U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2012

Volume 1

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EXECUTIVE SUMMARY

Under the 1994 amendments of the Marine Mammal Protection Act (MMPA), the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS) were required to generate stock assessment reports (SARs) 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 2012 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 an appendix. 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), 4) summary tables of abundance estimates generated over recent years and the surveys from which they are derived (Appendix IV), and 5) the the USFWS West Indian manatee assessments (Appendix VI).

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 2011 publication. Most of the changes incorporate new information into sections on population size and/or mortality estimates. A total of 52 of the Atlantic and Gulf of Mexico stock assessment reports were revised for 2012. The revised SARs include 15 strategic and 37 non-strategic stocks. Ten of the Atlantic reports required a second period of public and scientific review due to some changes in abundance estimates and are not available in this online edition. Full reports for North Atlantic stocks of sei whale, fin whale, minke whale, sperm whale, harbor porpoise, white-sided-dolphin, Risso's dolphin and the Cuvier's, Gervais' and Sowerby's beaked whales will be published in a subsequent volume of this document.

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 February 2012 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 2012 SARs. In 1997 and 2004 SARs were not produced.

In this document, major revisions and updating of the SARs were completed for Atlantic strategic stocks and stocks for which significant new information were available. These are identified by the December 2012 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 2006-2010. The “SAR revised” column indicates 2012 stock assessment reports that have been revised relative to the 2011 reports (Y=yes, N=no). If abundance, mortality, PBR or status have been revised, they are indicated with the letters “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	SAR Revised
North Atlantic right whale	Western North Atlantic	NEC	444	0	444	0.04[a]	0.1	0.9	3.0[a]	1.8[a]	Y	Y a, m, p
Humpback whale	Gulf of Maine	NEC	823	0	823	0.065	0.1	2.7	7.8[b]	5.8[b]	Y	Y a, m, p
Fin whale	Western North Atlantic	NEC	This report is still under review.									Y a, m, p
Sei whale	Nova Scotia	NEC	This report is still under review.									Y a, m, p
Minke whale	Canadian east coast	NEC	This report is still under review.									Y a, m, p
Blue whale	Western North Atlantic	NEC	unk	unk	440	0.04	0.1	0.9	unk	unk	Y	N (2010)
Sperm whale	North Atlantic	NEC	This report is still under review.									Y a, m, p
Dwarf sperm whale	Western North Atlantic	SEC	1,042	0.65	632	0.04	0.5	6.3	0	0	N	Y a, m. p
Pygmy sperm whale	Western North Atlantic	SEC	741	0.40	535	0.04	0.5	5.4	0	0	N	Y a, m. p
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	N (2008)
Cuvier's beaked whale	Western North Atlantic	NEC	This report is still under review.									Y a, m. p
Blainville’s beaked whale	Western North Atlantic	NEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y a, m. p)
Gervais beaked whale	Western North Atlantic	NEC	This report is still under review.									Y a, m. p
Sowerby’s beaked whale	Western North Atlantic	NEC	This report is still under review.									Y a, m. p
True’s beaked whale	Western North Atlantic	NEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y a, m. p

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	This report is still under review.									Y a, m, p
Pilot whale, long-finned	Western North Atlantic	NEC	12,619	0.37	9,333	0.04	0.5	93	162 [c]	162 (0.15)	Y	N (2011)
Pilot whale, short-finned	Western North Atlantic	SEC	24,674	0.45	17,190	0.04	0.5	172	162[c]	162 (0.15)	N	N (2011
Atlantic white-sided dolphin	Western North Atlantic	NEC	This report is still under review.									Y a, m, p,
White-beaked dolphin	Western North Atlantic	NEC	2,003	0.94	1,023	0.04	0.5	10	0	0	N	N (2007)
Short-beaked common dolphin	Western North Atlantic	NEC	67,191	0.29	52,893	0.04	0.5	529	166	166 (0.11)	N	Y a, m, p
Atlantic spotted dolphin	Western North Atlantic	SEC	26,798	0.66	16,151	0.04	0.5	162	0.2	0	N	Y a,m,p
Pantropical spotted dolphin	Western North Atlantic	SEC	4,439	0.49	3,010	0.04	0.5	30	6	6 (1.0)	N	N (2007)
Striped dolphin	Western North Atlantic	NEC	46,882	0.33	35,763	0.04	0.5	358	0	0	N	Y a, m, p
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	N (2008)
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 [d]	0.17	70,775[d]	0.04	0.4	566	unk	unk	N	N (2008)
Bottlenose dolphin	Western North Atlantic, coastal, northern migratory	SEC	9,604	0.36	7,147	0.04	0.5	71	5.9-8.2	5.9-8.2	Y	N (2010)
Bottlenose dolphin	Western North Atlantic, coastal, southern migratory	SEC	12,482	0.32	9,591	0.04	0.5	96	24-55	24-55	Y	N (2010)
Bottlenose dolphin	Western North Atlantic, coastal, S. Carolina/Georgia	SEC	7,738	0.23	6,399	0.04	0.5	64	unk	unk	Y	N (2010)
Bottlenose dolphin	Western North Atlantic, coastal, northern Florida	SEC	3,064	0.24	2,511	0.04	0.5	25	unk	unk	Y	N (2010)
Bottlenose dolphin	Western North Atlantic, coastal, central Florida	SEC	6,318	0.26	5,094	0.04	0.5	51	unk	unk	Y	N (2010)

Bottlenose dolphin	Northern North Carolina Estuarine System	SEC	950	0.23	785	0.04	0.5	7.9	4.1-22.6	4.1-22.6	Y	Y a, p
Bottlenose dolphin	Southern North Carolina Estuarine System	SEC	2,454	0.53	1,614	0.04	0.5	16	0.6-1.2	0.6-1.2	Y	N (2010)
Bottlenose dolphin	Charleston Estuarine System	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2009)
Bottlenose dolphin	Northern Georgia/ Southern South Carolina Estuarine System	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2009)
Bottlenose dolphin	Southern Georgia Estuarine System	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2009)
Bottlenose dolphin	Jacksonville Estuarine System	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2009)
Bottlenose dolphin	Indian River Lagoon Estuarine System	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2009)
Bottlenose dolphin	Biscayne Bay	SEC	unk	unk	unk	0.04	0.5	unk	unk	0.2	Y	N (2009)
Bottlenose dolphin	Florida Bay	SEC	514	0.17	447	0.04	0.5	4.5	unk	unk	N	N (2009)
Harbor porpoise	Gulf of Maine/Bay of Fundy	NEC	This report is still under review.									Y a, m, p
Harbor seal	Western North Atlantic	NEC	unk	unk	unk	0.12	0.5	undet	342	337 (0.15)	N	Y m
Gray seal	Western North Atlantic	NEC	unk	unk	unk	0.12	1.0	unk	5,250	850 (0.14)	N	Y m
Harp seal	Western North Atlantic	NEC	unk	unk	unk	0.12	1.0	unk	379,673[e]	282 (0.19)	N	Y m
Hooded seal	Western North Atlantic	NEC	unk	unk	unk	0.12	0.75	unk	5,199[f]	25(0.82)	N	N (2007)
Sperm whale	Gulf of Mexico Oceanic	SEC	763	0.38	560	0.04	0.1	1.1	0.2	0	Y	Y a, m, p
Bryde's whale	Gulf of Mexico Oceanic	SEC	33	1.07	16	0.04	0.5	0.1	0.2	0	Y	Y a, p
Cuvier's beaked whale	Gulf of Mexico Oceanic	SEC	74	1.04	36	0.04	0.5	0.4	0	0	N	Y a, p
Blainville's beaked whale	Gulf of Mexico Oceanic	SEC	149[m]	0.91	77[m]	0.04	0.5	0.8[n]	0	0	N	Y a, p
Gervais' beaked whale	Gulf of Mexico Oceanic	SEC	149[m]	0.91	77 [m]	0.04	0.5	0.8[n]	0	0	N	Y a, p

Bottlenose dolphin	Gulf of Mexico Continental shelf	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	N	Y Stranding and fishery data
Bottlenose dolphin	Gulf of Mexico, eastern coastal	SEC	7,702	0.19	6,551	0.04	0.5	66	unk	unk	N	Y Stranding and fishery data
Bottlenose dolphin	Gulf of Mexico, northern coastal	SEC	2,473	0.25	2,004	0.04	0.5	20	unk	unk	Y	Y Stranding and fishery data
Bottlenose dolphin	Gulf of Mexico, western coastal	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	Y	Y Stranding and fishery data
Bottlenose dolphin	Gulf of Mexico Oceanic	SEC	5,806	0.39	4,230	0.04	0.5	42	0.6	0.6 (1.0)	N	Y a, m, p
Bottlenose dolphin	Gulf of Mexico bay, sound, and estuary (29 stocks)	SEC	unk for all but 4 stocks	unk	unk for all but 4 stocks	0.04	0.5	undet for all but 4 stocks	unk	unk	Y for all	Y Stranding and fishery data
Bottlenose dolphin	Barataria Bay	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	Y	Y Stranding and fishery data
Bottlenose dolphin	St. Joseph Bay	SEC	146	0.18	126	0.04	0.5	1.3	unk	unk	Y	Y Stranding and fishery data
Bottlenose dolphin	Choctawhatchee Bay	SEC	179	0.04	173	0.04	0.5	1.7	unk	unk	Y	Y Stranding and fishery data
Atlantic spotted dolphin	Gulf of Mexico (Continental shelf and Oceanic)	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	N	Y Stranding and fishery data
Pantropical spotted dolphin	Gulf of Mexico Oceanic	SEC	50,880	0.27	40,699	0.04	0.5	407	3.2	3.2 (0.69)	N	Y a, m, p
Striped dolphin	Gulf of Mexico Oceanic	SEC	1,849	0.77	1,041	0.04	0.5	10	0	0	N	Y a, p
Spinner dolphin	Gulf of Mexico Oceanic	SEC	11,441	0.83	6,221	0.04	0.5	62	0	0	N	Y a, p
Rough-toothed dolphin	Gulf of Mexico (Outer continental shelf and Oceanic)	SEC	624	0.99	311	0.04	0.5	3	0	0	N	Y a, p
Clymene dolphin	Gulf of Mexico Oceanic	SEC	129	1.00	64	0.04	0.5	0.6	0	0	N	Y a, p
Fraser's dolphin	Gulf of Mexico Oceanic	SEC	unk	unk	unk	0.04	0.5	undet	0	0	N	Y a, p
Killer whale	Gulf of Mexico Oceanic	SEC	28	1.02	14	0.04	0.5	0.1	0	0	N	Y a, p
False killer whale	Gulf of Mexico Oceanic	SEC	unk	unk	unk	0.04	0.5	undet	0	0	N	Y a, p

Pygmy killer whale	Gulf of Mexico Oceanic	SEC	152	1.02	75	0.04	0.5	0.8	0	0	N	Y a, p
Dwarf sperm whale	Gulf of Mexico Oceanic	SEC	186[e]	1.04	90[g]	0.04	0.5	0.9[g]	0	0	N	Y a, p
Pygmy sperm whale	Gulf of Mexico Oceanic	SEC	186[e]	1.04	90[g]	0.04	0.5	0.9[g]	0.3	0.3 (1.0)	N	Y a, m, p
Melon-headed whale	Gulf of Mexico Oceanic	SEC	2,235	0.75	1,274	0.04	0.5	13	0	0	N	Y a, p
Risso's dolphin	Gulf of Mexico Oceanic	SEC	2,442	0.57	1,563	0.04	0.5	16	1.7	1.7 (0.63)	N	Y a, m, p
Pilot whale, short-finned[h]	Gulf of Mexico Oceanic	SEC	2,415	0.66	1456	0.04	0.5	15	0	0	N	Y a, p
Sperm Whale	Puerto Rico and US Virgin Islands stock	SEC	unk	unk	unk	0.04	0.1	unk	unk	unk	Y	N (2010)
Bottlenose dolphin	Puerto Rico and US Virgin Islands stock	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2011)
Cuvier's beaked whale	Puerto Rico and US Virgin Islands stock	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2011)
Pilot whale, short-finned	Puerto Rico and US Virgin Islands stock	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2011)
Spinner dolphin	Puerto Rico and US Virgin Islands stock	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2011)
Atlantic spotted dolphin	Puerto Rico and US Virgin Islands stock	SEC	unk	unk	unk	0.04	0.5	unk	unk	unk	Y	N (2011)

a. The R given for right whales is the default Rmax of 0.04. The total estimated human-caused mortality and serious injury to right whales is estimated at 3.0 per year (USA waters, 1.4; Canadian waters, 0.6). This is derived from two components: 1) non-observed fishery entanglement records at 1.8 per year (USA waters, 1.6; Canadian waters, 0.2), and 2) ship strike records at 1.2 per year (USA waters, 0.8; Canadian waters, 0.4).

b. The total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as 7.8 per year (USA waters, 7.6; Canadian waters, 0.2). This average is derived from two components: 1) incidental fishery interaction records 5.8 (USA waters, 5.6; Canadian waters, 0.2); 2) records of vessel collisions, 2.0 (USA waters, 2.0; Canadian waters, 0)

c. While abundance estimates have been attributed to each stock, the bycatch estimate includes both long-finned and short-finned pilot whales.

d. Estimates may include sightings of the coastal form.

e. The total estimated human caused annual mortality and serious injury to harp seals is 379,673. Estimated annual human caused mortality in US waters) 282 harp seals CV=0.19) from the observed US fisheries. The remaining mortality is derived from five components: 1) 2006-2010 average catches of Northwest Atlantic harp seals by Canada, 188,646; 2) 2006-2010 average Greenland Catch, 82,063; 3) 1,000 average catches in the Canadian Arctic; 4) 12,330 average bycatches in the Newfoundland lumpfish fishery; and 5) 95,347 average struck and lost animals.

f. This is derived from three components: 1) 5,173 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; 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.

g. This estimate includes Gervais' beaked whales and Blainville's beaked whales.

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

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The western North Atlantic right whale population ranges primarily from calving grounds in coastal waters of 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), northern Norway (Jacobsen *et al.* 2004), and the Azores (Hamilton *et al.* 2009). 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 are extensive. 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). There is also at least one recent case of a calf apparently being born in the Gulf of Maine (Patrician *et al.* 2009).

New England waters are important feeding habitats for right whales, which feed in this area primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*). 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 Provincetown 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. Analysis of the sightings data has shown that utilization of these areas has a strong seasonal component (Pace and Merrick 2008). The consistency with which right whales occur in such locations is relatively high, but these studies also highlight the high interannual

variability in right whale use of some habitats (Pendleton *et al.* 2009) .

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified 7 mtDNA haplotypes in the western North Atlantic right whale, including hetroplasmy that led to the declaration of the 7th haplotype (Malik *et al.* 1999, McLeod and White 2010). 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 by Malik *et al.* (2000). The low diversity in North Atlantic right whales might be indicative of inbreeding, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure, 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 that nearly all the remains in the North American Basque whaling archaeological sites were bowhead whales and not right whales (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% 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 conclusion was that the majority of these calves must have different fathers that cannot be accounted for by the 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. Since 2006, collaborators have sampled approximately 66% of the calves detected in the wintering grounds.

POPULATION SIZE

The western North Atlantic minimum stock size is based on a census of individual whales identified using photo-identification techniques. A review of the photo-ID recapture database as it existed on 21 October 2011 indicated that 425 individually recognized whales in the catalog were known to be alive during 2009. Whales catalogued by this date included 20 of the 39 calves born during that year. Thus adding the 19 calves not yet catalogued brings the minimum number alive in 2009 to 444 (Figure 1). This number represents a minimum population size. This count has no associated coefficient of variation.

Previous estimates using the same method with the added assumption that whales seen within the previous seven years were still alive have resulted in counts of 295 animals in 1992 (Knowlton *et al.* 1994) and 299 animals in 1998 (Kraus *et al.* 2001). An International Whaling Commission (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).

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, 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 444 individuals in 2009 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 2008, but not recorded in the individual sightings database as seen during 1 December 2008 to 21 October 2011 (note that matching of photos taken during 2010-2011 was not complete at the time these data were received).

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, but that number may have been influenced by discovery phenomenon as existing whales were recruited to the catalog. 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). At the time, no one examined the early part of the recapture series for excessive retrospective recaptures which had the potential to positively bias survival as the catalog was being developed.

An increase in mortality in 2004 and 2005 was cause for serious concern (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 those mortalities, six were adult females, three of which were carrying near-term fetuses. Furthermore, four of these females were just starting to bear calves, losing their complete lifetime reproduction potential. Strong evidence for flat or negative growth exists in the time series of minimum number alive during 1998-2000, which coincided with very low calf production, 2004 and 2005 appear to show good growth (Figure 1).

Examination of the minimum number alive population index calculated from the individual sightings database, as it existed on 21 October 2011, for the years 1990-2009 (Figure 1) suggests a positive and slowly accelerating trend in population size. These data reveal a significant increase in the number of catalogued whales with a geometric mean growth rate for the period of 2.6%.

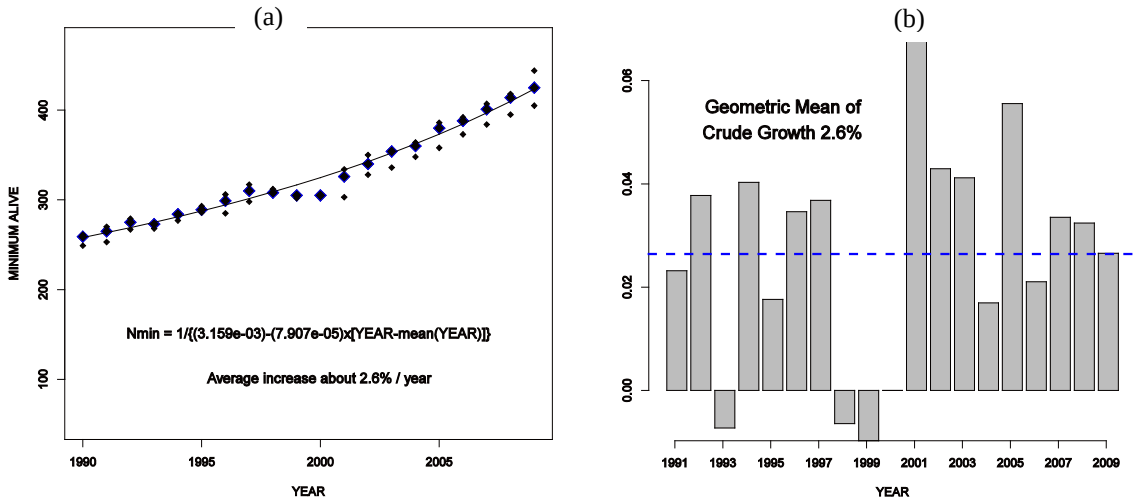

Figure 1. Minimum number alive (a) and crude annual growth rate (b) for cataloged North Atlantic right whales. Minimum number (N) of cataloged individuals known to be alive in any given year includes all whales known to be alive prior to that year and seen in that year or subsequently plus all whales newly cataloged that year. Cataloged whales may include some but not all calves produced each year. Bracketing the minimum number of cataloged whales is the number without calves (below) and that plus calves above, the latter which yields Nmin for purposes of stock assessment. Mean crude growth rate (dashed line) is the exponentiated mean of $\log_e [(N_{t+1}-N_t)/N_t]$ *for each year (t).*

The minimum number alive may increase slightly in later years as analysis of the backlog of unmatched but high-quality photographs proceeds. 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 set.

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 2009 are shown below in Table 1. The mean calf production for this seventeen year period was 17.2 (15.3-19.4; 95% C.I.). During the 2004 and 2005 calving seasons three adult females were found dead with near-term fetuses.

An updated analysis of calving intervals through the 1997/1998 season suggests that the mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al.* 2001). This conclusion was 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 southern right whales, *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 3 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. Calf and perinatal mortality was estimated by Browning *et al.* (2010) to be between 17 and 45 animals during the period 1989 and 2003. 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.

The maximum net productivity rate is 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).

Table 1. North Atlantic right whale calf production and mortality, 1993-2010.

Year[a]	Reported calf production	Reported calf mortalities
1993	8	2
1994	9	0
1995	7	0
1996	22	3
1997	20	1
1998	6	1
1999	4	0
2000	1	0
2001	31	4
2002	21	2
2003	19	0
2004	17	1
2005	28	0
2006	19	2
2007	23	2
2008	23	2
2009	39	1
2010	19	0

a. includes December of the previous year

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 for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The recovery factor for right whales is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). The minimum population size is 444. The maximum productivity rate is 0.04, the default value for cetaceans. PBR for the Western Atlantic stock of the North Atlantic right whale is 0.9.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2006 through 2010, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 3.0 per year (U.S. waters, 2.4; Canadian waters, 0.6). This is derived from two components: 1) incidental fishery entanglement records at 1.8 per year (U.S. waters, 1.6; Canadian waters, 0.2), and 2) ship strike records at 1.2 per year (U.S. waters, 0.8; Canadian waters, 0.4). Of the 8 reported fisheries entanglements from U. S. waters during this 5-year time period that were classified as serious injury or mortality, 5 were reported before the Atlantic Large Whale Take Reduction Plan's sinking-groundline rule went into effect in April 2009, and 3 were reported after enactment of the rule. Of the 4 reported ship strike serious injury and mortalities from U.S. waters during this 5-year time period, 3 were in 2006 (prior to the speed limit rule which went into effect in December 2009), and 1 was in 2010, after the rule was in effect. Statistical analysis of the effectiveness of both of these rules is underway. 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). 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 Henry *et al.* (2012). Annual rates calculated from detected mortalities should not be considered an unbiased estimate of human-caused mortality, but they represent a definitive lower bound. Detections are haphazard, incomplete and not the result of a designed sampling scheme. As such they represent a minimum

estimate of human-caused mortality which is almost certainly biased low.

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; Henry *et al.* 2012). 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 minimum detected annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) for the period 2006–2010 was 3.0 right whales per year (U.S. waters 2.4; Canadian waters, 0.6). 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 3.0 right whales per year must be regarded as a minimum count (Henry *et al.* 2012).

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 was recorded (IWC 1999; Knowlton and Kraus 2001; Glass *et al.* 2009). 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 2006 through 2010, 9 of 15 records of mortality or serious injury (including records from both U.S. and Canadian waters) involved entanglement or fishery interactions. For this time frame, the average reported mortality and serious injury to right whales due to fishery entanglement was 1.8 whales per year (U.S. waters, 1.6; Canadian waters, 0.2). 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 often unsuccessful or not possible for many cases, during the period 2006 through 2010, there were at least two documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious-injury determination. An adult female, #2029, first sighted entangled in the Great South Channel on 9 March 2007, may have avoided serious injury due to being partially disentangled on 18 September 2007 by researchers in the Bay of Fundy, Canada. On 8 December 2008, #3294 was successfully disentangled. Sometimes, even with disentanglement, an animal may die of injuries sustained from fishing gear. A female yearling right whale, #3107 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. Additionally, but infrequently, a whale listed as seriously injured becomes gear-free without a disentanglement effort and is seen later in reasonable health. Such was the case for whale #1980, listed as a serious injury in 2008 but seen gear-free and apparently healthy in 2011.

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 observed by the Northeast Fisheries Observer Program was in the pelagic drift gillnet fishery in 1993. No mortalities or serious injuries have been documented in any of the other fisheries monitored by NMFS.

Entanglement records from 1990 through 2010 maintained by NMFS Northeast Regional Office (NMFS, unpublished data) included 74 confirmed right whale entanglements, including right whales in weirs, gillnets, and 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 that were 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 2006 through 2010 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 1.2 whales per year (U.S. waters, 0.8; Canadian waters, 0.4).

Table 2. Confirmed human-caused mortality and serious injury records of Western North Atlantic right whales (Eubalaena glacialis), 2006 - 2010.

