed information, little is known about capture sites, seasonality of occurrence, etc. (Rathbun et al., 1985). Because these deaths account for a substantial proportion of known human-related mortalities (and because of the prevalence of fishery reports), it is apparent that fisheries interactions significantly affect the status of the manatee in Puerto Rico.

STATUS OF STOCK

The manatee is listed as "endangered" under provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), as amended. The manatee is considered a "strategic stock" as defined in Section 12 of the Marine Mammal Protection Act of 1972, as amended. The basis for this designation is the high level of documented mortality relative to the estimated population level and continuing, severe threats to critical manatee habitats throughout its range.

POTENTIAL BIOLOGICAL REMOVAL

Because of its endangered status, the recovery factor for the Antillean manatee in Puerto Rico should be 0.1, the lowest allowable figure. Given a minimum population estimate of 86 and an R_{max} (maximum net productivity rate) of 0.04, the Potential Biological Removal (PBR) rate for Antillean manatees in Puerto Rico and the U.S. Virgin Islands is as follows:

$$PBR = (86)(.02, \text{ or } 1/2 \ R_{max})(.1) = 0$$

We currently have insufficient knowledge of the Puerto Rican manatee population to determine the Optimum Sustainable Population. Inadequate information on population size and net productivity rate for manatees in Puerto Rico render the calculation of a PBR level for this population an exercise of limited value. Marmontel (1994) estimated net productivity for the Florida manatee population. This estimate, based largely on a long term sex and age dataset for that population, suggested that the net productivity was essentially zero (-0.003). When the default value above (0.2) is replaced with this empirical value, the equation results in a PBR level of zero.

The U.S. Fish and Wildlife Service has consistently concluded in Section 7 Biological Opinions, pursuant to the Endangered Species Act, that the take of a single manatee would "jeopardize the continued existence" of the species. We therefore believe that designating any level of take for Antillean manatees would be inappropriate and inconsistent with manatee recovery plans.

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