Date[a]	Report Type	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship Strike	Entanglement/ Fishery interaction	
1/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
1/22/06	mortality	Calf Female[b] 5.6m	off Ponte Vedra Beach, FL		P	Significant premortem lesions from entanglement in apparent monofilament netting; no gear present
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
3/31/07	mortality	Calf Male 7.7m	Outer Banks, NC		P	Edema associated with flipper and dorsal & ventral thoracic musculature; epidermal abrasion indicated entangling body and flipper wraps; no gear recovered

9/24/08[c]	serious injury	Adult Male #2110	Jeffreys Ledge	S	P	Spinal scoliosis associated with fresh entanglement injuries; compromised pectorals; emaciated; heavy cyamid load; pale skin; healed lacerations from previously documented vessel strike injury potentially exacerbate scoliosis; no gear present
1/14/09	serious injury	Juvenile sex unknown #3311	off Brunswick, GA		P	Partial disentanglement; embedded wrap in rostrum & lip removed; decline in health; fixed trap/pot gear
1/27/09	serious injury	Juvenile Male #3710 9.8m	Cape Lookout Shoals, NC		P	Live stranded w/ spinal scoliosis; euthanized; necropsy determined scoliosis due to entanglement and not congenital; entanglement wounds chronically infected; no gear recovered
6/27/10	mortality	Adult Male	off Cape May, NJ		P	Evidence of constricting rostrum, mouth & flipper wraps w/ associated hemorrhage and bone damage; no gear recovered
7/2/10	mortality	Calf Male 7.9m	off Grand Manan Island, ME	P		2 large lacerations from dorsal to ventral surface
8/12/10	mortality	Adult Male 14.1m	Digby Neck, NS		P	Evidence of entanglement with associated hemorrhaging around right flipper; no gear present
9/10/10	serious injury	Adult Female #1503	Jeffreys Ledge		p	Constricting rostrum wrap; evidence of health decline; no gear recovered

12/25/10	serious injury	Juvenile Female #3911	off Jacksonville, FL		p	Embedded line in mouth and on flipper; severe health decline; acute cause of death was shark predation; gear analysis pending

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. Additional information on previous event that was not included in previous reports.
c. Additional even not included in previous reports.

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 2005). NMFS is presently engaged in evaluating the need for critical habitat designation for the North Atlantic right whale. Under a prior listing as northern right whale, 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). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the North Atlantic right whale (Brown *et al.* 2009). 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 3.0 right whales per year from 2006 through 2010. Given that PBR has been set to 0.9, 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 (Waring *et al.* 2000); 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 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).

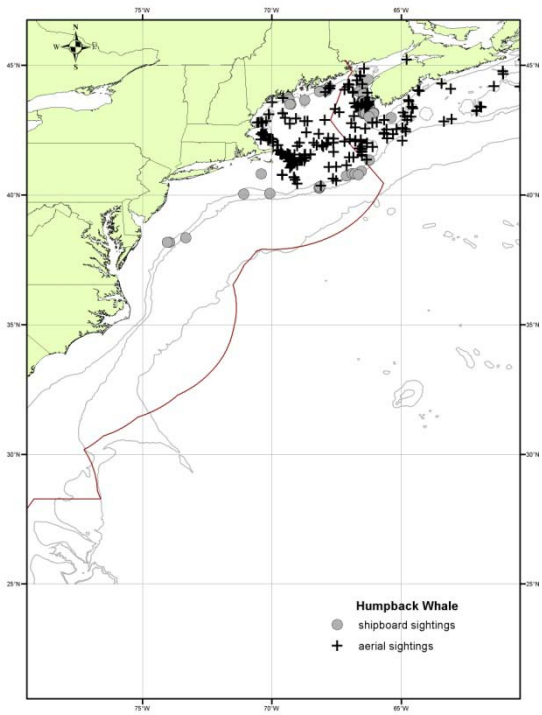

Figure 1. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

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 were compared to both 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 Provincetown 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 of the 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 other 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 North Atlantic feeding areas (including the Gulf of Maine) mate and calve in the West Indies, where spatial and genetic mixing among feeding groups occurs (Katona and Beard 1990; Clapham *et al.* 1993; Palsbøll *et al.* 1997; Stevick *et al.* 1998). A few whales likely using eastern North Atlantic feeding areas migrate to the Cape Verde Islands (Reiner *et al.* 1996; Wenzel *et al.* 2009). 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 may be 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 that 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 numbers of 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 (i.e., the closest feeding ground) and other areas in the North Atlantic. Of 21 live whales, 9 (43%) matched to the Gulf of Maine, 4 (19%) 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.

In New England waters, feeding is the principal activity of humpback whales, and their distribution in this region has been largely correlated to abundance of prey species, although behavior and bottom topography are factors influencing 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 (Wienrich *et al.* 1997). Diel patterns in humpback foraging behavior have

been shown to correlate with diel patterns in sand lance behavior (Friedlaender *et al.* 2009).

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.

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 Gulf of Maine to estimate abundance and refine knowledge of the North Atlantic humpback whales' population structure. The work is intended to update the YONAH population assessment.

Gulf of Maine stock - earlier estimates

Please see Appendix IV for earlier estimates. 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.

Gulf of Maine Stock - Recent surveys and abundance estimates

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 a small 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.). Photo-identification evidence indicates a 25% exchange rate between whales on the Scotian Shelf and the catalogued Gulf of Maine population (Clapham *et al.* 2003), which suggest that a 25% correction factor should be applied to the humpback population estimate from the Scotian Shelf stratum. Because the Scotian Shelf was surveyed during 2006, the 25% correction factor was applied to only the 2006 abundance estimate. In contrast to 2006, a line-transect based abundance estimate for humpbacks on the Scotian Shelf based on the 2007 Canadian component of the Trans-North Atlantic Sighting Survey (TNASS) survey was 2,612 (CV=0.26) whales (Lawson and Gosselin 2011).

An abundance of 335 (CV=0.42) humpback whales was estimated from a line-transect survey conducted during June–August 2011 by ship and plane (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a two-simultaneous-team data collection procedure, which allows estimation of abundance corrected for perception bias (Laake and Borchers, 2004). Estimation of abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling (MRDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). This estimate did not include the portion of the Scotian Shelf that is known to be part of the range used by

Gulf of Maine humpback whales. These various line-transect surveys lack consistency in geographic coverage, and because of the mobility of humpback whales, pooling stratum estimates across years to produce a single estimate is not advisable. However, similar to an estimate that appeared in Clapham *et al.* (2003), Robbins (2010) used photo-id evidence of presence to calculate the minimum number alive of catalogued individuals seen during the 2008 feeding season within the Gulf of Maine, or seen both before and after 2008, plus whales seen for the first time as non-calves in 2009. That procedure placed the minimum number alive at 823 animals.

Minimum Population Estimate

For statistically-based estimates, 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 most recent line-transect survey, which did not include the Scotian Shelf portion of the stock, produced an estimate of abundance for Gulf of Maine humpback whales of 331 animals (CV=0.48) with a resultant minimum population estimate for this stock of 228 animals. The line-transect based Nmin is unrealistic because at least 500 uniquely identifiable individual whales from the GOM stock were seen during the calendar year of that survey and the actual population would have been larger because re-sighting rates of GOM humpbacks have historically been <1. Using the minimum count from at least 2 years prior to the year of a stock assessment report allows time to resight whales known to be alive prior to and after the focal year. Thus the minimum population estimate is set to the 2008 mark-recapture based count of 823.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales with month, year, and area covered during each abundance survey, and resulting abundance estimate (N_{best}) and coefficient of variation (CV).

Month/Year	Type	N_{best}	CV
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
Jun-Oct 2008	Gulf of Maine and Bay of Fundy	823	0
Jun-Aug 2011	North Carolina to lower Bay of Fundy	335	0.42

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

Zerbini *et al.* (2010) reviewed various estimates of maximum productivity rates for humpback whale populations, and, based on simulation studies, they proposed that 11.8% be considered as the maximum rate at which the species could grow. 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). More recent work by Robbins (2007) places apparent survival of calves at 0.664 (95% CI: 0.517-0.784), a value intermediate between those used by Barlow and Clapham (1997).

Despite the uncertainty accompanying the more recent estimates of observed population growth rate for the Gulf of Maine stock, the maximum net productivity rate was assumed to be 6.5% calculated by Barlow and Clapham (1997) because it represents an observation greater than the default of 0.04 for cetaceans (Barlow *et al.* 1995) but is conservative in that it is well below the results of Zerbini *et al.* (2010).

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 823 whales. The maximum productivity rate is 0.065. 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 2.7 whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2006 through 2010, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 7.8 animals per year (U.S. waters, 7.2; Canadian waters, 0.6). This value includes incidental fishery interaction records, 5.8 (U.S. waters, 5.2; Canadian waters, 0.6); and records of vessel collisions, 2.0 (U.S. waters, 2.0; Canadian waters, 0) (Henry *et al.* 2012).

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 from the southern side of Nova Scotia 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) 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 data assessed for serious injury and mortality. 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 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 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. 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). A total of 965 humpbacks were reported entangled in fishing gear in Newfoundland and Labrador from 1979 to 2008 (Benjamins *et al.* 2011). 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. In more recent times, following the collapse of the cod fishery, groundfish gillnets for other fish species and crab pot lines have been the most common sources of humpback entanglement. One humpback whale was reported released alive (status unknown) from a herring weir off Grand Manan in 2009 (H. Koopman, UNC Wilmington, pers. comm.).

As reported by Wiley *et al.* (1995), serious injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. However in the NMFS records for 2006 through 2010, there are 10 reports of mortalities as a result of collision with a vessel and 29 serious injuries and mortalities attributed to entanglement. Because it has never been shown that serious injuries and mortalities related to ships or to fisheries interactions are equally detectable, it is unclear as to which human source of mortality is more prevalent. 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 (Henry *et al.* 2012).

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, 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). Large whale entanglements are rarely observed during fisheries sampling operations. However, during 2008, 3 humpback whales were observed as incidental bycatch: 2 in gillnet gear (1 no serious injury; 1 undetermined) and 1 in a purse seine (released alive).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period 2006 through 2010 were reviewed. Entanglements accounted for nine mortalities and 20 serious injuries and were a secondary cause of mortality for another animal. 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 minimum frequency of entanglements. Of the 27 reported fisheries entanglements resulting in serious injury or mortality from U.S. waters during this 5-year time period, 17 were reported before the Atlantic Large Whale Take Reduction Plan's sinking-groundline rule went into effect in April 2009, and 10 were reported after enactment of the rule. Statistical analysis of the effectiveness of this rule is underway.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January 2006 - December 2010. 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.

Date[a]	Report Type	Age, Sex, ID, Length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
1/9/2006	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
3/17/2006	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
3/25/2006	serious injury	Juvenile sex unknown 8m (est)	Flagler Beach, FL (confirmed Canadian gear)[b]		P	Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys and was identified as Canadian lobster pot gear
8/6/2006	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

8/23/2006	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
09/06/06[c]	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth, continuing back to multiple wraps around peduncle; no gear recovered
09/27/06[d]	serious injury	age & sex unknown	off Cape May, NJ		P	Line anchored in mouthline & crosses over back; extent of entanglement unknown but animal is emaciated
10/15/2006	mortality	Juvenile Female 10.1m	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
1/27/2007	serious injury	age & sex unknown	off Beach Haven, NJ		P	Body wrap likely to become constricting; random cyamid patches; thin body condition; probable flipper wraps; no gear recovered
5/10/2007	mortality	Adult Female 12.5m	off Wachapreague, VA	P		Cranium shattered, hemorrhaging on left lateral side midway between flippers & fluke

5/13/2007	mortality	Juvenile Male 9.3m	Rockport, MA	P		Areas of hemorrhaging indicate major blunt trauma to chest, neck, & head
6/23/2007	serious injury	age unknown Male "Egg Toss"	Wildcat Knoll		P	Body wrap of gear imbedded; no gear recovered
6/24/2007	mortality	Juvenile Female "Tofu" 9.9m	Stellwagen Bank	P		Subdermal hemorrhaging involving blubber, fascia, & muscle extending from/around the insertion of the right flipper ventrally to the axilla
12/21/2007	mortality	age unknown Male 9.4m	Ocean Sands, Corolla, NC		P	Documented wrapped in gear, gear removed without permission prior to necropsy; external lesions at flukes, flippers, mouth, dorsal fin, dorsal keel, & ventral pleats consistent with gillnet entanglement; emaciated; no gear recovered
1/6/2008	serious injury	age & sex unknown 10m (est)	off Cape Lookout, NC		P	Constricting line cutting into right flipper in several places; heavy cyamid load; emaciated; no gear recovered
5/30/2008	mortality	age & sex unknown	Georges Bank		P	Constricting body wraps, one wrap under lower jaw; open wound on right flipper; no gear recovered
6/9/2008	mortality	age & sex unknown	Georges Bank		P	Constricting body wrap; gear analysis pending

7/8/2008	serious injury	Adult Female "Estuary"	off Nauset, MA		P	Cuts were made, but no gear was removed; emaciated; moderate cyamid coverage; deep wounds in fluke blades from gear; hunched over position maintained after cuts were made to the gear; gear analysis pending
8/13/2008	serious injury	age & sex unknown 10m (est)	off NJ		P	Partial disentanglement; emaciated; lethargic; heavy cyamid load; gear analysis pending
8/21/2008	serious injury	age & sex unknown	off Chatham, MA		P	Evidence of decline in health; no gear recovered
11/4/2008	mortality	Juvenile Male 10.1m	Assateague Island, MD	P		Cranial fractures with associated hemorrhaging
2/8/2009	mortality	age unknown Male 9.7m	Cape Fear, NC		P	Evidence of entanglement at mouthline, peduncle, and flipper with associated hemorrhaging; emaciated; no gear present
2/16/2009	mortality	Juvenile Male 10.0m	Nags Head, NC		P	Evidence of entanglement involving anchoring or heavily weighted gear with associated hemorrhaging; no gear present
2/25/2009	serious injury	Juvenile sex unknown	off Sandy Hook, NJ		P	Disentangled from anchoring gear; maintained hunched body position post-disentanglement; no gear recovered

6/9/2009	serious injury	age & sex unknown	Stellwagen Bank		P	Constricting body wrap just forward of the flippers; no gear recovered
12/9/2009	serious injury	age & sex unknown	off Jacksonville, FL (confirmed Canadian gear)[b]		P	Disentangled; evidence of health decline; Canadian gillnet gear
3/7/2010	serious injury	age & sex unknown	off Ponte Vedre, FL		P	Constricting body & flipper wraps; evidence of severe health decline
3/13/2010	mortality	Juvenile Female 9.1m	Ocean City, MD	P		Skull fractures with associated hemorrhaging
5/5/2010	serious injury	Juvenile sex unknown	Chesapeake Bay		P	Gear likely to become constricting as animal grows; evidence of health decline; no gear recovered
5/8/2010	mortality	Adult Female 9.8m	Narragansett, RI		P	Evidence of constricting gear with associated hemorrhaging; fluid filled lungs; gear analysis pending
5/15/2010	serious injury	Juvenile Male 8.8m	off Hatteras Inlet, NC		P	Live stranded; euthanized; necrotic infected injuries consistent with entanglement; no gear present
5/18/2010	serious injury	Adult sex unknown "Pinch"	Stellwagen Bank		P	Constricting body wrap; no gear recovered
5/28/2010	mortality	Adult Female 11.2m	Edgartown, MA		P	Evidence of entanglement with associated bruising & edema; gear analysis pending
6/10/2010	mortality	Juvenile Male 9.6m	Jones Beach State Park, NY	P		Extensive hemorrhage & edema on right dorsal lateral surface
7/4/2010	mortality	Juvenile Female 8.7m	off Assateague, MD	P		Extensive hemorrhage & edema to left lateral area

8/13/2010	serious injury	age & sex unknown	off Nauset, MA		P	Head wrap likely to become constricting; gear analysis pending
8/20/2010	serious injury	Juvenile sex unknown 2008 calf of "Trident"	Stellwagen Bank		P	Embedded peduncle wrap; evidence of health decline; no gear recovered
11/27/2010	mortality	Juvenile Male 7.5m (est)	Bay of Fundy, Canada		P	Evidence of constricting wraps on fluke, peduncle, and flipper; no gear recovered
12/23/2010	serious injury	age & sex unknown	off Port Everglades Inlet, FL		P	Evidence of entanglement & severe health decline; no gear present

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. Gear origin not included in previous reports.

c. Record was added after review of carcasses sighted on 08/20/06 and 09/06/06. Previous reports stated these were the same animal. Recent review could not confirm the resight; therefore they are now being treated as two separate events. There was inconclusive evidence with regard to the carcass on 08/20/06 to determine mortality caused by entanglement.

d. Record was added after review of event; not included in previous reports

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.

In July 2003, an Unusual Mortality Event (UME) was invoked 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. Causes of these UME events have not been determined.

STATUS OF STOCK

NMFS recently concluded a global humpback whale status review, the report of which is expected to be completed in 2012. NMFS will include the relevant results of this review in the SARs when they are available. 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. A Recovery Plan was 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). 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. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species.

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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.

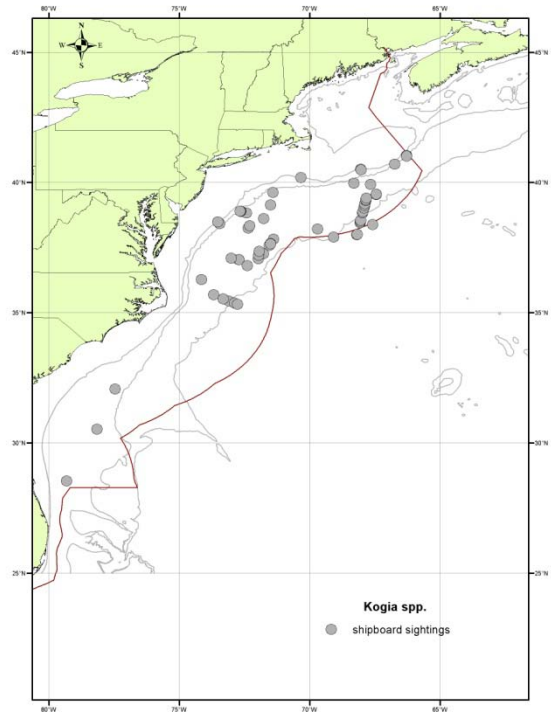

Figure 1. *Distribution of Kogia spp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

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.

POPULATION SIZE

Abundanceestimates from selected regions of the dwarf sperm whale habitat exist for select time periods. Because *K. sima* and *K. breviceps* are difficult to differentiate at sea, the reported abundance estimates prior to the 2011 estimate are for both species of *Kogia*. The best abundance estimate for dwarf sperm whales is the result of the 2011 survey—1,042 (CV=0.65).

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

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 $\geq$ 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 *Kogia* sp. between Florida and Maryland was 37 animals (CV=0.75).

An abundance estimate of 1,042 (CV=0.65) dwarf sperm whales was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). The abundance estimates of dwarf sperm whales include a percentage of the estimate of animals identified as *Kogia* sp. (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified dwarf sperm whales to the total of positively identified pygmy sperm whales and positively identified dwarf sperm whales; the CV of the abundance estimate includes the variance of the estimated fraction. Both sighting platforms used a two-simultaneous team data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling (MRDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). In addition, an abundance survey was conducted concurrently in the southern U.S. waters (from North Carolina to Florida). The abundance estimates from this southern survey are being calculated and are not available at this time.

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

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
Jun-Aug 2011	North Carolina to lower Bay of Fundy	1,042	0.65

[a] 2011 estimates are for dwarf sperm whales alone, not the *Kogia* sp.

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 dwarf sperm whales is 1,042 (CV=0.65) The minimum population estimate for dwarf sperm whales is 632 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 dwarf sperm whales is 632. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic dwarf sperm whales is 6.3.

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 2006–2010 was zero for dwarf sperm whales, as there were no reports of mortality or serious injury to this species.

Earlier Interactions

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

From 2006–2010, 32 dwarf sperm whales were reported stranded along the U.S. Atlantic coast and Puerto Rico (Table 2). In addition, there were 5 records of unidentified *Kogia*.

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2006–2010. 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	2006			2007			2008			2009			2010			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Maine	0	1	0	0	2	0	0	0	0	0	1	0	0	0	0	0	4	0
Massachusetts	0	1	0	0	1	1	0	2	0	1	2	0	0	0	0	1	6	1
Rhode Island	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
New York	0	0	0	0	1	0	0	0	0	0	2	0	0	2	0	0	5	0
New Jersey	0	0	0	0	1	0	0	1	0	0	0	0	0	3	0	0	5	0
Delaware	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	0	1	0	0	6	0	2	0	0	0	0	0	0	0	2	2	7	2
North Carolina	8	7	0	7	5	0	1	4	1	1	6	0	3	5	0	20	27	1
South Carolina	0	1	0	1	3	0	0	5	0	1	6	0	1	6	0	3	21	0

Georgia	0	2	0	0	1	0	0	3	0	0	2	0	0	2	0	0	10	0
Florida	1	2	0	1	5	0	2	5	0	0	6	0	2	17	1	6	35	1
Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
TOTALS	9	18	0	9	27	1	5	20	1	3	26	0	6	36	3	32	127	5

There was one documented stranding of a dwarf sperm whale along the U.S. Atlantic coast during 2006–2010 which was classified as a human interaction. This was a 2006 Florida mortality that was classified as a fishery interaction.

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 western North Atlantic stock of dwarf sperm whales is not a strategic stock because the average annual human-related mortality and serious injury rate does not exceed the PBR. 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. The status of dwarf sperm whales relative to OSP in the western U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. This species is not listed as endangered or threatened under the Endangered Species Act.

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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.

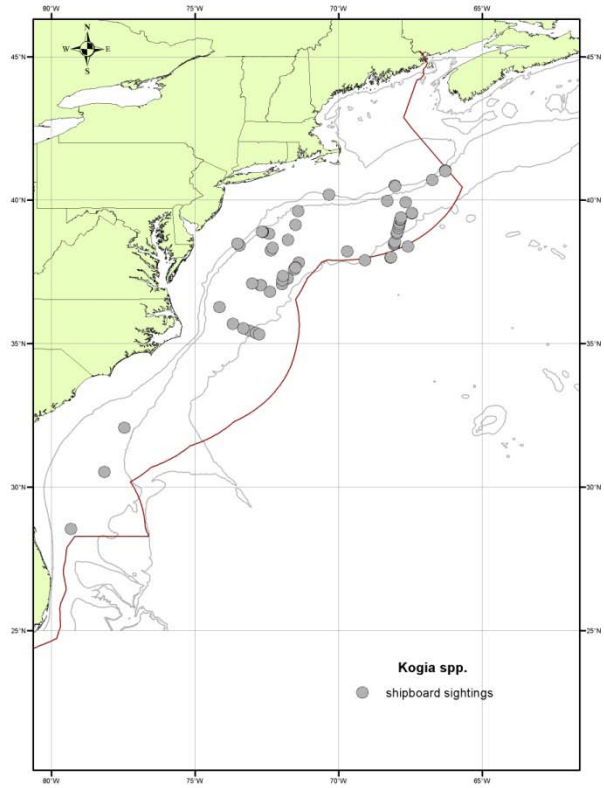

Figure 1. *Distribution of Kogia spp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

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.

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 prior to the 2011 estimate are for both species of *Kogia*. The best abundance estimate for pygmy sperm whales is the result of the 2011 survey—741 (CV=0.40).

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

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).

An abundance estimate of 741 (CV=0.40) pygmy sperm whales was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a two-simultaneous team data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling (MRDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). The abundance estimates of pygmy sperm whales include a percentage of the estimate of animals identified as *Kogia* sp. (the two species being sometimes hard to distinguish). The percentage used is the ratio of positively identified pygmy sperm whales to the total of positively identified pygmy sperm whales and positively identified dwarf sperm whales; the CV of the abundance estimate includes the variance of the estimated fraction. In addition, an abundance survey was conducted concurrently in the southern U.S. waters (from North Carolina to Florida). The abundance estimates from this southern survey are being calculated and are not available at this time.

Table 1. Summary of abundance estimates for the western North Atlantic *Kogia* sp. [a] 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
Jun-Aug 2011	North Carolina to lower Bay of Fundy	741	0.40

a. 2011 estimates are for pygmy sperm whales alone, not the *Kogia* sp.

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 pygmy sperm whales is 741 animals (CV=0.40). The minimum population estimate for pygmy sperm whales is 535 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 pygmy sperm whales. is 535. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic pygmy sperm whales is 5.4.

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 2006–2010 was zero for pygmy sperm whales, as there were no reports of mortality or serious injury to this species.

Earlier Interactions

Between 1992 and 2005, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in the pelagic longline fishery in the Atlantic in 2000 (Yeung 2001).

Other Mortality

From 2006–2010, 127 pygmy sperm whales were reported stranded along the U.S. Atlantic coast and Puerto Rico (Table 2). In addition, there were 5 records of unidentified *Kogia*.

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2006–2010. 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	2006			2007			2008			2009			2010			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Maine	0	1	0	0	2	0	0	0	0	0	1	0	0	0	0	0	4	0
Massachusetts	0	1	0	0	1	1	0	2	0	1	2	0	0	0	0	1	6	1
Rhode Island	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0
New York	0	0	0	0	1	0	0	0	0	0	2	0	0	2	0	0	5	0
New Jersey	0	0	0	0	1	0	0	1	0	0	0	0	0	3	0	0	5	0
Delaware	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	4	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	0	1	0	0	6	0	2	0	0	0	0	0	0	0	2	2	7	2
North Carolina	8	7	0	7	5	0	1	4	1	1	6	0	3	5	0	20	27	1
South Carolina	0	1	0	1	3	0	0	5	0	1	6	0	1	6	0	3	21	0
Georgia	0	2	0	0	1	0	0	3	0	0	2	0	0	2	0	0	10	0
Florida	1	2	0	1	5	0	2	5	0	0	6	0	2	17	1	6	35	1

Puerto Rico	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
TOTALS	9	18	0	9	27	1	5	20	1	3	26	0	6	36	3	32	127	5

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 and one dwarf sperm whale 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 16 documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 2006–2010 which were classified as human interactions. In 2006, mortalites in Maine, North Carolina and Rhode Island (1 each) were classified as human interactions. In Massachusetts in 2007, a pygmy sperm whale was classified as a human interaction because it was pushed off the beach. The animal was last seen swimming with its mother. Two other human interaction cases were documented in 2007—one in South Carolina and one (fishery interaction) in Virginia. In 2008, one animal in Georgia was classified as a human interaction. In 2009, there was a fishery interaction stranding mortality in Massachusetts and a human interaction in South Carolina. There were 7 strandings classified as human interactions in 2010—3 in Florida, 2 in New Jersey and 2 in South Carolina (one of them classified as a fishery interaction).

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 western North Atlantic stock of pygmy sperm whales is not a strategic stock because the average annual human-related mortality and serious injury rate does not exceed the PBR. 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. The status of pygmy sperm whales relative to OSP in the western U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. This species is not listed as endangered or threatened under the Endangered Species Act.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus Mesoplodon, there are four species of beaked whales that reside in the northwest Atlantic. These include True's beaked whale, *M. mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens* (Mead 1989). These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only. Stock structure for each species is unknown. Therefore, it is plausible the stock could actually contain multiple demographically independent populations that should themselves be stocks, because the current stock spans multiple eco-regions (Longhurst 1998; Spalding *et al.* 2007).

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989; Nawojchik 1994; Mignucci-Giannoni *et al.* 1999; MacLeod *et al.* 2006; Jefferson *et al.* 2008). Off the U.S. Atlantic coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the shelf-edge and deeper oceanic waters (Figure 1; CETAP 1982; Waring *et al.* 1992; Tove 1995; Waring *et al.* 2001; Hamazaki 2002; Palka 2006). Most sightings were in late spring and summer, which corresponds to survey effort.

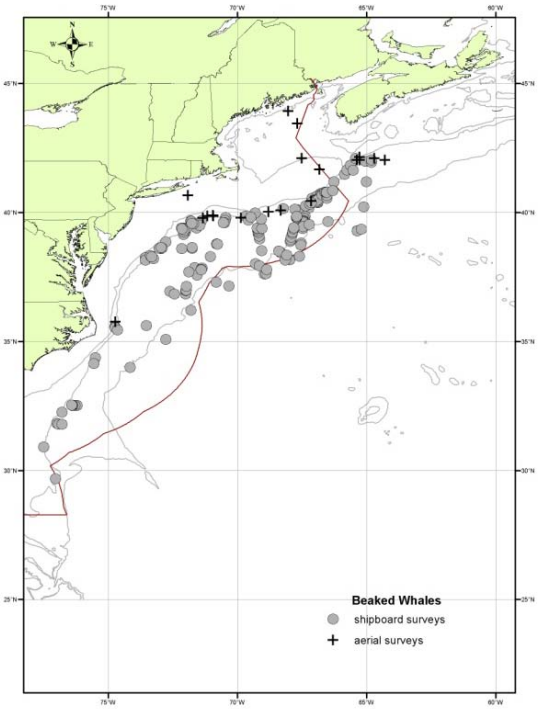

Figure 1: *Distribution of beaked whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, and 2007, 2008, 2010, and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth*

Blainville's beaked whales have been reported from southwestern Nova Scotia to Florida, and are believed to be widely but sparsely distributed (Leatherwood *et al.* 1976; Mead 1989; Nicolas *et al.* 1993; MacLeod *et al.* 2006; Jefferson *et al.* 2008). There are two records of strandings in Nova Scotia which probably represent strays from the Gulf Stream (Mead 1989). They are considered rare in Canadian waters (Houston 1990).

POPULATION SIZE

The total number of Blainville's beaked whales off the eastern U.S. and Canadian Atlantic coast is unknown, and seasonal abundance estimates are not available for this stock. 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).

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent surveys and abundance estimates

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 > 50m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June–August, 2004. The survey employed two independent visual teams searching with 25× 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.)

No beaked whales sighted during a shipboard and aerial abundance survey conducted during June–August 2011 were identified as Blainville's beaked whales (Palka 2012). The aerial portion covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). In addition, an abundance survey was conducted concurrently in the southern U.S. waters (from North Carolina to Florida). The abundance estimates from this southern survey are being calculated and are not available at this time.

Although the 1990-2011 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 1990-2011 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. NMFS survey results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features (Waring *et al*. 2001, Hamazaki 2002).

Because the estimates presented here were not dive-time corrected, they are likely negatively biased and probably underestimate actual abundance. Given that *Mesoplodon* spp. prefer 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
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

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 these species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. *Mesoplodon* spp. life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3m, length at sexual maturity 6.1m 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 0.5. PBR for the western North Atlantic stock of Blainville's beaked whales is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2006–2010 total average estimated annual mortality of Blainville's beaked whales in fisheries in the U.S. Atlantic EEZ is 0.2 based on one stranded animal likely killed in 2007 by fishery entanglement (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 2006–2010 in U.S. fisheries was 0.2.

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 from the 1989 to 1993 period 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). Estimates of bycatch mortality by species are available for the 1994-1998 period. None of the animals were identified as Blainville's beaked whales. Estimated annual fishery-related mortality for unidentified *Mesoplodon* beaked whales during this period was 0 in 1994, 3 (0) in 1995, 2 (0.25) in 1996, and 7 (0) in 1998. There was no fishery during 1997. During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part".

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 – 2010. The estimated average combined mortality in 2006–2010 was zero beaked whales.

Other Mortality

From 2006–2010, a total of 4 Blainville's beaked whales stranded along the U.S. Atlantic coast between Florida

and Massachusetts (NMFS unpublished data). One animal in 2007 that stranded in South Carolina was classified as a fishery interaction)

Several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities (D'Amico *et al.* 2009; Filadelfo *et al.* 2009). 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; D'Amico *et al.* 2009; Filadelfo *et al.* 2009). 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).

Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Cox *et al.* 2006, Fernandez *et al.* 2005; Martin *et al.* 2004). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez *et al.* 2005).

Table 2. Blainville's beaked whale (*Mesoplodon densirostris*) strandings along the U.S. Atlantic coast.

State	2006	2007	2008	2009	2010	Total
North Carolina	1	1	1	0	0	**3**
South Carolina[a]	0	1	0	0	0	**1**
Total	**1**	**2**	**1**	**0**	**0**	**4**

a. Animal in South Carolina in 2007 is classified as a fishery interaction due to entanglement marks around its peduncle.

STATUS OF STOCK

The western North Atlantic stock of Blainville's beaked whale is not a strategic stock. There are insufficient data to determine the population size or trends, and PBR cannot be calculated for this stock. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and a single 2007 stranding record was the only fishery-related mortality and serious injury observed during the recent 5-year (2006–2010) period. Therefore, total U.S. fishery-related mortality and serious injury rate can be considered to be insignificant and approaching zero. The status of Blainville's beaked whales relative to OSP in U.S. Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus *Mesoplodon*, there are four species of beaked whales that reside in the northwest Atlantic. These include True's beaked whale, *M. mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens* (Mead 1989). These species are difficult to identify to the species level at sea; therefore, much of the available characterization for beaked whales is to genus level only. Stock structure for each species is unknown. Therefore, it is plausible the stock could actually contain multiple demographically independent populations that should themselves be stocks, because the current stock spans multiple eco-regions (Longhurst 1998; Spalding *et al.* 2007).

The distribution of *Mesoplodon* spp. in the northwest Atlantic is known principally from stranding records (Mead 1989; Nawojchik 1994; Mignucci-Giannoni *et al.* 1999; MacLeod *et al.* 2006; Jefferson *et al.* 2008). Off the U.S. Atlantic coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the shelf-edge and deeper oceanic waters (Figure 1; CETAP 1982; Waring *et al.* 1992; Tove 1995; Waring *et al.* 2001; Hamazaki 2002; Palka 2006). Most sightings were in late spring and summer, which corresponds to survey effort.

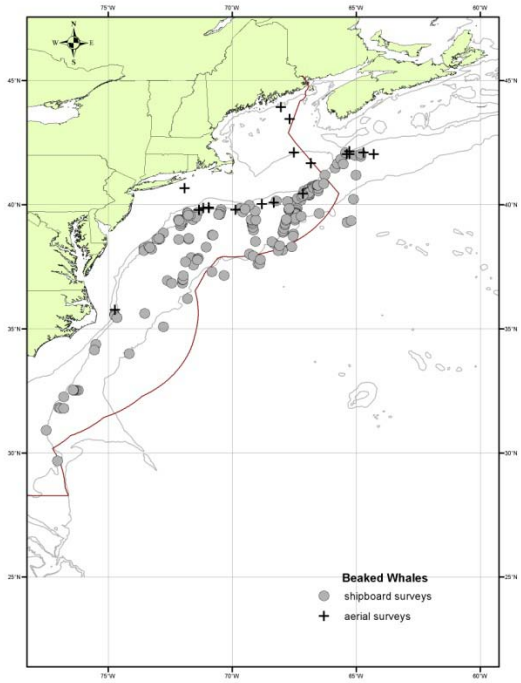

Figure 1: *Distribution of beaked whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1995, 1998, 1999, 2002, 2004, 2006, 2007, 2008, 2010, and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

True's beaked whale is a temperate-water species that has been reported from Cape Breton Island, Nova Scotia, to the Bahamas (Leatherwood *et al.* 1976; Mead 1989; MacLeod *et al.* 2006; Jefferson *et al.* 2008). It is considered rare in Canadian waters (Houston 1990).

POPULATION SIZE

The total number of True's beaked whales off the eastern U.S. and Canadian Atlantic coast is unknown, and seasonal abundance estimates are not available for this stock. 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).

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent surveys and abundance estimates

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 > 50m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June–August, 2004. The survey employed two independent visual teams searching with 25× 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.)

No beaked whales were identified as True's beaked whales during a shipboard and aerial abundance survey conducted during June–August 2011 (Palka 2012). The aerial portion covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). In addition, an abundance survey was conducted concurrently in the southern U.S. waters (from North Carolina to Florida). The abundance estimates from this southern survey are being calculated and are not available at this time.

Although the 1990-2011 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 1990-2011 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. NMFS survey results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features (Waring *et al*. 2001, Hamazaki 2002).

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
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

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 species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. *Mesoplodon* spp. life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3m, length at sexual maturity 6.1m 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 0.5. PBR for the western North Atlantic stock of True's beaked whales is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The 2006–2010 total average estimated annual mortality of True's beaked whales in observed fisheries in the U.S. Atlantic EEZ is zero.

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 2006–2010 in U.S. fisheries was zero. 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 from the 1989 to 1993 period 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). Estimates of bycatch mortality by species are available for the 1994-1998 period. For animals identified as True's beaked whales, bycatch estimates were 0 in 1994, 1 (0) in 1995, 2 (0.26) in 1996 and 2 (0) in 1998. Estimated annual fishery-related mortality for unidentified *Mesoplodon* beaked whales during this period was 0 in 1994, 3 (0) in 1995, 2 (0,25) in 1996, and 7 (0) in 1998. There was no fishery during 1997. During July 1996, one beaked whale was entangled and released alive with "gear in/around a single body part".

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 - 2010. The estimated average combined mortality in 2006–2010 was zero beaked whales.

Other Mortality

During 2006–2010, two True's beaked whales stranded along the U.S. Atlantic coast (Table 3). Neither of these animals showed evidence of a human interaction.

Several unusual mass strandings of beaked whales throughout their worldwide range have been associated with naval activities activities (D'Amico *et al.* 2009; Filadelfo *et al.* 2009. During the mid- to late 1980's 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 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; A'Amico *et al.* 2009; Filadelfo *et al.* 2009). 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). Fourteen beaked whales (mostly Cuvier's beaked whales but also including Gervais' and Blainville's beaked whales) stranded in the Canary Islands in 2002 (Cox *et al.* 2006, Fernandez *et al.* 2005; Martin *et al.* 2004). Gas bubble-associated lesions and fat embolism were found in necropsied animals from this event, leading researchers to link nitrogen supersaturation with sonar exposure (Fernandez *et al.* 2005).

Table 3. True's beaked whale (*Mesoplodon mirus*) strandings along the U.S. Atlantic coast.

State	2006	2007	2008	2009	2010	Total
New Jersey	0	1	0	0	0	**1**
New York	0	1	0	0	0	**1**
Total	**0**	**2**	**0**	**0**	**0**	**2**

STATUS OF STOCK

The western North Atlantic stock of True's beaked whale is not a strategic stock. There are insufficient data to determine the population size or trends, and PBR cannot be calculated for this stock. The permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality, and no fishery-related mortality and serious injury has been observed during the recent 5-year (2006–2010) period. Therefore, total U.S. fishery-related mortality and serious injury rate can be considered to be insignificant and approaching zero. The status of True's beaked whales relative to OSP in U.S. Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act.

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SHORT-BEAKED COMMON DOLPHIN (*Delphinus delphis 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 and subtropical seas. In the North Atlantic, common dolphins occur over the continental shelf along the 100-2000-m isobaths and over prominent underwater topography and east to the mid-Atlantic Ridge (29˚W) (Doksaeter *et al.* 2008; Waring *et al*. 2008). The species is less common south of Cape Hatteras, although schools have been reported as far south as the Georgia/South Carolina border (32º N) (Jefferson *et al*. 2009). In waters off the northeastern USA coast, common dolphins are distributed along the continental slope 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), more often in the last few years (Figure 1). 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).

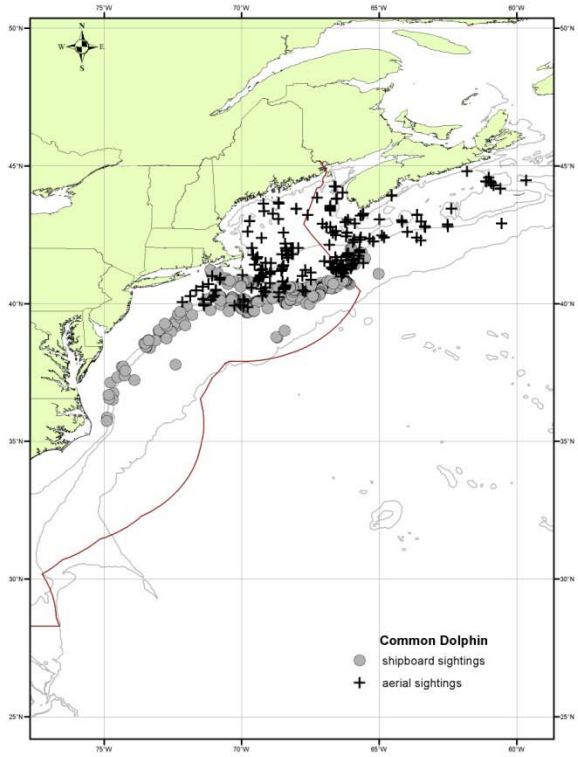

Figure 1. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

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 than 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).

There is a peak in parturition during July and August with an average birth day of 28 July. 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

Several abundance estimates are available for common dolphins from selected regions for selected time periods. The current best abundance estimate for common dolphins off the U.S. or Canadian Atlantic coast is the result of the 2011 survey—67,191 (CV=0.29).

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 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 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.).

An abundance estimate of 173,486 (CV=0.55) common dolphins was generated from the Canadian Trans North Atlantic Sighting Survey in July–August 2007 (Lawson and Gosselin 2009). This aerial survey covered area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. The abundance estimates from this survey have been corrected for perception and availability bias, when possible. In general this involved correcting for perception bias using mark-recapture distance sampling (MRDS), and correcting for availability bias using dive/surface times, as reported in the literature, and the Laake (1997) analysis method (Lawson and Gosselin in 2011).

An abundance estimate of 67,191 (CV=0.29) common dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a two-simultaneous team data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling (MRDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009).

Please see appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions. 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.

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
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
July-Aug 2007	N. Labrador to Scotian Shelf	173,486	0.29
Jul-Aug 2011	North Carolina to lower Bay of Fundy	67,191	0.29

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 67,191 animals (CV=0.29) derived from the 2011 surveys. The minimum population estimate for the western North Atlantic common dolphin is 52,893.

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 52,893 animals. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.5, the default value for stocks of unknown status relative to optimum sustainable population (OSP), and 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 529.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2006–2010 was 164 (CV=0.12) common dolphins.

Fishery information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

For more details on the historical fishery interactions prior to 1999 see Waring *et al.* (2007).

In the Atlantic pelagic longline fishery between 1990 and 2007, 20 common dolphins were observed hooked and

released alive.

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.

Northeast Sink Gillnet

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). 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. Four common dolphins were observed taken in northeast sink gillnet fisheries in 2005, one in 2006, one in 2007, two in 2008, 3 in 2009, and 4 in 2010. 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, 5 (0.80) in 2005, 20 (1.05) in 2006, 11 (0.94) in 2007, 34 (0.77) in 2008, 43 (0.77) in 2009, and 42 (0.94) in 2010. The 2006–2010 average annual mortality attributed to the northeast sink gillnet was 30 animals (CV=0.42).

A study of the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40´) in February, March and April. Researchers purposely picked an area of historically high bycatch rates in order to have a chance of finding a significant difference. Eight research strings of fourteen nets each were fished and 159 hauls were completed during the course of the 2009-2010 study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. One common dolphin was caught in this study south of New England in 72 hauls during 2009 and one animal was caught in 72 hauls during the 2010 experiment in the Northeast (A.I.S., Inc. 2010). These 2 takes are included in Table 2.

Mid-Atlantic Gillnet

Two common dolphins were observed taken in 1995, 1996, and 1997, and no takes were observed from 1998 to 2005. One common dolphin was taken in an observed trip during 2006, none were observed in 2007 – 2009, and 10 takes were observed in 2010. 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, 11 (1.03) in 2006, 0 in 2007 – 2009, and 31 (0.65) in 2010. Average annual estimated fishery-related mortality attributable to this fishery during 2006–2010 was 8.4 (CV=0.55) common dolphins (Table 2). A study of the effects of tie-downs and bycatch rates of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in both control and experimental gillnet gear operating in Statistical Area 612 (off NY and NJ) between 14 November 2010 and 18 December 2010 had 100% observer coverage. This experimental fishery captured 7 common dolphins and two unidentified dolphins, (unidentified due to lack of photos) during this time period (Fox *et al.* 2011). These 7 takes are included in Table 2.

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. One common dolphin was observed taken in 2002, 3 in 2004, 5 in 2005, 1 in 2006, 3 in 2007, 1 in 2008, 5 in 2009 and 9 in 2010 (Table 2). 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, 25 in 2006, 24 (0.28) in 2007, 17 (0.29) in 2008, 19 (0.30) in 2009, and 17 (0.28) in 2010. The 2006–2010 average annual mortality attributed to the northeast bottom trawl was 20 animals (CV=0.13).

Mid-Atlantic Bottom Trawl

Three common dolphins were observed taken in mid-Atlantic bottom trawl fisheries in 2000, 2 in 2001, 9 in 2004, 15 in 2005, 14 in 2006, 0 in 2007, 1 in 2008, 12 in 2009, and 2 in 2010 (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, 131 (0.28) in 2006, 66 (0.27) in 2007, 108 (0.28) in 2008, 104 (0.29) in 2009 and 104 (0.29) in 2010. The 2006–2010 average annual mortality attributed to the mid-Atlantic bottom trawl was 103 animals (CV=0.13).

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

A short-beaked common dolphin mortality was observed in this fishery in 2010 (Table 2) but an expanded bycatch estimate has not been calculated since the observed takes are so rare.

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

The first year a short-beaked common dolphin mortality had been observed in this fishery was in 2007. This animal was taken in the same haul as an Atlantic white-sided dolphin. Due to small sample sizes, the bycatch rate model used the 2003 to September 2007 observed mid-water trawl data, including paired and single, and northeast and mid-Atlantic mid-water trawls (Palka, pers. comm.). The model that best fit these data was a Poisson logistic regression model that included latitude and bottom depth as significant explanatory variables, where soak duration was the unit of effort. The resultant estimated annual fishery-related mortality and serious injury (CV in parentheses) was 3.2 (0.70) for 2007. The 2006–2010 average annual mortality attributed to the mid-Atlantic mid-water trawl was 0.6 (0.70) animals.

Pelagic Longline

In 2009, a common dolphin mortality was observed in the pelagic longline fishery, mid-Atlantic Bight fishing area (Garrison and Stokes 2010). The expanded estimate (CV in parentheses) for common dolphin bycatch attributed to this fishery was 8.5 (1.0) for 2009. The 2006–2010 average annual mortality was 1.7 (1.0).

Table 2. Summary of the incidental mortality of short-beaked common dolphins (*Delphinus delphis delphis*) by commercial fishery including the years sampled (Years), 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	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	06-10	Obs. Data, Trip Logbook, Allocated Dealer Data	.04, .07, .05, .04, .17	0, 0, 0, 0, 0	1, 1, 2, 3, 4	0, 0, 0, 0, 0	20, 11, 34, 43, 42	20, 11, 34, 43, 42	1.05, .94, .77, .77, .94	30 (.42)
Mid-Atlantic Gillnet[e]	06-10	Obs. Data, Trip Logbook, Allocated Dealer Data	.04, .06, .03, .03, .04	0, 0, 0, 0, 0	1, 0, 0, 0, 10	0, 0, 0, 0, 0	11, 0, 0, 0, 31	11, 0, 0, 0, 31	1.03, 0, 0, 0, .65	8.4 (.55)

Mid-Atlantic Mid-water Trawl - Including Pair Trawl	06-10	Obs. Data Weighout Trip Logbook	.089, .039, .13, .13, .25	0, 0, 0, 0, 0	0, 1, 0, 0, 0	0, 0, 0, 0, 0,	0, 3.2, 0, 0, 0	0, 3.2, 0, 0, 0	0, .70, 0, 0, 0, 0	0.6 (.70)
Northeast Mid-water Trawl - Including Pair Trawl	06-10	Obs. Data Weighout Trip Logbook	.031, .08, .199, .42, .54	0, 0, 0, 0, 0	0, 0, 0, 0, 1	0, 0, 0, 0, 0	0, 0, 0, 0, na	0, 0, 0 , 0, na	0, 0, 0 , 0, na	na
Northeast Bottom Trawl [d]	06-10	Obs. Data Dealer Data VTR Data	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	1, 3, 1, 5, 9	0, 0, 0, 0, 0	25, 24, 17, 19, 17	25, 24, 17, 19, 17	.28, .28, .29, .30, .28	20 (.13)
Mid-Atlantic Bottom Trawl [d]	06-10	Obs. Data Dealer	.02, .03, .03. .05, .06	0, 0, 0, 0 , 0	14, 0, 1, 12, 2	0, 0, 0, 0, 0	131, 66, 108, 104, 104	131, 66, 108, 104, 104	.28, .27, .28, .29, .29	103 (.13)
Pelagic Longline [b]	06-10	Obs. Data Logbook	.07, .07, .07, .10, .08	0, 0, 0, 0, 0	0, 0, 0, 1, 0	0, 0, 0, 0, 0	0, 0, 0, 8.5, 0	0, 0, 0, 8.5, 0	0, 0, 0, 1.0, 0	1.7 (1.0)
TOTAL										164 (.12)

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 mid-Atlantic bottom trawl, and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear in the year 2010 includes only samples collected from traditional fisheries observer, but not the fishery monitors. In the Northeast region 437 and 658 bottom trawl trips were sampled by observers and monitors, respectively. In the mid-Atlantic region, 661 and 75 bottom trawl trips were sampled by observers and monitors, respectively. Monitor trips will be incorporated next year, for 2011, the first full year of monitor coverage.

d. NE and MA bottom trawl mortality estimates reported for 2007-2010 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005; Rossman 2010) and the respective annual fishing effort (2007-2010). Because of this pooling, years with no observed mortality may still have a calculated estimate. The methods used in Rossman 2010 are scheduled to be updated during 2012-2013 to reflect data collected during the latest five year (2006–2010) period. 2010 estimates include only takes observed by traditional fishery observers. Observed takes do not include those observed by fishery 'monitors' and so are not incorporated into 2010 bycatch estimation.

e. One common dolphin was incidentally caught in 2009 and one in 2010 as part of a NEFSC hanging ratio study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. Seven common dolphins were caught in another research study in 2010. These animals are included in the observed interactions and added to the total estimates, though these interactions and their associated fishing effort were not included in bycatch rate calculations.

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

Two common dolphins were reported as incidental mortalities in NEFSC Atlantic herring monitoring activities in 2004. In 2007, one common dolphin was reported taken in a NEFSC spring bottom trawl survey.

From 2006 to 2010, 469 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass stranded common dolphins in Massachusetts during 2006 (a total of 65 in 10 events), 2007 (a total of 23 in 5 separate events), 2008 (one event of 5 animals and one of 2 animals), 2009 (a total of 26 in 6 events) and 2010 (a total of 30 in 8 events). Eighteen animals in 2006, 2 animals in 2007, 2 animals in 2008, 5 animals in 2009 and 11 animals in 2010 were released or last sighted alive. Human interactions were indicated on one of the 2007 New York mortality records and one of the 2006 Virginia mortality records. In 2008, seven common dolphins had indications of human interactions, four which were fishery interactions. In 2009, six common dolphins had indications of human interaction, 3 of which were classified as fishery interactions. In 2010, 7 animals were classified as human interactions, 3 of which were fishery interactions (all Massachusetts mass-stranded animals) and 2 of which (Rhode Island) involved animals last sighted free-swimming. An Unusual Mortality Event (UME) was declared in 2008 due to a relatively high number of strandings between January and April 2008, from New Jersey to North Carolina. Twenty-seven common dolphins were involved in this event (http://www.nmfs.noaa.gov/pr/health/mmume/midatlantic2008.htm accessed 19 April 2011). In Bogomolni's 2010 analysis of mortality causes of stranded marine mammals on Cape Cod and southeastern Massachusetts between 2000 and 2006, 61% of stranded common dolphins were involved in mass-stranding events, and 37% of all the common dolphin stranding mortalities were disease related (Bogomolni 2010).

Four common dolphin strandings (6 individuals) were reported on Sable Island, Nova Scotia from 1996 to 1998 (Lucas and Hooker 1997; 2000). The Marine Animal Response Society of Nova Scotia reported one common dolphin stranded in 2008, one in 2009 and one (released alive) in 2010 (Tonya Wimmer, pers. comm.).

Table 3. Short-beaked common dolphin (*Delphinus delphis delphis*) reported strandings along the U.S. Atlantic coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTALS
Maine	0	1	0	0	1	2
Massachusetts[a]	100	65	19	53	71	308
Rhode Island[c]	2	4	3	6	7	22
New York [b, c]	3	23	2	7	9	44
New Jersey[c]	2	4	9	6	14	35
Delaware[c]	0	0	2	4	0	6
Maryland	0	0	2	2	0	4
Virginia[c]	1	4	20	2	5	32
North Carolina[c]	2	0	1	7	6	16
TOTALS	110	101	58	87	113	469

a. Massachusetts mass strandings (2006 - 2,2,3,4,4,3,9,10,14, and 14; 2007 - 9,2,4,6,2; 2008 - 5 and 2; 2009 - 2,3,3,4,6,8, 2010 - 2,2,3,3,3,4,5,8).
b. One common dolphin was released alive from a pound net in 2006 in New York. Twenty (12 dead, 8 rescued; one of the mortalities classified as human interaction) animals were involved in a mass stranding in Suffolk county in 2007. Seven animals were involved in 2 mass stranding events in March 2009 (six euthanized, 1 died at site, 2 had signs of fishery interation). In addition, in 2008 3 animals were relocated from the Nansemond River.
c. One 2006 mortality in Virginia and one 2007 mortality in New York were reported as having human interactions. Seven records were reported with signs of human interaction in 2008 - 3 from Virginia, 1 from Massachusetts, one from North Carolina, and one from Delaware. Of these, 4 were fishery interactions. Six human interaction cases were reported in 2009 (2 Massachusetts, 3 Rhode Island, 1 New York), 3 of which were classified as fishery interactions (2 in Rhode Island and one in Massachusetts). Seven HI cases were reported in 2010 (4 mortalities in MA, 2 released alive in RI, and 1 mortality in NJ), 2 of which (MA) were classified as fishery 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.

STATUS OF STOCK

The 2006–2010 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock. 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 status of short-beaked common dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this species. The species is not listed as threatened or endangered under the Endangered Species Act.

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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.

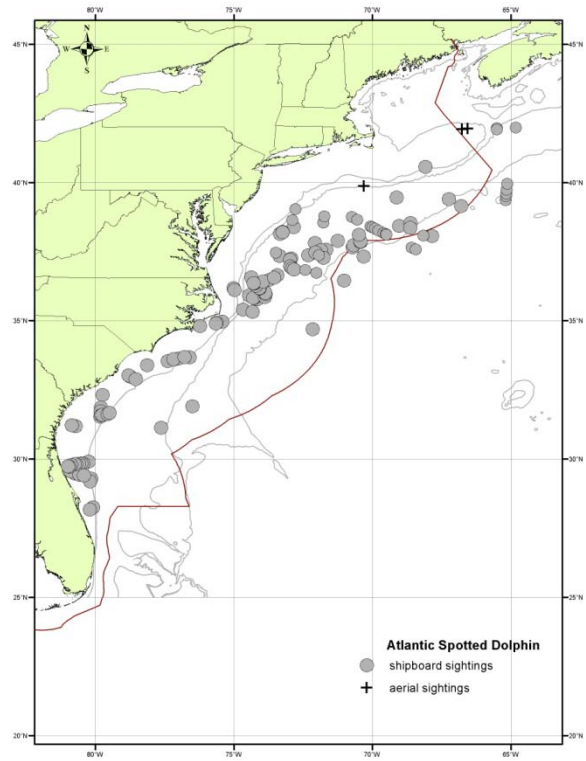

Figure 1. *Distribution of Atlantic spotted dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

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.

POPULATION SIZE

Atlantic spotted dolphin 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 result of the 2011 survey—26,798 (CV= 0.66) .

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

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

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) (Figure 1; Palka Unpublished Ms.). 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 (Figure 1; Palka Unpublished Ms).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ≥50 m) between 27.5 – 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 Atlantic spotted dolphins between Florida and Maryland was 47,400 animals (CV=0.45).

An abundance estimate of 26,798 (CV= 0.66) Atlantic spotted dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a two-simultaneous team data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling (MRDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). In addition, an abundance survey was conducted concurrently in the southern U.S. waters (from North Carolina to Florida). The abundance estimates from this southern survey are being calculated and are not available at this time.

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
Jun-Aug 2011	North Carolina to lower Bay of Fundy	26,798	0.66

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best abundance estimate is 26,798 (CV= 0.66). The minimum population estimates based on the 2011 abundance estimates is 16,151.

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 16,151. 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 162.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality or serious injury to this stock during 2006–2010 was 0.2 due to one animal in the stranding records that was struck by a boat.

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.

Between 1992 and 2005, 2 spotted dolphins (recorded as Atlantic spotted dolphins) were hooked and released alive in the pelagic longline fishery 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).

Other Mortality

From 2006–2010, 19 Atlantic spotted dolphins were stranded between Massachusetts and Puerto Rico (NMFS unpublished data). One of these strandings had documented signs of fishery or human interactions—a Florida 2007 mortality with extensive propeller wounds.

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, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTALS
New York	0	0	0	0	1	1
New Jersey	0	0	0	0	1	1
Virginia	0	0	0	0	1	1
North Carolina	1	0	1	1	6	9
South Carolina	1	0	0	0	0	1
Georgia	0	1	0	0	0	1
Florida[a]	0	2	0	2	0	4
Puerto Rico	0	0	0	0	1	1
TOTALS	2	3	1	3	10	19

a. One of the 2007 Florida animals was classified as a boat strike, One of the 2009 animals live stranded and was transferred to rehab.

STATUS OF STOCK

Average annual human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock. 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. The status of Atlantic spotted dolphins relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this species. The species is not listed as threatened or endangered under the Endangered Species Act.

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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; Archer 2002). 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). 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 dee per than 900 m.

Although striped dolphins are considered to be uncommon in Canadian Atlantic waters (Baird *et al.* 1997), 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).

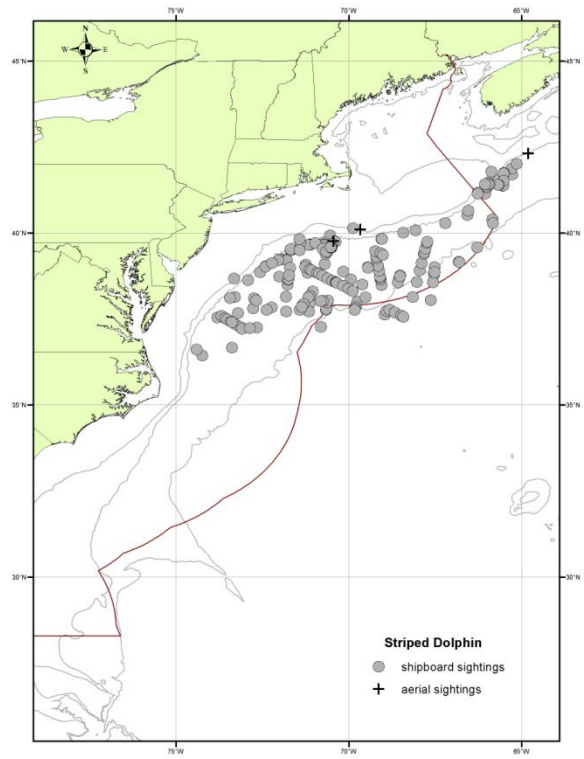

Figure 1: *Distribution of striped dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007, 2010 and 2011. Isobaths are the 100-m, 1000-m and 4000-m depth contours.*

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 continental slope areas west of Georges Bank (Figure 1). The best abundance estimate for striped dolphins is the result of the 2011 survey—46,882 (CV=0.33).

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 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 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 trackline 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).

An abundance estimate of 46,882 (CV=0.33) striped dolphins was generated from a shipboard and aerial survey conducted during June–August 2011 (Palka 2012). The aerial portion that contributed to the abundance estimate covered 5,313 km of tracklines that were over waters north of New Jersey and shallower than the 100-m depth contour through the U.S. and Canadian Gulf of Maine and up to and including the lower Bay of Fundy. The shipboard portion covered 3,107 km of tracklines that were in waters offshore of North Carolina to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the U.S. EEZ). Both sighting platforms used a two-simultaneous team data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers, 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling (MRDS) option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). Striped dolphins were also seen during the SEFSC summer 2011 abundance survey, which covered waters from North Carolina to Florida. The abundance resulting from the SEFSC survey has currently not yet been estimated.

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
Jun-Aug 2011	North Carolina to lower Bay of Fundy	46,882	0.33

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 46,882 (CV=0.33) obtained from the 2011 surveys. The minimum population estimate for the western North Atlantic striped dolphin is 35,763.

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 38,373. 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 358.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality to this stock during 2006–2010 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 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

A total of 68 striped dolphins have been reported stranded along the U.S. Atlantic coast between 1995 and 2005 (NMFS unpublished data). This includes one record of a mass stranding of 12 animals in North Carolina in 2005. During the period 2006–2010, a total of 47 striped dolphins were reported stranded along the U.S. Atlantic coast (Table 2).

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.

Table 3: Striped dolphin reported strandings along the U.S. Atlantic coast 2006–2010.

Stranding State	2006	2007	2008	2009	2010	**Total**
Maine	0	1	0	0	0	**1**
Massachusetts[a]	1	5	2	2	4	**14**
Rhode Island	0	0	1	0	1	**2**
New York	4	2	0	1	1	**8**
New Jersey[b]	1	2	7	0	2	**12**
Delaware	0	1	0	0	0	**1**
North Carolina[b]	1	3	2	2	0	**8**
Maryland	0	1	0	0	0	**1**
TOTALS	**7**	**15**	**12**	**5**	**8**	**47**

a. In 2007 one live stranding in Massachusetts was classified as a human interaction due to being pushed off the beach.

b. In 2008 one animal in New Jersey and one in North Carolina were classified as fishery interaction mortalities.

STATUS OF STOCK

Average annual human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock. 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. The status of striped dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this species. The species is not listed as threatened or endangered under the Endangered Species Act.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Northern North Carolina Estuarine System Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The coastal morphotype of bottlenose dolphin is continuously distributed along the Atlantic coast south of Long Island, New York, to the Florida peninsula, including inshore waters of the bays, sounds and estuaries. Several lines of evidence support a distinction between dolphins inhabiting coastal waters near the shore and those present primarily in the inshore waters of the bays, sounds and estuaries. Photo-identification (photo-ID) and genetic studies support the existence of resident estuarine animals in several areas (Caldwell 2001; Gubbins 2002; Zolman 2002; Gubbins *et al.* 2003; Mazzoil *et al.* 2005; Litz 2007), and similar patterns have been observed in bays and estuaries along the Gulf of Mexico coast (Wells *et al.* 1987; Balmer *et al.* 2008). Recent genetic analyses using both mitochondrial DNA and nuclear microsatellite markers found significant differentiation between animals biopsied along the coast and those biopsied within the estuarine systems at the same latitude (NMFS unpublished data). Similar results have been found off the west coast of Florida (Sellas *et al.* 2005; Balmer *et al.* 2008).

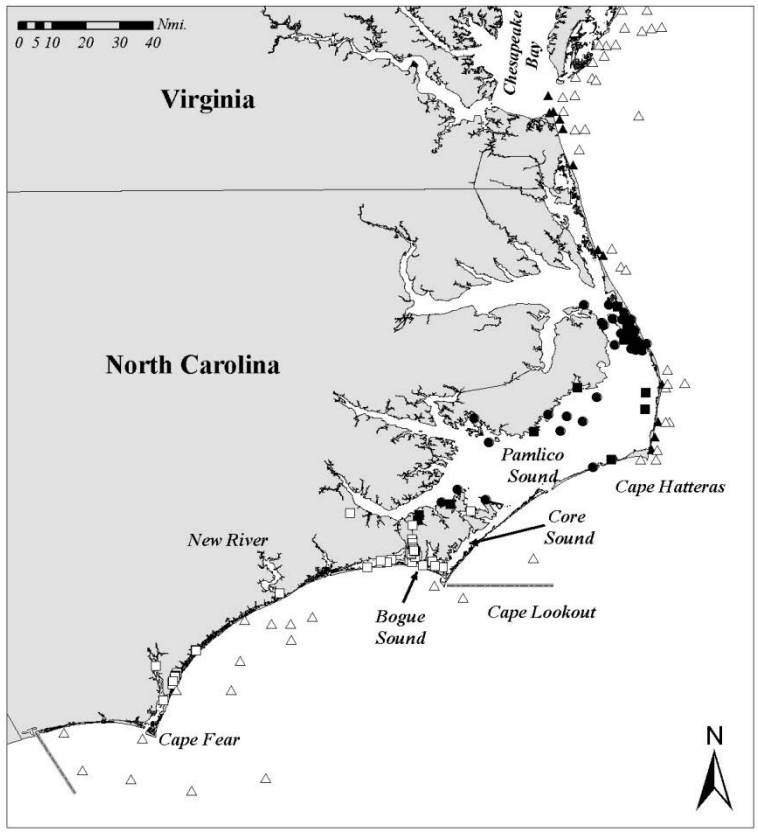

Figure 1. *The summer (July–August) distribution of bottlenose dolphins occupying coastal and estuarine waters in North Carolina and Virginia. Locations are shown from aerial surveys (triangles), satellite-linked telemetry (circles), and photo-identification studies (squares). Sightings assigned to the Northern North Carolina Estuarine System stock are shown with filled symbols. Photo-identification data are courtesy of Duke University and the University of North Carolina at Wilmington.*

The Northern North Carolina Estuarine System (NNCES) Stock is defined as animals that occupy estuarine waters of Pamlico Sound during summer months (July–August). The ranging patterns of bottlenose dolphins in photo-ID studies support the presence of a group of dolphins within these waters that are distinct from both dolphins occupying estuarine and coastal waters in southern North Carolina and animals in the Northern and Southern Migratory Stocks that occupy coastal waters of North Carolina at certain times of the year (Read *et al.* 2003; NMFS 2001; NMFS unpublished data). In addition, stable isotope analysis of animals sampled along the beaches of North Carolina between Cape Hatteras and Bogue Inlet during February and March showed very low stable isotope ratios of ^{18}O relative to ^{16}O (referred to as "depleted oxygen", Cortese 2000). One explanation for the depleted oxygen signature is a resident group of dolphins in Pamlico Sound that move into nearby coastal waters in the winter (NMFS 2001). The estuarine waters of Pamlico Sound had previously been included in the abundance estimates and stock assessment reports for the Northern migratory stock and the winter “mixed” North Carolina management unit of coastal bottlenose dolphins (Waring *et al.* 2007). However, they are now recognized as a distinct stock based upon these

differences in seasonal ranging patterns and stable isotope signatures.

The seasonal movements of the NNCES Stock are best described using a combination of telemetry and long-term photo-ID studies. Animals captured and released near Beaufort, North Carolina, were fitted with satellite-linked transmitters during November 1999 (3 animals), April 2000 (8 animals), and April 2006 (5 animals) (NMFS unpublished data). In addition, long-term photo-ID studies have been conducted in waters of North Carolina that include records of both these tagged animals and animals that were captured and freeze-branded near Beaufort, North Carolina, during summer months (Hansen and Wells 1996; Duke University unpublished data; University of North Carolina at Wilmington unpublished data; NMFS unpublished data). Of these tagged or freeze-branded animals, 18 occupied waters of northern Pamlico Sound during summer months and hence were identified as belonging to the NNCES Stock. The NNCES Stock occurs primarily within the waters of Pamlico Sound north of Core Sound during summer months (July–August). There is evidence that some of these animals also move into nearshore coastal waters along the northern coast of North Carolina and into coastal waters of Virginia and perhaps into Chesapeake Bay. One animal that was tagged near Virginia Beach in September 1998 was observed to move south into waters of Pamlico Sound and had a photo-ID record within the sound during July (NMFS unpublished data). In addition, there are photo-ID matches between inshore waters of Virginia Beach, Virginia, and Pamlico Sound (Urian, pers. comm.) that also demonstrate movements of NNCES animals between these areas. Therefore, it is presumed that the spatial range of NNCES animals during summer and fall months (July-October) includes Pamlico Sound and coastal waters (<1 km from shore) of North Carolina from Beaufort north to southern Virginia and the lower Chesapeake Bay (Figure 1).

There are fewer telemetry data for assigned NNCES animals during winter months. However, photo-ID studies, available tag data and stable isotope data indicate that the stock moves out of the waters of Pamlico Sound into coastal waters south of Cape Hatteras during late fall and through winter (November–April). Telemetry records show that NNCES animals move as far south as the New River during winter months (January–February) (NMFS unpublished data). The Northern Migratory Stock also occupies the nearshore coastal waters of North Carolina during these months, and hence there is likely overlap between these stocks, particularly between Cape Hatteras and Cape Lookout.

The movements of animals from the NNCES Stock are distinct from those of the Southern North Carolina Estuarine System Stock (SNCES). Some of the animals tagged or freeze-branded near Beaufort moved south to Cape Fear and occupied nearshore coastal and estuarine waters during winter months. During summer and fall, these animals moved north and occupied inshore and nearshore coastal waters near Cape Lookout including Bogue Sound and Core Sound. It is probable that there is spatial overlap between these 2 estuarine stocks during late summer and fall in the waters near Beaufort. However, SNCES Stock animals were not observed to move north of Cape Lookout in coastal waters nor into the main portion of Pamlico Sound during summer (NMFS unpublished data; Duke University unpublished data; University of North Carolina at Wilmington unpublished data). These movement patterns are consistent with those in resightings of individual dolphins during a photo-ID study that sampled much of the estuarine waters of North Carolina (Read *et al.* 2003). Read *et al.* (2003) suggested that movement patterns, differences in group sizes, and habitats are consistent with 2 stocks of animals occupying estuarine waters of North Carolina. Finally, genetic analysis of samples from animals in waters of southern North Carolina (between Cape Lookout and the North Carolina/South Carolina border) demonstrate significant differentiation from animals occupying waters from Virginia and further north and waters of South Carolina (Rosel *et al.* 2009).

In summary, during summer and fall months (July–October), the NNCES Stock occupies waters of Pamlico Sound and nearshore coastal (<1 km from shore) and estuarine waters of central and northern North Carolina to Virginia Beach and the lower Chesapeake Bay (Figure 1). It likely overlaps with animals from the Southern Migratory Stock in coastal waters during these months. During late fall and winter (November–March), the NNCES Stock moves out of estuarine waters and occupies nearshore coastal waters between the New River and Cape Hatteras. It overlaps with the Northern Migratory Stock during this period, particularly between Cape Lookout and Cape Hatteras. It appears that the region near Cape Lookout including Bogue Sound and Core Sound is an area of overlap with the SNCES Stock during late summer.

POPULATION SIZE

Read *et al.* (2003) provided the first abundance estimate of bottlenose dolphins that occur within the estuarine portion of the NNCES Stock range. This estimate was based on a photo-ID mark-recapture survey of a portion of North Carolina waters inshore of the barrier islands, conducted during July 2000. Because the survey did not sample all of the estuarine waters where dolphins are known to occur, the estimates of abundance may be negatively biased. Read *et al.* (2003) estimated the number of animals in the inshore waters of North Carolina equivalent to that of the NNCES Stock to be 919 (95% CI 730 - 1,190, CV=0.13). Gubbins *et al.* (2003) also conducted a photo-ID

mark-recapture study during 1997 and provided an abundance estimate (513, CV=0.13) for inshore and nearshore waters near Beaufort, North Carolina, but this area represented only a small portion of the NNCES Stock area and included animals in coastal waters. Goodman *et al.* (2007) conducted seasonal, strip-transect aerial surveys of southwestern Pamlico Sound from July 2004 through April 2006. Their survey area sampled approximately 25% or less of the waters within the NNCES Stock boundaries. Mean seasonal abundance estimates ranged from a low of 54 (CV=0.46) during June - August 2005 (summer), to a high of 426 (CV=0.35) during September–November 2004 (autumn), but seasonal patterns were not consistent among years. For example, the estimate for spring of 2005 was only 71 (CV=0.39) while the estimate for spring of 2006 was 323 (CV=0.35).

Since both telemetry studies and photo-identification records indicate that some portion of the NNCES Stock occurs in coastal waters between Cape Hatteras, North Carolina, and Virginia during summer months, it is appropriate to include animals from summer aerial surveys of these areas in the abundance estimate. Aerial surveys to estimate the abundance of coastal bottlenose dolphins in the Atlantic 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 40m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. The surveys employed 2 observer teams operating independently on the same aircraft to estimate visibility bias. Abundance estimates were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The 2002 surveys included 2 teams of observers to derive a correction for visibility bias. The independent and joint estimates from the 2 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).

An abundance estimate for the NNCES Stock in coastal waters was derived from the summer 2002 aerial survey. Survey data were post-stratified to estimate the abundance of dolphins within a strip extending from the shoreline to 1km from shore between Cape Lookout, North Carolina, and Virginia Beach, Virginia. Telemetry records indicated that NNCES animals rarely ventured further away from shore. However, animals from the Southern Migratory Stock do occur within this strip during summer months. Therefore, the estimate of abundance within this strip includes both NNCES animals and Southern Migratory animals and hence overestimates abundance The resulting best abundance estimate for the NNCES Stock in coastal waters was 468 (CV=0.32).

The abundance estimate for the NNCES Stock during 2000-2002 was the combined abundance from estuarine and coastal waters. This combined estimate is 1,387 (CV=0.17).

A photo-ID mark-recapture study was conducted in 2006 using similar methods to those in Read *et al.* (2003) which included estuarine waters from Core Sound to Albemarle Sound. A boundary line between the NNCES Stock and the neighboring SNCES Stock was identified at 34°46’ N Latitude in central Core Sound, and this boundary is consistent with the descriptions of the ranges of the 2 stocks during summer months. The survey also included coastal waters extending up to 1km from shore, which is also consistent with the current understanding of the distribution of this stock. The survey did not include estuarine and coastal waters north of Albemarle Sound, and it is therefore possible that some portion of the NNCES Stock was outside of the boundaries of the current survey. Thus, the updated abundance estimate is most likely negatively biased. The resulting abundance estimate includes a correction for the proportion of dolphins with non-distinct fins in the population. The abundance estimate for the NNCES Stock based upon photo-ID mark-recapture surveys in 2006 was 950 animals (CV = 0.23, 95% Confidence Interval = 516-1,384; Urian *et al*., unpublished manuscript). This is the best available abundance estimate for the NNCES Stock.

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 NNCES Stock is 950 (CV=0.23). The minimum population estimate for the NNCES Stock is 785.

Current Population Trend

There are insufficient data to determine the population trends for this stock. However, Urian *et al.* (unpublished manuscript) noted that there was no statistically significant difference between abundance estimates within estuarine waters from the surveys conducted during 2000 and those conducted during 2006.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The maximum net productivity rate was

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the NNCES Stock of bottlenose dolphins is 785. 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. The resulting PBR for this stock is 7.9 animals.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

The NNCES Stock interacts with 3 Category II fisheries: the Atlantic blue crab trap/pot fishery, North Carolina long haul seine fishery and North Carolina inshore gillnet fishery. There is no systematic federal observer coverage of these fisheries by the National Marine Fisheries Service (NMFS), although the North Carolina Division of Marine Fisheries operates systematic coverage of the fall flounder gillnet fishery in Pamlico Sound (Price 2008). As a result, information about interactions with North Carolina inshore fisheries is based solely on stranding data and it is not possible to estimate the annual number of interactions or mortalities in these fisheries. The NNCES Stock may also interact with the mid-Atlantic gillnet fishery, the mid-Atlantic haul/beach seine fishery and the Virginia Pound Net fishery. The magnitude of the interaction with each of these fisheries is unknown because of both uncertainty in the movement patterns of the stock and the spatial overlap between the NNCES Stock and other bottlenose dolphin stocks in coastal waters. The total estimated average annual fishery mortality on the NNCES Stock ranges between a minimum of 4.1 and a maximum of 22.6 animals per year. This range reflects the uncertainty in assigning observed or reported mortalities to a particular stock.

Mid-Atlantic Gillnet

This fishery has the highest documented level of mortality of coastal morphotype bottlenose dolphins, and the sink gillnet gear in North Carolina 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). From 2001-2008, 7 additional bottlenose dolphin mortalities were observed in the mid-Atlantic gillnet fishery. Three mortalities were observed in 2001 with 1 occurring off of northern North Carolina during April and 2 occurring off of Virginia during November. Four additional mortalities were observed along the North Carolina coast near Cape Hatteras: 1 in May 2003, 1 in September 2005, 1 in September 2006, and 1 in October 2006. Because the Northern Migratory, Southern Migratory, Northern North Carolina Estuarine System and Southern North Carolina Estuarine System bottlenose dolphin stocks all occur in waters off of North Carolina, it is not possible to definitively assign all observed mortalities, or extrapolated bycatch estimates, to a specific stock. In addition, the Bottlenose Dolphin Take Reduction Plan (TRP) was implemented in May 2006 resulting in changes in the gear configurations and other characteristics of the fishery.

To estimate the mortality of bottlenose dolphins in the mid-Atlantic gillnet fishery, the available data were divided into the period from 2002 through April 2006 (pre-TRP) and from May 2006 – 2008 (post-TRP). Three alternative approaches were used to estimate bycatch rates. First, a generalized linear model (GLM) approach was used similar to that described in Rossman and Palka (2001). This approach included all observed mortalities from 1995-2008 where the fishing gear was still in use during the period from 2002-2008. Second, a simple ratio estimator of catch per unit effort (CPUE = observed catch / observed effort) was used based directly upon the observed data. Finally, a ratio estimator pooled across years was used to estimate different CPUE values for the pre-TRT and post-TRT periods. In each case, the annual reported fishery effort (represented as reported landings) was multiplied by the estimated bycatch rate to develop annual estimates of fishery-related mortality, again similar to the approach in Rossman and Palka (2001). To account for the uncertainty in the most appropriate of these 3 alternative approaches, the average of the 3 model estimates (and the associated uncertainty) are used to estimate the mortality of bottlenose dolphins for this fishery (Table 1). It should be noted that the extrapolated estimates of total mortality include landings from inshore waters where the NNCES Stock is likely to occur.

Table 1. Summary of the 2002-2008 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) in the Northern North Carolina Estuarine System Stock in the commercial mid-Atlantic coastal gillnet fisheries. The estimated annual and average mortality estimates are shown for the period prior to the implementation of the Bottlenose Dolphin Take Reduction Plan (pre-TRP) and after the implementation of the plan (post-TRP). Three alternative modeling approaches were used, and the average of the 3 was used to represent mortality estimates. The minimum and maximum estimates indicate the range of uncertainty in assigning observed bycatch to stock. Observer coverage is measured as a proportion of reported landings (tons of fish landed). Data are derived from the Northeast Observer program, NER dealer data, and NCDMF dealer data. Values in parentheses indicated the CV of the estimate.

Period	Year	Observer Coverage[a]	Min Annual Ratio	Min Pooled Ratio	Min GLM	Max Annual Ratio	Max Pooled Ratio	Max GLM
pre-TRP	2002	0.01	0	0	15.64 (0.63)	0	39.45 (0.92)	33.69 (0.38)
	2003	0.01	0	0	11.03 (0.58)	49.46 (0.94)	12.77 (0.92)	19.29 (0.36)
	2004	0.02	0	0	12.10 (0.62)	0	28.46 (0.92)	28.42 (0.34)
	2005	0.03	0	0	11.84 (0.60)	0	22.58 (0.92)	23.01 (0.37)
	Jan-Apr 2006	0.03	0	0	1.40 (0.50)	0	0	1.99 (0.37)
Annual Avg. pre-TRP			Minimum: 3.47 (CV=0.30)			Maximum: 19.79 (CV=0.11)		
post-TRP	May-Dec 2006	0.03	0	0	5.08 (0.42)	73.37 (0.69)	18.84 (0.68)	12.46 (0.36)
	2007	0.03	0	0	8.32 (0.43)	0	24.47 (0.68)	18.77 (0.34)
	2008	0.01	0	0	8.14 (0.42)	0	21.91 (0.68)	16.77 (0.34)
Annual Avg. post-TRP			Minimum: 2.39 (CV=0.25)			Maximum: 18.99 (CV=0.11)		

[a] Observer coverage is reported on an annual basis for the entire fishery as a proportion of the reported tons of fish landed.

There have been 3 observed takes in the mid-Atlantic gillnet fishery since 2001 that could potentially be assigned to the Northern North Carolina Estuarine System Stock. However, in each of these cases, the take could potentially be assigned to the Southern Migratory Stock since they occurred in near-shore coastal waters of northern North Carolina. Since observed mortalities (and effort) cannot be definitively assigned to a particular stock within certain regions and times of year, the minimum and maximum possible mortality on the NNCES Stock are presented for comparison to PBR (Table 1).

Based upon these analyses, the minimum mortality estimate for the NNCES Stock for the pre-TRP period was 3.47 (CV=0.30) animals per year, and that for the post-TRP period was 2.39 (CV=0.25) animals per year. The

maximum estimates were 19.79 (CV=0.11) for the pre-TRP period and 18.99 (CV=0.11) for the post-TRP period (Table 1).

Beach Haul Seine/Beach-based Gillnet Gear

Two coastal bottlenose dolphin takes were observed in beach haul seine gear: 1 in May 1998 and 1 in December 2000. These takes occurred during a striped bass fishery within the spatial and seasonal range of the Northern Migratory Stock. Beach-based gillnet gear is now considered part of the mid-Atlantic gillnet fishery described above; however, it is not included in the observer program or resulting mortality estimates. Data from the Southeast Region Stranding Network from 2002-2008 include 2 confirmed reports of bottlenose dolphin mortalities in beach-based gillnet gear for striped bass during winter months off the coast of northern North Carolina: 1 in December 2002 and 1 in January 2008. A third possible mortality associated with this gear occurred during December 2002 (Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). Based upon their location and time of year, these mortalities were most likely animals from the Northern Migratory Stock rather than the NNCES Stock since they occurred north of Cape Hatteras in winter months.

Crab Pots and Other Pots

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 interactions with pot gear are a common occurrence and result in mortalities of coastal morphotype bottlenose dolphins in some regions (Burdett and McFee 2004). Southeast Regional Marine Mammal Stranding Network data (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009) from 2004 through 2008 include 13 reports of interactions between bottlenose dolphins and confirmed blue crab pot gear with the majority of these occurring in waters from Florida to South Carolina. In addition, there were 4 interactions documented with pot gear where the fishery could not be confirmed. In these cases, the gear was confirmed to be associated with a pot or trap, but may have been from a fishery other than blue crab (e.g., whelk fisheries in Virginia). Of the confirmed blue crab pot interactions, there was 1 reported mortality in this 5 year period in waters of Virginia and North Carolina. This case occurred in August 2004 and is most likely assigned to the NNCES Stock. There was 1 mortality in pot gear where the fishery type could not be confirmed in Virginia. This mortality was reported in August 2007 and could be assigned to either the Southern Migratory or the NNCES Stock.

Virginia and North Carolina Pound Nets

Historical and recent stranding network data report interactions between bottlenose dolphins and pound nets in Virginia. Stranding data for 2004-2008 indicate 17 cases where bottlenose dolphins were removed from pound net gear, and it was determined that animals were entangled pre-mortem. In each case, the bottlenose dolphin was recovered directly from the fishing gear. Of these 17 cases, 14 were documented mortalities while 3 were released alive (S. Barco, Virginia Aquarium, unpublished data; Northeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). These interactions occurred primarily inside estuarine waters near the mouth of the Chesapeake Bay and in summer months. Nine of these mortalities occurred during the summer (July-September) when they could have impacted either the Southern Migratory or the Northern North Carolina Estuarine System Stocks. The overall impact of the Virginia Pound Net fishery on the Northern North Carolina Estuarine System Stock is unknown due to the limited information on the stock's movements, particularly whether or not it occurs within waters inside the mouth of the Chesapeake Bay. In addition, 1 bottlenose dolphin was recovered dead from pound net gear in North Carolina during August 2004. This mortality is most likely assigned to the NNCES Stock.

Other Mortality

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies and fisheries surveys. From 2002-2009, there have been 15 reported interactions during research activities resulting in 13 documented mortalities of bottlenose dolphins. A mortality occurring in a turtle relocation trawl off of North Carolina during March 2002 could have been attributed to either the Southern Migratory Stock or the NNCES Stock. One mortality in a research beach seine was reported from June 2007 in northern North Carolina that was consistent with the spatial range of the Northern Migratory Stock, the Southern Migratory Stock or the NNCES Stock. Finally, a mortality was observed in July 2007 in a research net in the Neuse River that is most likely

from the NNCES Stock.

Three bottlenose dolphins that were captured, tagged with satellite-linked transmitters, and released near Beaufort, North Carolina, during April 2006 by the NMFS as part of a long-term stock delineation research project were believed to have died shortly thereafter as a result of the capture or tagging (NMFS unpublished data). Two of the animals were recovered stranded but because of advanced decomposition of the carcasses cause of death could not be determined. One of these 2 animals was known from long-term photo-ID and was likely of the Southern North Carolina Estuarine System Stock. The third animal has not been observed subsequent to release, but patterns in the data received from its satellite tag were similar to that of the other 2 and indicated the fates were similar. These last 2 animals were, based on satellite-derived locations, most likely from the NNCES Stock. All known human-caused mortalities including both commercial fisheries and research related mortalities are summarized in Table 2.

This stock inhabits areas with significant drainage from agricultural, industrial and urban sources, and as such is exposed to contaminants in runoff from those sources. The blubber of 47 bottlenose dolphins captured and released in and around Beaufort contained detectable environmental contaminants, and 7 had unusually high levels of the pesticide methoxychlor (Hansen *et al.* 2004). While there are no estimates of indirect human-caused mortality from pollution or habitat degradation, Schwacke *et al.* (2002) found that the levels of polychlorinated biphenyls (PCBs) observed in Beaufort female bottlenose dolphins would likely impair reproductive success, especially of primiparous females.

Table 2. Summary of annual reported and estimated mortality of bottlenose dolphins from the Northern North Carolina Estuarine System Stock. Where minimum and maximum values are reported, there is uncertainty in the assignment of mortalities to this particular stock due to spatial overlap with other bottlenose dolphin stocks in certain areas and seasons. The reported mortalities in Virginia Pound Net, beach-based gillnet and crab pot fisheries are confirmed reports and are likely an underestimate of total mortalities in these fisheries.

Year	mid-Atlantic Gillnet	Virginia Pound Net[a]	Beach-based Gillnet	Blue Crab Pot	Other Pot	Research	Total
2004	Min = 4.0 Max= 18.9	Min = 1 Max = 4	0	1	0	0	Min = 6.0 Max = 23.9
2005	Min = 4.0 Max= 15.2	Min = 0 Max = 1	0	0	0	0	Min = 4.0 Max = 16.2
2006	Min = 2.2 Max = 35.6	Min = 0 Max = 2	0	0	0	2	Min = 4.2 Max = 39.6
2007	Min = 2.8 Max = 14.4	Min = 0 Max = 1	0	0	Min = 0 Max = 1	Min = 1 Max = 2	Min = 3.8 Max = 18.4
2008	Min = 2.7 Max = 12.9	Min = 0 Max = 2	0	0	0	0	Min = 2.7 Max = 14.9
Annual Average Mortality (2004-2008)				Minimum Estimated = 4.1 Maximum Estimated = 22.6			

[a] Pound nets also include a mortality observed in North Carolina in 2004.

Strandings

Between 2004 and 2008, 422 bottlenose dolphins stranded along the Atlantic coast in North Carolina and Virginia

that could be assigned to the NNCES Stock (Table 3; Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009). The assignment of animals to a particular stock is impossible in some seasons and regions, particularly in coastal waters of North Carolina and Virginia. Therefore, it is likely that the counts below include some animals from either the Southern Migratory or Northern Migratory Stocks. Within estuarine waters of North Carolina, where the probability is very high that strandings are from the NNCES Stock, there were a total of 73 strandings in this 5 year period. In addition, stranded carcasses are not routinely identified to either the offshore or coastal morphotype of bottlenose dolphin, therefore it is possible that some of the reported strandings were of the offshore form. In most cases, it was not possible to determine if a human interaction had occurred due to the decomposition state of the stranded animal. However, in cases where a determination could be made, the incidence of evidence of fisheries interactions was high. In cases where a determination could be made, 65% of stranded animals from Virginia, 41% of cases from coastal waters of North Carolina and 82% (14/17) of cases from North Carolina estuarine waters had evidence of human interaction. It should be recognized that evidence of human interaction does not indicate cause of death, but rather only that there was evidence of interaction with a fishery (e.g., line marks, net marks).

Table 3. Strandings of bottlenose dolphins from North Carolina and Virginia that can possibly be assigned to the Northern North Carolina Estuarine System (NNCES) Stock. Strandings observed in North Carolina are separated into those occurring within Pamlico Sound and other estuaries (Estuary) vs. coastal waters. Assignments to stock were based upon the understanding of the seasonal movements of this stock. However, particularly in coastal waters, there is likely overlap between the NNCES Stock and other bottlenose dolphin stocks. HI = Evidence of Human Interaction, CBD = Cannot Be Determined whether an HI occurred or not. NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 21 September 2009 and 18 November 2009

State	**2004**			**2005**			**2006**			**2007**			**2008**		
Type	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD	HI Yes	HI No	CBD
North Carolina - Coastal	6	8	25	7	7	41	1	7	25	5	8	26	5	5	28
North Carolina- Estuary	6	1	9	2	0	7	4	2	11	2	0	19	0	0	10
Virginia[a]	13	5	10	7	9	13	9	3	17	6	3	19	8	1	22
Annual Total	83			93			79			88			79		

[a] Strandings from Virginia include primarily waters inside Chesapeake Bay during late summer through fall. It is likely that the NNCES Stock overlaps with the Southern Migratory Stock in this area.

STATUS OF STOCK

From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the western

North Atlantic, and the entire stock was listed as depleted as a result of the 1987-1988 mortality event. Scott *et al.* (1988) suggested that dolphins residing in the bays, sounds and estuaries adjacent to these coastal waters were not affected by the mortality event, and these animals were explicitly excluded from the depleted listing (Federal Register: 54(195), 41654-41657; 56(158), 40594-40596; 58(64), 17789-17791).

The status of the NNCES Stock 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 population trends for this stock. The annual average of human caused mortality for this stock ranges between a minimum of 4.1 and a maximum of 22.6, but this is an underestimate of total mortality associated with commercial fisheries. The calculated PBR is 7.9 animals; therefore, it is possible that mortality in commercial fisheries exceeds PBR for this stock. However, because mortality cannot be reliably assigned to stocks, it is currently not possible to evaluate the status relative to PBR. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. However, the total human-caused mortality and serious injury is most likely greater than 10% of PBR and may exceed PBR. Because relatively few mortalities and serious injuries would exceed PBR, the NMFS considers this stock to be a strategic stock.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above about 30ºN (Burns 2009; Desportes *et al.* 2010). 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; Desportes *et al.* 2010). 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. High philopatry has been reported in other North Atlantic populations (Goodman 1998; Andersen and Olsen 2010). 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; Andersen and Olsen 2010). 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).

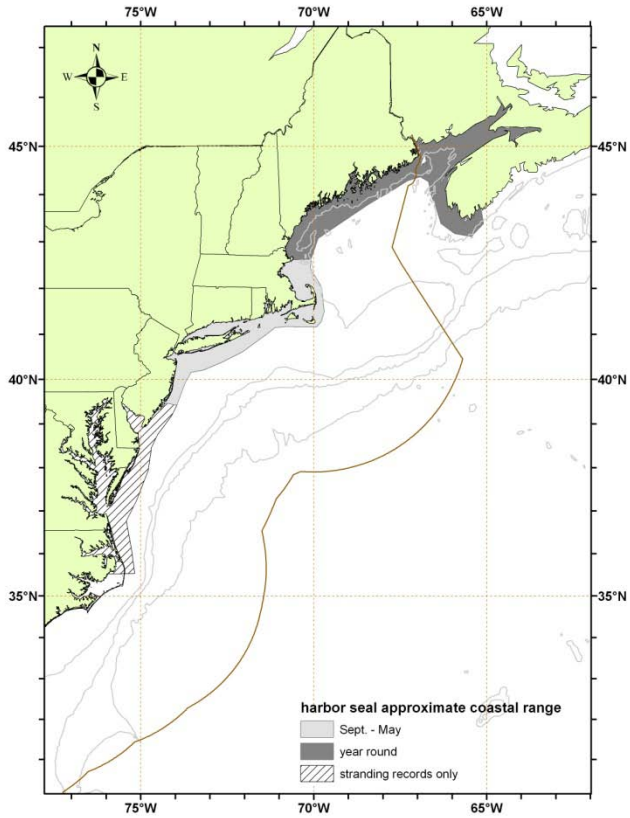

Figure 1. *Approximate coastal range of harbor seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.*

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). In 2011 photographic evidence of a recently established seasonal haul out site at Oregon Inlet, North Carolina was reported (Todd Pusser, pers. comm. June 2011). 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 in southern New England (Payne and Schneider 1984; Barlas 1999); however, more recent anecdotal reports suggest that some pupping is occurring at high-use haulout sites off Manomet, Massachusetts. 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 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, there is no current abundance estimate for harbor seals. 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 (pups in parenthesis) for 2001 was 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 recruiting 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 the average 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).

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

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on uncorrected haul-out counts over the 1981 to 2001 survey period, the harbor seal population was 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 recovery factor (F_R) for this stock is 0.5, the value for stocks of unknown status. PBR for the western North Atlantic

stock of harbor seals is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY

For the period 2006–2010 the total human caused mortality and serious injury to harbor seals is estimated to be 337 per year. The average was derived from two components: 1) 332 (CV=0.15; Table 2) from the 2006–2010 observed fishery; and 2) 5 from average 2006–2010 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). Between 2006 and 2010, there are 5 records of harbor seals and 2 of unidentified seals with evidence of gunshot wounds in the Northeast Regional Office Marine Mammal Stranding Network database.

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 658 harbor seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2010, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data) but including one animal taken in a hanging ratio experiment (see below). Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (i.e.. 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, 87 (0.58) in 2006, 92 in 2007, 243 (0.41) in 2008, 516 (0.28) in 2009, and 461 (0.30) in 2010 (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). There were 2, 9, 14, 8, 14, 6, 8, and 5 unidentified seals observed during 2003–2010, 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 2006–2010 was 280 harbor seals (CV=0.17; Table 2).

Mid-Atlantic Gillnet

A study on the effects of two different hanging ratios in the bottom-set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010 with 100% observer coverage. Commercial fishing vessels from Massachusetts and New Jersey were used for the study, which took place south of the Harbor Porpoise Take Reduction Team Cape Cod South Management Area (south of 40° 40´) in February, March and April. Eight research strings of fourteen nets each were fished, and 159 hauls were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh. There was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. Four harbor seals (3 in mid-Atlantic gillnet and 1 in NE gillnet) were caught in this project during 2010 (Schnaittacher 2011).

No harbor seals were taken in observed trips during 1993–1997, or 1999–2003. Two harbor seals were observed taken in 1998, 1 in 2004, 2 in 2005, 1 in 2006, 0 in 2007, 2 in 2008, 2 in 2009, and 6 in 2010. Using the observed and experimental 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, 26 (0.98) in 2006, 0 in 2007, 88 (0.74) in 2008, 47 (0.68) in 2009, and 89 (0.41) in 2010. Average annual estimated fishery-related mortality attributable to this fishery during 2006–2010 was 50 (CV =0.34) harbor seals (Table 2).

Northeast Bottom Trawl

Three harbor seal mortalities were observed in 2007, 0 in 2008, 1 in 2009, and 0 in 2010. (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2006–2010 is calculated as 0.8 animals (4 animals/5 years).

Mid-Atlantic Bottom Trawl

One harbor seal mortality was observed in this fishery in 2010. (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2006–2010 is calculated as 0.2 animals (1 animal/5 years).

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

One harbor seal mortality was observed in this fishery in 2009 and 2 in 2010 (Table 2). The resultant estimated annual fishery-related mortality and serious injury (CV in parentheses) was 1.3 in 2009 but an extended bycatch rate has not been calculated for 2010. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2006–2010 is calculated as 0.7 animals (2 animals +1.3 animals/5 years).

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

A harbor seal mortality was observed in this fishery in 2010. An expanded bycatch estimate has not been generated. . Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2006–2010 is calculated as 0.2 animals (1 animal/5 years).

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, 1 in 2008, and none in 2006 or 2009-2010. In addition, 5 seals of unknown species were captured and released alive in 2004, 2 in 2005, 1 in 2007, and none in 2009-2010. 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 concolor*) 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	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast [c] Sink Gillnet	06-10	Obs. Data, Weighout, Logbooks	.04, .07, .05, .04, .17	3, 6, 9, 21, 71	87, 93, 243, 516, 461	.58, .49, .41, .28, .30	280 (0.17)
Mid-Atlantic Gillnet	06-10	Obs. Data, Weighout	.04, .06, .03, .03, .04	1, 0, 2, 2, 9	26, 0, 88, 47, 88	.98, 0, .74, .68, .41	50 (0.34)
Northeast Bottom Trawl	06-10	Obs. Data, Weighout	.06, .05, .08, .09, .16	0, 3, 0, 1, 0	0, unk[d], 0, unk[d], unk[d],	0, unk[d], 0, unk[d], unk[d],	0.8 (na)[d]

Mid-Atlantic Bottom Trawl	06-10	Obs. Data Dealer	.02, .03, .03. .05, .06	0, 0, 0, 0 ,1	0, 0, 0, 0, na[d]	0, 0, 0, 0, na[d]	0.2 (na)[d]
Northeast Mid-water Trawl - Including Pair Trawl	06-10	Obs. Data Weighout Trip Logbook	.031, .08, .199, .42, .53	0, 0, 0, 1, 2	0, 0, 0, 1.3, na[d]	0, 0, 0, .81, na[d]	0.7[d]
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	06-10	Obs. Data Weighout Trip Logbook	.089, .039, .13, .13, .25	0, 0, 0, 0, 1	0, 0, 0, 0, na[d]	0, 0, 0, 0, na[d]	0.2 (na)[d]
TOTAL							332 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 northeast bottom trawl are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear in the year 2010 includes samples collected from traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP). In the Northeast region 437 and 658 bottom trawl trips were sampled by observers and monitors, respectively. In the mid-Atlantic region, 661 and 75 bottom trawl trips were sampled by observers and monitors, respectively,

[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 2006 - 2010, respectively, 3, 2, 0, 8 and 23 takes were observed in nets with pingers. In 2006 – 2010, respectively, 0, 4, 9, 13 and 48 takes were observed in nets without pingers.

[d] Analyses of bycatch mortality attributed to the Northeast or mid-Atlantic bottom trawl fisheries for the years 2006–2010, or mid-water trawl fisheries for 2010 have not been generated.

Other Mortality

Canada: Aquaculture operations in eastern Canada are licensed to shoot nuisance seals, but the number of seals killed is unknown (Jacobs and Terhune 2000; Baird 2001). Small numbers of harbor seals are taken in subsistence hunting in northern Canada, and Canada also issues personal hunting licenses which allow the holder to take six seals annually (DFO 2008).

U.S.: 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; Lelli *et al*., 2009). Bounty-hunting ended in the mid-1960s.

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, 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 2006–2010, 1,400 harbor seal stranding mortalities were reported between Maine and Florida (Table 3; NMFS unpublished data). Sixty-five (4.6%) of the seals stranded during this five-year period showed signs of human interaction (8 in 2006, 21 in 2007, 10 in 2008, 6 in 2009, and 20 in 2010), with 24 having some sign of fishery interaction (8 in 2006, 5 in 2007, 5 in 2008, 0 in 2009, and 6 in 2010). Five harbor seals during this period were reported as having been shot. 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 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 concolor*) stranding mortalities along the U.S. Atlantic coast (2006–2010) with subtotals of animals recorded as pups in parentheses[a].

State	2006[b]	2007[b]	2008	2009	2010	Total
ME	371 (220)	106 (80)	178 (152)	72 (64)	70 (64)	797
NH	28 (19)	6 (5)	3 (2)	15 (12)	20 (15)	72
MA	94 (35)	51 (17)	50 (4)	74 (36)	82 (26)	351
RI	6 (3)	8 (1)	6 (4)	5 (2)	4 (0)	29
CT	2 (1)	3	0	0	0	5
NY	11	11 (7)	5 (1)	14 (1)	15 (0)	56
NJ	7	6	7	11 (2)	21 (0)	52
DE	1	0	0	0	0	1
MD	0	0	0	2	0	2
VA	2	0	1	3	1 (0)	7
NC	4	0	6 (2)	6 (5)	11 (1)	27
SC	0	0	0	0	1	1
FL	1	0	0	0	0	1
Total	526	191	257	202	224	1400
Unspecified seals (all states)	46	34	51	34	22	187

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. Records of 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.

b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2006-2007.

STATUS OF STOCK

Although PBR cannot be determined for this stock, the level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is believed to be low relative to the total stock size; therefore, this is not a strategic 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 believed to be low relative to the population size in U.S. waters but cannot be considered to be approaching zero mortality and serious injury rate.

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GRAY SEAL (*Halichoerus grypus 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). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New York 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; Rough 1995: Gilbert *et al.* 2005). 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 adjacent sites in Nantucket Sound, and Green and Seal Islands off the coast of Maine (Wood *et al.* 2007). To assess the stock structure of gray seals in the northwest Atlantic, tissue samples were collected from Canadian and U.S. populations for genetic analyses (Wood *et al.* 2011). Based on examination of nine highly variable microsatellite loci, all individuals were placed into one population. This provides additional confirmation that recolonization by Canadian gray seals is the source of the U.S. population.

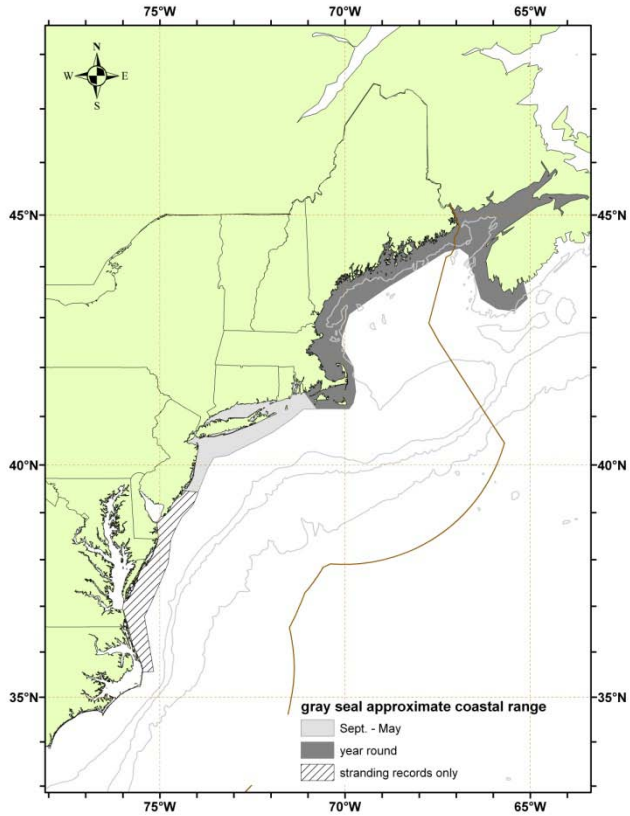

Figure 1. Approximate coastal range of gray seals. Isobaths are the 100-m, 1000-m, and 4000-m depth contours.

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 total Canadian population from 1977 to 2010 has been estimated by modeling gray seal population dynamics and available pup production data divided into three breeding regions: Sable Island, Gulf of St. Lawrence, and Coastal Nova Scotia (Thomas *et al.* 2011). The 2010 total population estimate was 348,900 (95% CI 291,300-414,900). This is 4% higher than the 2009 estimate (335,200; 95% CI 292,300-395,100) (Thomas *et al.* 2011). Average annual rates of total population increase were estimated to be 6% in the 1980s, 9% in the 1990s, and 6% in the 2000s. The authors note that these estimates should be treated with caution due to modeling and data concerns. In comparison to the pooled estimates, Bowen *et al.* (2003) reported that

the Sable Island had been increasing by approximately 13% for nearly 40 years, but subsequently declined to 7% based on the 2004 pup production survey (Trzcinski *et al.* 2005; Bowen *et al.* 2007).

In U.S. waters, gray seals currently pup at three established colonies: Muskeget Island, Massachusetts, Green Island, Maine, and Seal Island, Maine, as well as, more recently, at Matinicus Rock in Maine. Although white coated pups have stranded on eastern Long Island beaches, no pupping colonies have been detected in that region. Gray seals have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1990. Pupping has taken place on Seal and Green Islands in Maine since at least the mid 1990s. Aerial survey data from these sites indicate that pup production is increasing. A minimum of 2,620 pups (Muskeget= 2,095, Green= 59, Seal= 466) were born in the U.S. in 2008 (Wood LaFond 2009). Table 2 summarizes single-day pup counts from the three U.S. pupping colonies from 2001/2002 to 2007/2008 pupping periods. The decrease in pup counts in some years is an artifact of survey timing and not indicative of true declines in those years. In recent years NMFS monitoring surveys have detected an occasional mother/pup (white coats) pair on both Monomoy Island and Noman's Land in Massachusetts. Some of the local breeders have been observed with brands and tags indicating they had been born on Sable Island, Canada (Rough 1995; L. Sette, pers. comm., Provincetown Center for Coastal Studies). The increase in the number of gray seals observed in the U.S. is probably due to both natural increase and immigration.

Gray seals are also observed in New England outside of the pupping season. In April–May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). Maine coast-wide surveys conducted during summer revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al.* 2005). 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). In March 2011 a maximum count of 15,756 was obtained in southeastern Massachusetts coastal waters (NMFS unpubl. data). No gray seals were recorded at haul-out sites between Newport, Rhode Island and Montauk Pt., New York (Barlas 1999), although, more recently several hundred gray seals have been recorded in surveys conducted off eastern Long Island (R. DiGiovanni, pers. comm., The Riverhead Foundation for Research and Preservation, Riverhead, NY).

Table 1. Summary of abundance estimates for the western North Atlantic gray seal: year, and area covered during each abundance survey, resulting total abundance estimate and 95% confidence interval.

Month/Year	**Area**	**Nbest**	**CI**
2010[a]	Gulf of St Lawrence + Nova Scotia Eastern Shore + Sable Island	348,900	95% CI 291,300-414,900

[a]Model based estimate derived from pup surveys.

Table 2. The number of pups observed on Muskeget, Seal, and Green Islands 2002-2008. Data are from aerial surveys. These are single-day counts, not estimates of total pup production. (Wood LaFond 2009).

Pupping Season	Muskeget Island	Seal Island	Green Island
2001-2	883	No data	34
2002-3	509	147	No data
2003-4	824	150	26
2004-5	992	365	33
2005-6	868	239	43
2006-7	1704	364	57
2007-8	2095	466	59

Minimum Population Estimate

Based on modeling, the total Canadian gray seal population was estimated to be 348,999 (95% CI 291,300–414,900) (Thomas *et al.* 2011). 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, increased exponentially at a rate of 12.8% per year between the 1970s and 1997 (Stobo and Zwanenburg 1990; Mohn and Bowen 1996; Bowen *et al.* 2003; Trzcinski *et al.* 2005; Bowen *et al.* 2007;DFO 2011a), but has declined to about 4% per year between 2007 and 2010 (DFO 2011a). The non Sable Island population increased from approximately 25,000 in the mid-1980s to a peak of 71,500in 2010 (Thomas *et al.* 2011). Modeling estimates of pup production increased from approximately 6,000 in 1985 to 17,400 in 2010 (Thomas *et al.* 2011). Approximately 70% 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).

Surveys of 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 1980's 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, 883 pups were counted on Muskeget Island and surrounding shoals (Wood Lafond 2009). 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 from southeastern Massachusetts (i.e., Monomoy, Muskeget and adjacent tidal bars) from 5,611 in spring 1999 to 15,756 in spring 2011 represents an annual increase of 8.6%, however, it has not been determined what proportion of the increase represents growth or immigration. For example, a few gray seals branded as pups on Sable Island in the 1970s and 2000s (Stobo and Zwanenburg 1990; C. denHeyer, pers. comm.. DFO, Halifax), and satellite tagged adults have been sighted in the Cape Cod region. .

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Recent studies estimated the current 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 which are 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 2006–2010, the total estimated human caused mortality and serious injury to gray seals was 5,253 per year. The average was derived from five components: 1) 853 (Table 3) from the 2006–2010 U.S. observed fishery; 2) 6 from average 2006–2010 non-fishery related, human interaction stranding mortalities (NMFS unpublished data); 3) 1,079 from average 2006–2010 kill in the Canadian hunt; 4) 23 from DFO scientific collections; and 5) 3,292 removals of nuisance animals in Canada.

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 375 gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and 2010. 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, 314 (0.22) in 2006, 886 (0.24) in 2007, 618 (0.23) in 2008, 1,063 (0.26) in 2009, and 1155 (0.31) in 2010 (Table 3). There were 2, 9, 14, 8, 14, 6, 8 and 7 unidentified seals observed during 2003-2010, 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 2006–2010 was 794 gray seals (CV=0.13) (Table 3). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Gillnet

Gray seal interactions were observed in this fishery in 2010, when nine gray seal and 2 unidentified seal mortalities were observed. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during 2010 was 53 (CV=0.76).

Mid-Atlantic Mid-Water Trawl

One gray seal mortality was observed in 2010 in this fishery. An expanded bycatch estimate has not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2006–2010 is calculated as 0.2 animal (1 animal /5 years).

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, 19 in 2005, 0 in 2007, 6 in 2008, 0 in 2009, and 4 in 2010. In addition, 5 seals of unknown species were captured and released alive in 2004, 2 in 2005, 1 in 2007 and none in 2008-2010.

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. No mortalities were observed in 2006. The estimated annual fishery-related mortality and serious injury attributable to this fishery was 0 between 2001 and 2004, and for 2006. Nine gray seal mortalities were attributed to this fishery in 2007, 4 in 2008, 8 in 2009, and 9 in 2010. Estimates have not been generated. Until this bycatch estimate can be developed, the average annual fishery-related mortality and serious injury for 2006–2010 is calculated as 6 animals (30 animals/5 years).

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 3. Summary of the incidental mortality of gray seal (*Halichoerus grypus grypus*) by commercial fishery including the years sampled (Years), 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	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality

Northeast Sink Gillnet[c]	06-10	Obs. Data, Weighout, Logbooks	.04, .07, .05. 04, .17	9, 80, 31, 52, 107	248, 886, 618, 1063, 1155	.47, .24, .23, .26, .31	794 (0.13)
Mid-Atlantic Gillnet	06-10	Obs. Data, Trip Logbook, Allocated Dealer Data	.03, .04, .03, .03, .04	0, 0, 0, 0, 9	0, 0, 0, 0, 265	0, 0, 0, 0, .76	53 (.76)
Northeast Bottom Trawl	06-10	Obs. Data, Weighout	.06, .06, .08, .09, .16	0, 9, 4, 8, 9	0, unk[d], unk[d], unk[d], unk[d]	0, unk[d], unk[d], unk[d], unk[d]	6 (na)[d]
Mid-Atlantic Mid-water Trawl - Including Pair Trawl	06-10	Obs. Data Weighout Trip Logbook	.089, .039, .13, .13, .25	0, 0, 0, 0, 1	0, 0, 0, 0,na	0, 0, 0, 0, unk[d]	0.2 (na)[d]
TOTAL							853 (0.13)

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. . North Atlantic bottom trawl mid-Atlantic bottom trawl, and mid-Atlantic mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for bottom trawl gear and gillnet gear in the year 2010 includes samples collected from traditional fisheries observers in addition to fishery monitors through the Northeast Fisheries Observer Program (NEFOP). In the Northeast region 437 and 658 bottom trawl trips were sampled by observers and monitors, respectively. In the mid-Atlantic region, 661 and 75 bottom trawl trips were sampled by observers and monitors, respectively,

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 2006- 2010, respectively, 1, 8, 4, 13, and 17 takes were observed in nets with pingers. In 2006 -2010, respectively, 8, 72, 27, 39, and 90 takes were observed in nets without pingers.

d. Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery and midwater trawl fishery has not been generated. Unexpanded values are provisionally provided.

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 2010 the annual kill of gray seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76), 2002 (126), 2003 (6), 2004 (0), 2005 (1073), 2006 (1,857) 2007 (1747), 2008 (1,471), 2009 (263), and 2010 (58). (DFO 2003; 2008; 2009; 2011b 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 2003). DFO established a total allowable catch (TAC) of 12,000 gray seals for 2007 and 2008: 2,000 in the Gulf and 10,000 on the Scotian Shelf. The TAC for 2009 and 2010 was 50,000 seals. Since 2007, a small commercial hunt has taken place on Hay Island in Nova Scotia (http://www.dfo-mpo.gc.ca/fm-gp/seal-phoque/faq-eng.htm). The Hay Island TAC for 2010 was 2,220 (DFO 2011c). The hunting of gray 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; DFO 2011b). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001). Further, between 2005 and 2010 the lethal removal of nuisance seals was: 2005 (3105), 2006 (3437), 2007 (3373), 2008 (3334), 2009 (3381, and 2010 (2933) (DFO 2011b).

U.S: Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960s (Katona *et al.* 1993; Lelli *et al*. 2009). This hunt may have severely depleted this stock in U.S. waters (Rough 1995; Lelli *et al*. 2009). 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 2006 to 2010, 375 gray seal stranding mortalities were recorded, extending from Maine to North Carolina (Table 4; NMFS unpublished data). Most stranding mortalities were in Massachusetts, which is the center of gray seal abundance in U.S. waters. Sixty (16.0%) of the total stranding mortalities showed signs of human interaction (5 in 2006, 8 in 2007, 21 in 2008, 14 in 2009, and 12 in 2010), with 30 having some indication of fishery interaction (5 in 2006, 5 in 2007, 7 in 2008, 9 in 2009, and 4 in 2010). Four gray seals are recorded in the NE stranding database during the 2006 to 2010 period as having been shot–one in Maine in 2009 and one in Maine and two in Massachusetts in 2010.

Table 4. Gray seal (*Halichoerus grypus grypus*) stranding mortalities [a] along the U.S. Atlantic coast (2006–2010) with subtotals of animals recorded as pups in parentheses.

State	2006	2007	2008	2009	2010	Total
ME	3	5 (1)	6 (1)	3	8 (4)	25
NH	0	1 (1)	0	1 (1)	0	2
MA	29 (5)	50 (9)	53 (4)	52 (7)	43 (5)	227
RI	2 (2)	5 (1)	7	10 (2)	8 (3)	32
CT	0	0	0	1(1)	0	1
NY	6 (4)	21 (17)	2 (2)	16 (7)	10 (7)	55
NJ	1 (1)	5 (2)	3	4	4 (1)	17
DE	0	0	1 (1)	0	0	1
MD	0	1	1	1	1	4
VA	0	1	1	2	1	5
NC	2	1 (1)	1 (1)	1 (1)	1	6
Total	43 (12)	90 (32)	75 (9)	91 (19)	76 (20)	375
Unspecified seals (all states)	46	34	51	34	22	187

a. 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 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. 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.

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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 late-February and April. Adults then assemble on suitable pack ice 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.

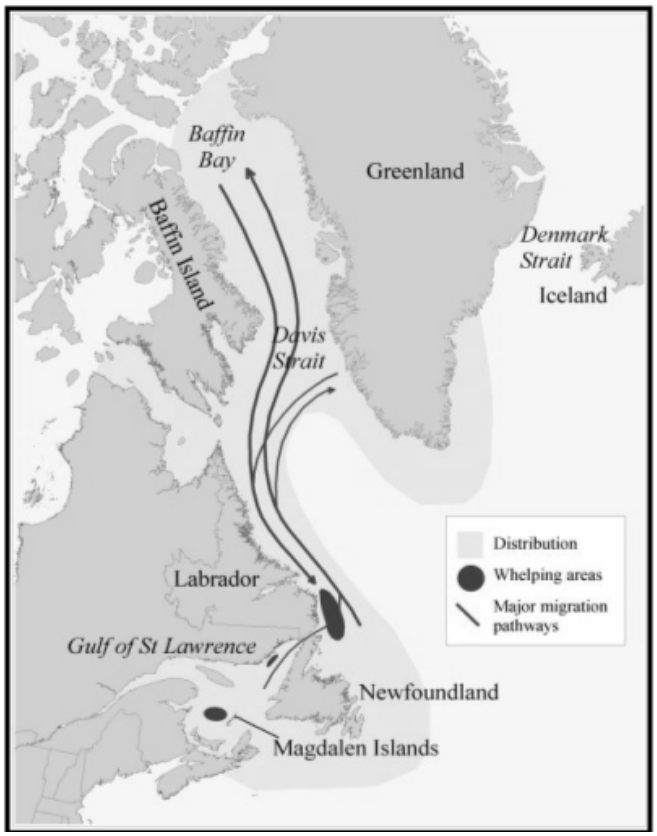

Figure 1: From: *Technical Briefing on the Harp Seal Hunt in Atlantic Canada*
http://www.dfo-mpo.gc.ca/misc/seal_briefing_e.htm

Since the early 1990s, 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; Rubinstein 1994; 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 (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). The 2008 and 2009 estimates, respectively, based on the 2008 survey of the Gulf and Front were 6.5 million (95% CI=5.7 to 7.3 million) and 6.9 million (95% CI=6.0 to 7.7 million; Table 1; DFO 2010). A revised model assuming density-dependent population growth, carrying capacity of 12 million and annual reproductive rate data was fitted to the 2008 survey data (DFO 2011 in review). The model estimated a total population 8.3 million (95% CI=7.5-8.9 million animals) increasing to 8.6 – 9.6 million (95% CI=7.8 to 10.8 million) animals in 2010.

Table 1. Summary of abundance estimates for western North Atlantic harp seals in Canadian waters. Year and area covered during each abundance survey, resulting abundance estimate (N_{best}) and confidence interval (CI).

Month/Year	Area	N_{best}	CI
2004	Front and Gulf	5.5 million	(95% CI 3.8-7.1 million)
2008	Front and Gulf	8.3 million	(95% CI 7.5-8.9 million)
2010	Front and Gulf	8.6-9.6 million	(95% CI 7.8-10.8 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 8.3 million (95% CI 7.5-8.9 million; DFO 2011 in review). 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) was not significantly different from the 1999 estimate, which suggested that the increase in pup production observed throughout the 1990s may have abated (Stenson *et al.* 2005). However, the 2008 revised estimate of pup production is 1,630,300 (CV=6.8%), based on photographic and visual aerial survey counts (DFO 2011), and indicates that pup production had increased in intervening years since 1999.

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

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 the population is increasing. PBR for the western North Atlantic harp seal in U.S. waters is unknown. The PBR for the stock in U.S. waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2006–2010 the total estimated annual human caused mortality and serious injury to harp seals was 379,672. This is derived from three components: 1) an average catch of 379,387 seals from 2006–2010 by Canada and Greenland, including bycatch in the lumpfish fishery (Table 2a); 2) 281 harp seals (CV=0.19) from the observed U.S. fisheries (Table 2b); and 3) an average of 4 stranded seals from 2006–2010 that showed signs of non fishing human interaction.

Table 2a. Summary of the Canadian directed catch and bycatch incidental mortality of harp seal (*Pagophilus groenlandicus*) by year

Fishery	**2006**	**2007**	**2008**	**2009**	**2010**	**Average**
Commercial catches[a]	354,867	224,745	217,85	76,66	69,101	**188,646**
Commercial catch struck and lost[b]	26,674	14,914	11,736	4,035	4,060	**12,284**
Greenland subsistence catch[c]	92,210	82,836	80,556	71,046	83,669	**82,063**
Canadian Arctic[d]	1,000	1,000	1,000	1,000	1,000	**1,000**
Greenland and Canadian Arctic struck and lost[e]	93,210	83,836	81,556	72,046	84,669	**83,063**
Newfoundland lumpfish[f]	12,330	12,330	12,330	12,330	12,330	**12,330**
Total	**580,291**	**419,661**	**405,028**	**237,125**	**254,829**	**379,387**

a. Hammill and Stenson 2003, DFO 2003, DFO 2005, DFO 2010; ICES 2011; Stenson unpublished data

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, 2011 DFO 2005, 2010; Stenson unpublished data

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).

f. DFO 2005; Stenson unpublished data; 2001-2004 average used.

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 208 harp seal mortalities observed in the Northeast sink gillnet fishery between 1990 and 2010. The bycatch occurred principally in winter (January-May) and was mainly in waters from New Hampshire south to the shelf and shelf-edge waters southwest 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, 65 (0.66) in 2006, 119 (0.35) in 2007, 238 (0.38) in 2008, 415 (0.27) in 2009, and 253 (0.62) in 2010 (Table 2b). There were also 2, 9, 14, 8, 18, 6, 8 and 5 unidentified seals observed during 2003 through 2010 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 2006–2010 was 218 harp seals (CV=0.20) (Table 2b).

A study on the effects of two different hanging ratios in the bottom set monkfish gillnet fishery on the bycatch of cetaceans and pinnipeds was conducted by NEFSC in 2009 and 2010. Commercial fishing vessels from Massachusetts and New Jersey were used for the study which took place south of the Harbor Porpoise Take Reduction Team Cape

Cod South Management Area (south of 40° 40´) in February, March and April. One hundred fifty-nine hauls with eight research strings each were completed during the course of the study. Results showed that while a 0.33 mesh performed better at catching commercially important finfish than a 0.50 mesh, there was no statistical difference in cetacean or pinniped bycatch rates between the two hanging ratios. Nine harp seals were caught in this project during 2009 and one during 2010 (A.I.S. Inc 2010). These animals are included in the observed interactions and added to the total estimates (Table 2b), though these interactions and their associated fishing effort were not included in bycatch rate calculations.

Mid-Atlantic Gillnet:

No harp seals were taken in observed trips during 1993-1997 or 1999-2006. One harp seal was observed taken in both 1998 and 2007, 4 were taken in 2008, 3 in 2009, and 1 in 2010. 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), 0 in 1999-2006 38 in 2007, 176 (0.74) in 2008, 70 (0.67) in 2009, and 32 (0.93) in 2010. Average annual estimated fishery-related mortality attributable to this fishery during 2006–2010 was 63 harp seals (CV=0.46) (Table 2b).

Northeast Bottom Trawl

Four mortalities were observed in the Northeast bottom trawl fishery between 2002 and 2010. 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 in 2002-2004, and 0 in 2006–2008, and 2010. Estimates have not been generated for 2005 or 2009.

Table 2b. Summary of the incidental mortality of harp seal (*Pagophilus groenlandicus*) by commercial fishery including the years sampled (Years), 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	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[e]	06-10	Obs. Data, Trip Logbook, Allocated Dealer Data	.04, .07, .05, .04, .17	3, 11, 14, 32, 8	65, 119, 238, 415, 253	.66, .35, .38, .27, .62	218 (0.20)
Mid-Atlantic Gillnet	06-10	Obs. Data, Trip Logbook, Allocated Dealer Data	.04, .05, .03, .03, .04	0, 1, 4, 3, 1	0, 38, 176, 70, 32	0, 0.9, .74, .67, .93	63 (0.46)
Northeast Bottom Trawl[d]	06-10	Obs. Data Weighout	.06, .06, .08, .09, .16	0, 0, 0, 1, 0	0, 0, 0, unk, 0	0, 0, 0, unk, 0	0.2 (na) [d]
TOTAL							281 (0.19)

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. The 2010 observer coverage in the NE sink gillnet fishery includes the At Sea Monitoring Program coverage.
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 2000-2010, respectively, 2, 1, 0, 0, 4, 0, 3, 0, 3, 4 and 1 takes were observed in nets with pingers. In 2000-2010, respectively, 1, 0, 0, 0, 11, 3, 0, 12, 15, 28, and 6 takes were observed in nets without pingers.
d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated. Unexpanded values are provisionally provided.
e. Nine harp seals in 2009 and 1 in 2010 were incidentally caught as part of a NEFSC hanging ratio study to examine the impact of gillnet hanging ratio on harbor porpoise bycatch. These animals were included in the observed interactions and added to the total estimates, though these interactions and their associated fishing effort were not included in bycatch rate calculations.

Other Mortality

Canada: Harp seals have been commercially hunted since the mid-1800s in the Canadian Atlantic (Stenson 1993). A total allowable catch (TAC) of 200,000 harp seals was set for the large vessel hunt in 1971. The TAC varied until 1982 when it was set at 186,000 seals and remained at this level through 1995 (Stenson 1993; ICES 1998). The TAC was increased to 250,000 and 275,000, respectively, in 1996 and 1997 (ICES 1998). The 1997 TAC remained in effect through 2002. In 2003, a three-year TAC was set at 975,000 with a maximum of 350,000 allowed in the first two years (ICES 2008). As a result of catches in the first two years the 2005 TAC was set at 319,517 (ICES 2008). The 2006 TAC was increased to 335,000 (325,000 commercial hunt, 6,000 Aboriginal initiative, and 2,000 allocation each for personal use and Arctic catches). The TAC was reduced to 270,000 in 2007 (263,140 commercial hunt, 4,860 for Aboriginal, and 2,000 for personal use) (ICES 2008). In 2008 the TAC was increased to 275,000 (268,050 commercial hunt, 4,950 for Aboriginal, and 2,000 for personal use). In 2009 the TAC was 280,000, it was increased to 330,000 in 2010, and to 400,000 in 2011 (DFO 2011). In recent years hunters have harvested only a small portion (<10%) of the TAC since there are currently few markets for these seal products.

U.S.: From 2006 to 2010, 487 harp seal stranding mortalities were reported (Table 3; NMFS unpublished data). Thirty-two (6.6%) of the mortalities during this five-year period showed signs of human interaction (2 in 2006, 6 in 2007, 3 in 2008, 6 in 2009, and 15 in 2010) and 6 having some sign of fishery interaction (1each in 2007 and 2008, 2 in 2009, and 2 in 2010)). However, the cause of death of stranded animals is not being evaluated (interactions may be non-fatal or even post-mortem). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of harp seal strandings in the Gulf of Maine is consistent with the species' seasonal migratory patterns in this region.

Table 3. Harp seal (*Pagophilus groenlandicus*) stranding mortalities [a] along the U.S. Atlantic coast (2006–2010) with subtotals of animals recorded as pups in parentheses.						
State	2006	2007	2008	2009	2010	Total
ME	14	8	15	9	13	59
NH	0	1	1	4	1	7
MA	24	51 (2)	51	59 (2)	45	230
RI	6	2	5	9	5	27
CT	4	1	2	3	5	15
NY	15	19 (1)	8	29	22	93
NJ	3 (1)	3	12	5	9	32
DE	0	2	0	0	1	3
MD	0	4	1	2	2	9
VA	0	5	3	1	2	11
NC	1	0	0	0	0	1
Total	**67**	**96**	**98**	**121**	**105**	487
Unspecified seals (all states)	46	34	51	34	22	187
a. 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 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.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.

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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 (i.e., U.S. Gulf of Mexico) systematic aerial and ship surveys indicate that sperm whales inhabit continental slope and oceanic waters where they are widely distributed (Figure 1; Fulling *et al.* 2003; Mullin and Fulling 2004; Mullin *et al.* 2004; Maze-Foley and Mullin 2006; 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).

Because there are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), sperm whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

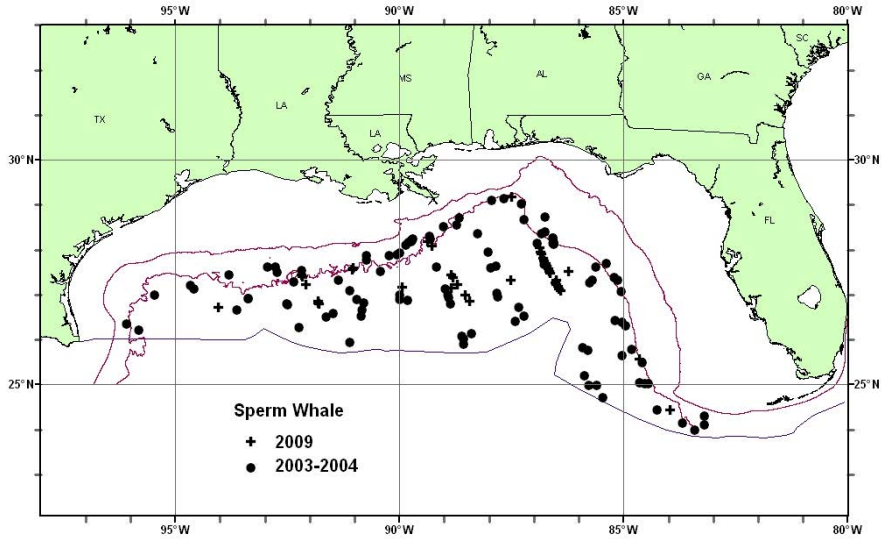

Figure 1. *Distribution of sperm whale sightings from SEFSC vessel surveys during summer 2003 and spring 2004, and during summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

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.* 2008). The following summarizes the most significant stock structure-related findings from the Sperm Whale Seismic Study (Jochens *et al*. 2008) and associated projects. Measurements of the total length of Gulf of Mexico sperm whales indicate that they are 1.5-2.0m smaller on average compared to whales measured in other areas. Female/immature group size in the Gulf is about one-third to one-fourth that found in the Pacific Ocean but more similar to group sizes in the Caribbean (Richter *et al.* 2008; Jaquet and Gendron 2009). Tracks from 39 whales satellite tagged in the northern Gulf were monitored for up to 607 days. No discernable seasonal migrations were made, but Gulf-wide movements primarily along the northern Gulf slope did occur. The tracks showed that whales exhibit 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. This animal moved into the North Atlantic and then back into the Gulf after about 2 months. Additionally, no matches were found when 285 individual whales photo-identified from the Gulf and

about 2500 from the North Atlantic and Mediterranean Sea were compared. Engelhaupt *et al.* (2009) conducted an analysis of matrilineally inherited mtDNA and found a significant genetic differentiation between animals from the northern Gulf of Mexico compared to those from the western North Atlantic Ocean, North Sea and Mediterranean Sea. Analysis of biparentally inherited nuclear DNA showed no significant difference between whales sampled in the Gulf and those from the other areas of the North 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 (Watkins and Schevill 1977; Whitehead and Weilgart 1991; Rendell and Whitehead 2001), and based on degree of social affiliation, mixed groups of sperm whales worldwide can be placed in recognizable acoustic clans (Rendell and Whitehead 2003). 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. It is assumed from this that groups from other clans enter the northern Gulf only infrequently (Gordon *et al.* 2008). Antunes (2009) used additional data to further examine variation in sperm whale coda repertoires in the North Atlantic Ocean, and found that variation in the North Atlantic is mostly geographically structured based on findings of coda patterns unique to certain regions and a significant negative correlation between coda repertoire similarities and geographic distance. His work also suggested sperm whale coda differentiation of the Gulf of Mexico from the North Atlantic.

Additional research by Gero *et al.* (2007) suggested that movements of sperm whales between the adjacent areas of the Caribbean Sea, Gulf of Mexico and Atlantic may not be common. No matches were made from animals photo-identified in the eastern Caribbean Sea (islands of Dominica, Guadeloupe, Grenada, St. Lucia and Martinique) with either animals from the Sargasso Sea or the Gulf of Mexico.

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico sperm whales is 763 (CV=0.38; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200-m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of sperm whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 530 (CV=0.31) (Hansen *et al.* 1995), and for 1996 to 2001, 1,349 (CV=0.23) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for sperm whales, pooled from 2003 to 2004, was 1,665 (CV=0.20) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for sperm whales in oceanic waters during 2009 was 763 (CV=0.38; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico sperm 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
Apr-Jun 1991-1994	Oceanic waters	530	0.31
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	1,349	0.23
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	1,665	0.20
Jun-Aug 2009	Oceanic waters	763	0.38

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 763 (CV=0.38). The minimum population estimate for the northern Gulf of Mexico is 560 sperm whales.

Current Population Trend

Four point estimates of sperm whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of more than three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of sperm whale abundance. 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 (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 560. 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 1.1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of a sperm whale during 1998-2010 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2008 there was 1 sperm whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009). Also during 2008 there was 1 sperm whale mortality due to entanglement in the sea anchor (parachute anchor and lines) of a longline fishing vessel.

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to sperm whales by this fishery. However, on 2 June 2008 there was 1 sperm whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009). The whale was entangled in mainline and other gear and was accompanied by a calf. The mainline broke when the whale dove and gear remained on the animal; however, since it was a large whale it was not considered seriously injured (Garrison and Stokes 2008). This was the first observed interaction between a sperm whale and this fishery. During 15 April – 15 June 2008 observer coverage in the Gulf of Mexico was greatly enhanced to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Resulting observer coverage for this time and area is dramatically higher than typical for previous years (Garrison *et al.* 2009).

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

There were 8 sperm whale strandings in the northern Gulf of Mexico during 2006–2010 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). For 1 stranding, no evidence of human interaction was detected; for the remaining 7 strandings, it could not be determined if there was evidence of human interactions. During June 2010, 1 dead sperm whale was found floating 77 miles due south of the Deepwater Horizon spill site. It was not found in oiled waters; however, the location of its death is unknown. Cause of death is also unknown; the animal did not appear oily. Stranding data probably underestimate the extent of human-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in human 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 human interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 2 animals from this stock were considered to be part of the UME.

Ship strikes to whales occur world-wide and are a source of injury and mortality. One possible sperm whale mortality due to a vessel strike has been documented for the Gulf of Mexico. The incident occurred in 1990 in the vicinity of Grande Isle, Louisiana. Deep cuts on the dorsal surface of the whale indicated the ship strike was probably pre-mortem (Jensen and Silber 2004).

During 2008 there was 1 sperm whale mortality due to entanglement in the sea anchor (parachute anchor and lines) of a longline fishing vessel. The animal was originally identified as "unknown marine mammal," but was later identified to species via genetic testing.

Table 1. Sperm whale (*Physeter macrocephalus*) strandings along the U.S. Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	0	0	0
Florida	0	1	1	0	1	3
Louisiana	0	0	0	0	2*	2
Mississippi	0	0	0	0	0	0
Texas	0	1	2	0	0	3
TOTAL	0	2	3	0	3	8

*These strandings are included in the Northern Gulf of Mexico UME

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved; the amount, frequency and duration of exposure; the route of exposure (inhaled, ingested, absorbed, or external); and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long-term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. However, 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 northern Gulf of Mexico sperm whale responses to seismic exploration indicate that sperm whales do not appear to exhibit horizontal avoidance of seismic survey activities. Data did suggest that there may be some decrease in foraging effort during exposure to full-array airgun firing, at least for some individuals. Further study is needed as samples sizes are insufficient at this time (Miller *et al.* 2009).

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.

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is 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 northern Gulf of Mexico (i.e., U.S. 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; Maze-Foley and Mullin 2006). However, there are stranding records from throughout the year (Würsig *et al.* 2000).

Although there are no confirmed records from Gulf of Mexico waters beyond U.S. boundaries, Bryde's whales may occur in other parts of the Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico.

It has been postulated that the Bryde's whales found in the northern 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

The best abundance estimate available for northern Gulf of Mexico Bryde's whales is 33 (CV=1.07; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

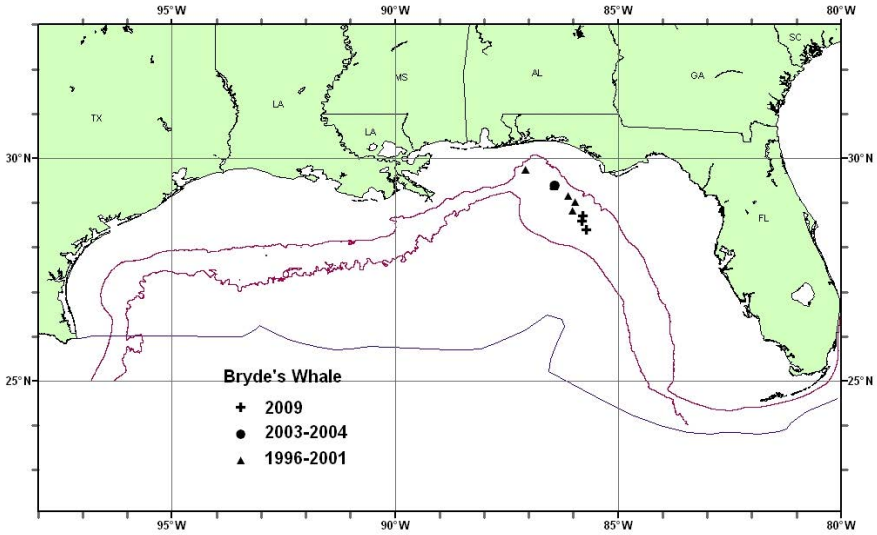

Figure 1. *Distribution of Bryde's whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Bryde's whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 35 (CV=1.10) (Hansen *et al.* 1995), and for 1996 to 2001, 40 (CV=0.61) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Bryde's whales, pooled

from 2003 to 2004, was 15 (CV=1.98) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for Bryde's whales in oceanic waters during 2009 was 33 (CV=1.07; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico Bryde's 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
Apr-Jun 1991-1994	Oceanic waters	35	1.10
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	40	0.61
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	15	1.98
Jun-Aug 2009	Oceanic waters	33	1.07

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 33 (CV=1.07). The minimum population estimate for the northern Gulf of Mexico is 16 Bryde's whales.

Current Population Trend

Four point estimates of Bryde's whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly three but the precision of the estimates is very poor. The vast majority of the small number of Bryde's whale sightings from each survey occurred in a very restricted area of the northeastern Gulf (Figure 1) during surveys that uniformly sampled the entire oceanic northern Gulf. Because the population size is small, in order to effectively monitor trends in Bryde's whale abundance in the future, other methods need to be used, such as line-transect surveys that focus fine scale survey effort specifically on the area they inhabit or mark-recapture studies. Additionally, whales need to be satellite tagged to determine whether they use this area exclusively or travel to other areas.

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 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 16. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Bryde's whale is 0.16.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Annual human-caused mortality and serious injury is unknown for this stock. There is no documented mortality or serious injury associated with commercial fishing. During 2009 there was 1 known Bryde's whale mortality as a result of a ship strike. For the period 2006 through 2010, the minimum annual rate of human-caused mortality and serious injury to Bryde's whales due to ship strikes was 0.2 per year. Detected mortalities should not be considered an unbiased representation of human-caused mortality. Detections are haphazard and not the result of a designed

sampling scheme. As such they represent a minimum estimate of human-caused mortality which is almost certainly biased low.

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There has been no reported fishing-related mortality or serious injury of a Bryde's whale by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were 2 reported strandings of Bryde's whales in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). During 2009 a Bryde's whale was found floating in the Port of Tampa (Florida). The whale had evidence of premortem and postmortem blunt trauma, and was determined to have been struck by a ship, draped across the bow and carried into port. The whale was a lactating female and measured 12.65m in length. One Bryde's whale calf live-stranded in Sandestin, Florida, during November 2006. No evidence of human interaction was detected for this stranded animal. Stranding data probably underestimate the extent of human-caused mortality and serious injury because not all of the marine mammals which die or are seriously injured from human 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 vessel collision, 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 human interactions.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans,the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. For large whales, oil can

foul the baleen they use to filter-feed. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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 stock. Total human-caused mortality and serious injury for this stock is not known but one human-caused mortality was documented during 2009. This is a strategic stock because the average annual human-caused mortality and serious injury exceeds 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 (i.e., U.S. 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. Beaked whale sightings made during spring and summer vessel surveys have been widely distributed in waters >500 m deep (Maze-Foley and Mullin 2006; Figure 1).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), Cuvier's beaked whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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.

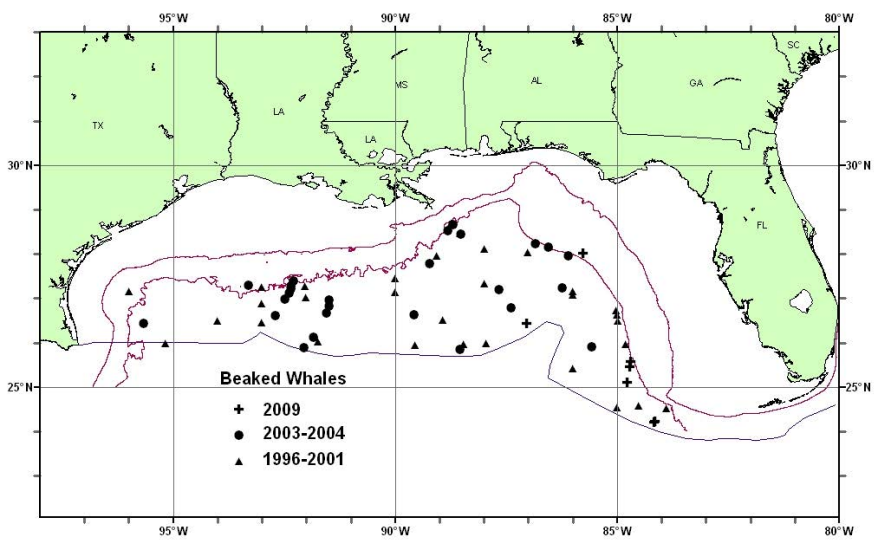

Figure 1. *Distribution of beaked whale sightings from SEFSC shipboard vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

POPULATION SIZE

The best abundance estimate available for Cuvier's beaked whales in the northern Gulf of Mexico is 74 (CV=1.04; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200 m isobath to the seaward extent of the U.S. EEZ. However, this abundance estimate is 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 is 74 (CV=1.04), which may also include an unknown number of Cuvier's beaked whales.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200-m isobath to seaward extent of the U.S EEZ), and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 to 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Cuvier's beaked whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 30 (CV=0.50) (Hansen *et al.* 1995), and for 1996 to 2001, 95 (CV=0.47) (Mullin and Fulling 2004; Table 1). 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 have also included an unknown number of Cuvier's beaked whales.

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Cuvier's beaked whales, pooled from 2003 to 2004, was 65 (CV=0.67) (Mullin 2007; Table 1). The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may have also included an unknown number of Cuvier's beaked whales.

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for Cuvier's beaked whales in oceanic waters during 2009 was 74 (CV=1.04; Table 1). The estimate for the same time period for unidentified Ziphiidae was also 74 (CV=1.04), which may have also included an unknown number of Cuvier's beaked whales.

Table 1. Summary of abundance estimates for northern Gulf of Mexico Cuvier's beaked 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
Apr-Jun 1991-1994	Oceanic waters	30	0.50
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	95	0.47
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	65	0.67
Jun-Aug 2009	Oceanic waters	74	1.04

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 74 (CV=1.04). The minimum population estimate for the northern Gulf of Mexico is 36 Cuvier's beaked whales.

Current Population Trend

Four point estimates of Cuvier's beaked whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of more than three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of Cuvier's beaked whale abundance. 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 (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 36. 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 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2007 there was 1 unidentified beaked whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield and Garrison 2008).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Cuvier's beaked whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al*. 2009; Garrison and Stokes 2010; 2011). However, during 2007, 1 unidentified beaked whale was observed entangled and released alive in the northern Gulf of Mexico. All gear was removed and the animal was presumed to have no serious injuries (Fairfield and Garrison 2008).

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 were no reported strandings of a Cuvier's beaked whale in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 1980's 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 active 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).

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days

millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, s the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

STATUS OF STOCK

The status of Cuvier's beaked whales and 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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. 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). Beaked whale sightings made during spring and summer vessel surveys have been widely distributed in waters >500 m deep (Maze-Foley and Mullin 2006; Figure 1). Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Ortega Ortiz 2002), Blainville's beaked whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The total number of Blainville's beaked whales in the northern Gulf of Mexico is unknown. The best available abundance estimate is for *Mesoplodon* spp., and is a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, using data from a summer 2009 oceanic survey, is 149 (CV=0.91; Table 1).

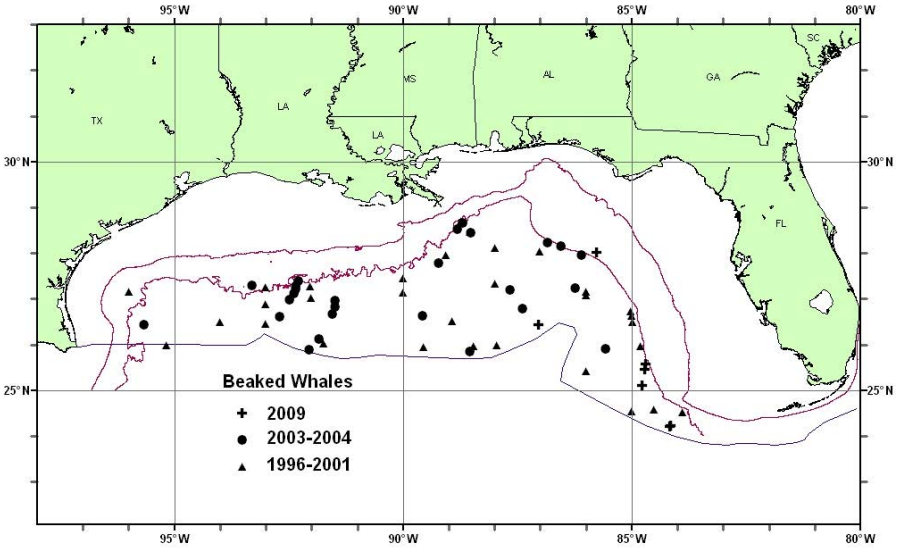

Figure 1. *Distribution of beaked whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200-m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year during 1991-1994, the 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. For 1996 to 2001, the survey effort-weighted estimated average abundance for *Mesoplodon* spp. was 106 (CV=0.41) (Mullin and Fulling 2004; Table 1). This was a combined estimate for Blainville's and Gervais' beaked whales. The estimate for the same time period for unidentified Ziphiidae was 146 (CV=0.46) which may have also included an unknown number of Blainville's beaked whales.

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The estimate of abundance for *Mesoplodon* spp., pooled from 2003 to 2004, was 57 (CV=1.40) (Mullin 2007; Table 1). This was a combined estimate for Blainville's and Gervais' beaked whales. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may have also included an unknown number of Blainville's beaked whales.

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The estimate of abundance for *Mesoplodon* spp. in oceanic waters during 2009 was 149 (CV=0.91; Table 1). This was a combined estimate for Blainville's and Gervais' beaked whales. The estimate for the same time period for unidentified Ziphiidae was 74 (CV=1.04), which may have also included an unknown number of Blainville's beaked whales.

Table 1. Summary of abundance estimates for northern Gulf of Mexico *Mesoplodon* spp., which is a combined estimate for Blainville's beaked whale and Gervais' beaked 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
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	106	0.41
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	57	1.40
Jun-Aug 2009	Oceanic waters	149	0.91

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 149 (CV=0.91). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is 77.

Current Population Trend

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. Three point estimates of *Mesoplodon* spp. abundance have been made based on data from surveys covering 1996-2009. The estimates vary by a maximum factor of nearly three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. 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 (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 77. 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 0.8. 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 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2007 there was 1 unidentified beaked whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield and Garrison 2008).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Blainville's or other beaked whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2007, 1 unidentified beaked whale was observed entangled and released alive in the northern Gulf of Mexico. All gear was removed and the animal was presumed to have no serious injuries (Fairfield and Garrison 2008).

Other Mortality

There were no strandings of *Mesoplodon* spp. or unidentified beaked whales during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). 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.

Since 1990, there have been 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and 1 of these included Blainville's beaked whales. Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *Karenia 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. An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 1980's 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 active 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) (NMFS 2001; Cox *et al.* 2006).

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. Gulf of Mexico) from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). Beaked whale sightings made during spring and summer vessel surveys have been widely distributed in waters >500m deep (Maze-Foley and Mullin 2006; Figure 1).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), Gervais' beaked whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The total number of Gervais' beaked whales in the northern Gulf of Mexico is unknown. The best available abundance estimate is for *Mesoplodon* spp., and is a combined estimate for Gervais' beaked whale and Blainville's beaked whale. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, using data from a summer 2009 oceanic survey, is 149 (CV=0.91; Table 1).

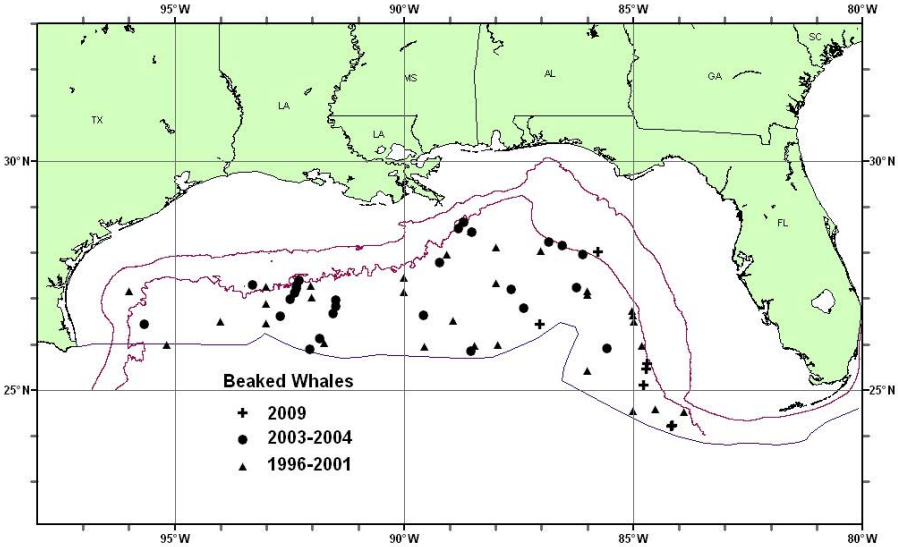

Figure 1. *Distribution of beaked whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year during 1991-1994, the 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. For 1996 to 2001, the survey effort-weighted estimated average abundance for *Mesoplodon* spp. was 106 (CV=0.41) (Mullin and Fulling 2004; Table 1). This was a combined estimate for Blainville's and Gervais' beaked whales. The estimate for the same time period for unidentified Ziphiidae was 146 (CV=0.46) which may have also included an unknown number of Gervais' beaked whales.

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The estimate of abundance for *Mesoplodon* spp., pooled from 2003 to 2004, was 57 (CV=1.40) (Mullin 2007; Table 1). This was a combined estimate for Blainville's and Gervais' beaked whales. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may have also included an unknown number of Gervais' beaked whales.

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The estimate of abundance for *Mesoplodon* spp. in oceanic waters during 2009 was 149 (CV=0.91; Table 1). This is a combined estimate for Blainville's and Gervais' beaked whales. The estimate for the same time period for unidentified Ziphiidae was 74 (CV=1.04), which may have also included an unknown number of Gervais' beaked whales.

Table 1. Summary of abundance estimates for northern Gulf of Mexico *Mesoplodon* spp., which is a combined estimate for Gervais' beaked whale and Blainville's beaked 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
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	106	0.41
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	57	1.40
Jun-Aug 2009	Oceanic waters	149	0.91

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 149 (CV=0.91). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is 77.

Current Population Trend

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. Three point estimates of *Mesoplodon* spp. abundance have been made based on data from surveys covering 1996-2009. The estimates vary by a maximum factor of nearly three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. 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 (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 77. 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 0.8. It is not possible to determine the PBR for only Gervais' beaked whales.

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There has been no reported fishing-related mortality of a beaked whale during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2007 there was 1 unidentified beaked whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield and Garrison 2008).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Gervais' or other beaked whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2007, 1 unidentified beaked whale was observed entangled and released alive in the northern Gulf of Mexico. All gear was removed and the animal was presumed to have no serious injuries (Fairfield and Garrison 2008).

Other Mortality

There were no strandings of *Mesoplodon* spp. or unidentified beaked whales during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 1980's 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 active 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).

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 truncatus*): Northern Gulf of Mexico Continental Shelf Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) Continental Shelf Stock of bottlenose dolphins inhabits waters from 20 to 200m 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 occur in the Gulf of Mexico (Hersh and Duffield 1990; LeDuc and Curry 1998). The Continental Shelf Stock probably consists of a mixture of both the coastal and offshore ecotypes. The offshore and coastal 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 34km and in waters deeper than 34 m. Within 7.5km 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 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 <20m deep in the northern 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).

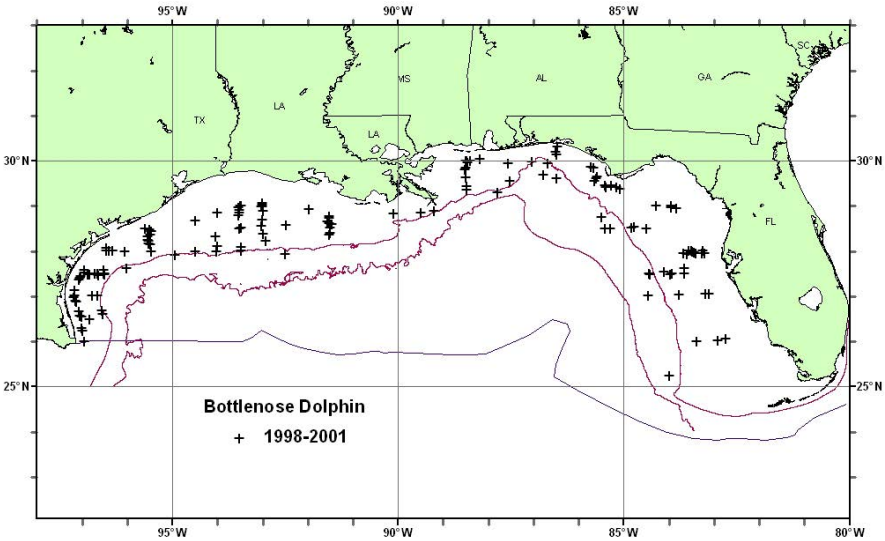

Figure 1. *Distribution of bottlenose dolphin sightings from SEFSC fall vessel surveys during 1998-2001. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Based on research currently being conducted on bottlenose dolphins in the northern 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 41 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 northern Gulf of Mexico. As research is completed, it may be necessary to revise stocks of bottlenose dolphins in the northern Gulf of Mexico.

POPULATION SIZE

The current population size for the bottlenose dolphin continental shelf stock in the northern Gulf of Mexico is unknown because the survey data are more than 8 years old. Estimates using data older than 8 years are deemed

unreliable; and, therefore, should not be used for PBR determinations (Wade and Angliss 1997).

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* (2000) and *Gordon Gunter* (1998, 1999, 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 to develop an average abundance estimate. The most recent abundance estimate of bottlenose dolphins from the Continental Shelf Stock 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).

Minimum Population Estimate

The minimum population estimate is unknown. 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 unknown. The minimum population estimate for the northern Gulf of Mexico is unknown.

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 (20-200m) 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 dolphins 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 (PBR) is undetermined. 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

One serious injury occurred in the Southeastern U.S. Atlantic, Gulf of Mexico, Caribbean snapper-grouper and other reef fish fishery during 2010. One mortality occurred during 2010 incidental to oil rig platform removal operations when an animal became entangled in line and drowned. One mortality during 2008 in the shrimp trawl fishery may have come from the continental shelf stock.

Fisheries Information

The commercial fisheries which potentially could interact with this stock in the Gulf of Mexico are: Southeastern U.S. Atlantic, Gulf of Mexico shark bottom longline fishery; Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl fishery, Southeastern U.S. Atlantic, Gulf of Mexico, Caribbean snapper-grouper and other reef fish fishery; and the Gulf of Mexico butterfish trawl fishery (Appendix III). 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.

One serious injury occurred in the Southeastern U.S. Atlantic, Gulf of Mexico, Caribbean snapper-grouper and other reef fish fishery during 2010. A bottlenose dolphin was hooked in the rostrum and line was wrapped around the rostrum. The injured animal was likely from the Continental Shelf 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). Based on the water depths of the interactions (12m, 29m and 60m), they likely involved animals from the Eastern Coastal and Continental Shelf Stocks. No interactions were observed during 2004-2010 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009; 2010; 2011). 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.

A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Four bottlenose dolphin mortalities were observed in the shrimp trawl fishery during 2003, 2007, 2008 and 2010. The 2008 mortality occurred off the Texas coast and could have belonged to the Western Coastal Stock or Continental Shelf Stock. During 2009, 1 bottlenose dolphin was released alive presumably with no serious injury after becoming entangled in the lazy line of a shrimp trawl. This animal could have belonged to the Continental Shelf Stock or the Western Coastal Stock. During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal stocks, and it is likely that 3-4 of the animals belonged to the Continental Shelf Stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed because there was no necropsy. In 2008, an additional dolphin carcass was caught on the tickler chain of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal stock or Continental Shelf Stock, or possibly to the Atlantic spotted dolphin stock.

A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980's with no records of incidental take of marine mammals (Burn and Scott 1988; NMFS unpublished data), although an experimental set by NMFS resulted in the death of 2 bottlenose dolphins (Burn and Scott 1988). There are no other data available.

Other Mortality

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 had been no reports of either serious injury or mortality to bottlenose dolphins until 2010 (NMFS unpublished data). One mortality occurred during 2010 when a bottlenose dolphin became entangled in a diver’s guide line during platform removal operations. A diver discovered the dolphin at a depth of 25.9m and reported it to be motionless and unresponsive with both tail flukes caught in poly guide line, which was being used to transfer equipment to the sea floor. No explosives were involved in this incident.

A total of 1,340 bottlenose dolphins were found stranded in the northern Gulf of Mexico from 2006 through 2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Of these, 114 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 estuary 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.)

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the

Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 221 bottlenose dolphins were considered to be part of the UME. The vast majority of stranded bottlenose dolphins are assumed to belong to one of the coastal stocks or to bay, sound and estuary stocks. Nevertheless, it is possible that some of the stranded bottlenose dolphins considered part of the UME belonged to the Continental Shelf Stock.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Despite an undetermined PBR and unknown population size, this is not a strategic stock because previous estimates of population size have been large compared to the number of cases of documented human-related mortality and serious injury.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (i.e., U.S. 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 climatic, 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 outer bay boundaries to the 20m isobath (Figure 1). The Eastern Coastal bottlenose dolphin stock area extends from 84°W longitude to Key West, Florida. The region is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. It is bordered on the north by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay.

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico Continental Shelf Stock and bay, sound and estuary stocks. The seaward boundary for coastal stocks, the 20m 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" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (Vollmer 2011), 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; Rosel *et al.* 2009). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34km from shore. The offshore ecotype was found exclusively seaward of 34km and in waters deeper than 34m. Within 7.5km of shore, all animals were of the coastal ecotype. The distance of the 20m isobath ranges from 4 to 90km from shore in the northern Gulf. Because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply.

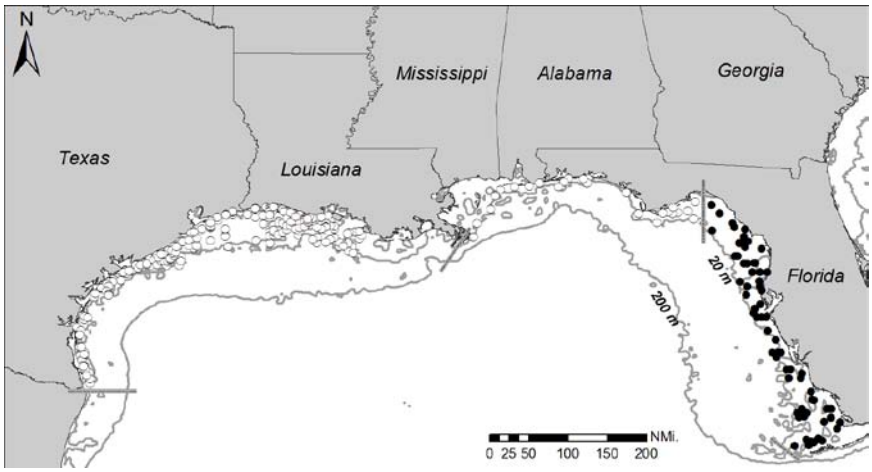

Figure 1. *Locations (circles) of bottlenose dolphin groups sighted in coastal waters during aerial surveys conducted in the Western Coastal Stock area in 1992 and 1996, and in the Northern Coastal Stock and Eastern Coastal Stock areas in 2007. Dark circles indicate groups within the boundaries of the Eastern Coastal Stock. The 20 and 200m isobaths are shown.*

Research on coastal stocks is limited. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay and Lemon Bay, Florida, 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. These findings support an earlier report by Irvine *et al.* (1981) of increased use of pass and coastal waters by

Sarasota Bay dolphins in winter. 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. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, and the coastal Gulf of Mexico (1-12km 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 estuary stocks from those occurring in adjacent Gulf coastal waters, as suggested by Wells (1986).

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, 285km north, in May 1992 and May 1993 (Lynn and Würsig 2002).

POPULATION SIZE

The best abundance estimate available for the northern Gulf of Mexico Eastern Coastal Stock of bottlenose dolphins is 7,702 (CV=0.19), and is a result of aerial surveys conducted during summer 2007.

Earlier abundance estimates

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 9km past the 18m isobath. Approximately 5% of the total survey area was visually searched. The previous bottlenose dolphin abundance estimate for the Eastern Coastal Stock based on the 1994 survey was 9,912 (CV=0.12).

Recent surveys and abundance estimates

Current abundance estimates for the Northern and Eastern Coastal Stocks were derived from aerial surveys conducted during 17 July to 8 August 2007. Survey effort covered waters from the shoreline to 200m depth and was stratified such that the majority of effort was expended in the 0-20m depth range of the coastal stocks. The survey team consisted of an observer stationed at each of two forward bubble windows and a third observer stationed at a belly window that monitored the trackline. Surveys were typically flown during favorable sighting conditions at Beaufort sea state less than or equal to 3 (surface winds <10 knots). Abundance estimates were derived using distance analysis including environmental covariates that had a significant influence on sighting probability (Buckland *et al.*, 2001), but these estimates were not corrected for *g(0)* and are thus negatively biased. The resulting abundance estimate for the Eastern Coastal Stock was 7,702 animals (CV=0.19).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Eastern Coastal Stock of bottlenose dolphins is 7,702 (CV=0.19). The minimum population estimate for the northern Gulf of Mexico Eastern Coastal Stock is 6,551 bottlenose dolphins.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (Wade and Angliss 1997). The minimum population size is 6,551. 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 Eastern Coastal Stock of bottlenose dolphins is 66.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Eastern Coastal Stock of bottlenose dolphins during 2006–2010 is unknown.

Fisheries Information

The commercial fisheries which potentially could interact with the Eastern Coastal Stock in the northern Gulf of Mexico are the shark bottom longline, shrimp trawl, blue crab trap/pot, stone crab trap/pot, spiny lobster trap/pot, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

Hook and Line Fisheries

During 2006 there were 2 mortalities, and during 2009, 1 mortality, for which hook and line gear entanglement or ingestion were documented in the stranding database. During 2010 an attempt was made to disentangle 1 live animal from hook and line gear. The mortalities and live entanglement were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011) and are included in the stranding totals presented in Table 1.

Shark Bottom Longline Fishery

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). Based on the water depths of the interactions (12m, 29m and 60m), they likely involved animals from the Eastern Coastal and Continental Shelf Stocks. No interactions were observed during 2004-2010 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009; 2010; 2011). 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.

Shrimp Trawl Fishery

A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Four bottlenose dolphin mortalities were observed during 2003, 2007, 2008 and 2010 which could have belonged to bay, sound and estuary stocks, the Western Coastal Stock, the Northern Coastal Stock and the Continental Shelf Stock. During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal Stocks, and it is likely that 3-4 of the animals belonged to the Continental Shelf Stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed because there was no necropsy.

Blue and Stone Crab and Spiny Lobster Trap/Pot Fisheries

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. During 2010, 3 dolphins likely belonging to the Eastern Coastal Stock were disentangled from probable stone crab trap gear in Florida and swam away in unknown condition. Also during 2010, 1 mortality was documented in which an animal was entangled in unidentified crab trap/pot gear. During 2008, another dolphin off Florida likely belonging to the Eastern Coastal Stock, reportedly half the size of an adult, was disentangled from a crab pot line and swam away with no reported injuries. The mortality and live entanglements were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011) and are included in the stranding totals presented in Table 1. Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Strandings

A total of 64 bottlenose dolphins were found stranded in Eastern Coastal waters of the northern Gulf of Mexico

from 2006 through 2010 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 10 of these dolphins. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

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 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and 3 of these have occurred within the boundaries of the Eastern Coastal Stock and may have affected the stock. 1) 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). 2) An unusual mortality event was declared for Sarasota Bay, Florida, in 1991, but the cause was not determined. 3) 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 November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 24 unidentified dolphins). The evidence suggests the effects of a red tide bloom contributed to the cause of this event. In addition, an UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from the Eastern Coastal Stock were considered to be part of this UME.

Table 1. Bottlenose dolphin strandings occurring in Eastern Coastal Stock waters of the northern Gulf of Mexico from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that strandings in coastal waters have been separated by coastal stock and separated from bay, sound and estuary stocks; therefore, the annual totals below will differ from those reported previously. Finally, there were an additional 24 dolphins not included in this or any other table that stranded either in bay, sound and estuary waters or in coastal waters that could not be assigned definitively to a stock due to bad location data. If/when the location data are resolved, the numbers below could increase.

Stock	**Category**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Eastern Coastal Stock	Total Stranded	30[a]	4	7	11	12	64
	Human Interaction						
	---Yes	2	0	2	1	5	10
	---No	5	1	1	5	1	13
	---CBD	23	3	4	5	6	41

[a] This total includes 28 animals that were part of the 2005-2006 UME

Other Mortality

The problem of dolphin depredation of fishing gear is increasing in the Gulf of Mexico. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second 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. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). 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, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). 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 (Powell and Wells 2011). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or

injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

The nearshore habitat occupied by the 3 coastal 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 PCBs 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 16-46µg/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).

STATUS OF STOCK

The status of the Eastern Coastal 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. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury is insignificant and approaching zero mortality and serious injury rate. Additionally, there is no systematic monitoring of all fisheries that may take this stock. 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. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (i.e., U.S. 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 climatic, 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 outer bay boundaries to the 20m isobath (Figure 1). The Northern Coastal bottlenose dolphin stock area extends from 84°W longitude to the Mississippi River Delta. 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 freshwater input. It is bordered on the east by an extensive area of coastal marsh and marsh islands typical of Florida's Apalachee Bay.

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico Continental Shelf Stock and bay, sound and estuary stocks. The seaward boundary for coastal stocks, the 20m 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" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (Vollmer 2011), 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; Rosel *et al.* 2009). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34km from shore. The offshore ecotype was found exclusively seaward of 34km and in waters deeper than 34m. Within 7.5km of shore, all animals were of the coastal ecotype. The distance of the 20m isobath ranges from 4 to 90km from shore in the northern Gulf. Because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply.

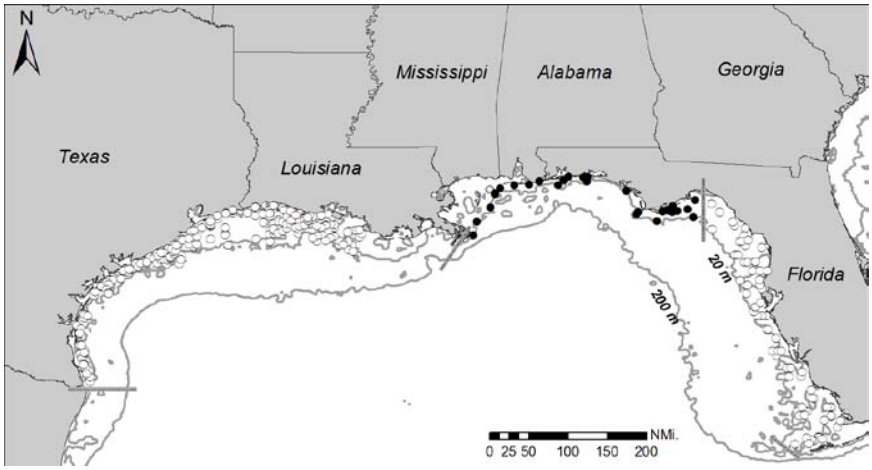

Figure 1. *Locations (circles) of bottlenose dolphin groups sighted in coastal waters during aerial surveys conducted in the Western Coastal Stock area in 1992 and 1996, and in the Northern Coastal Stock and Eastern Coastal Stock areas in 2007. Dark circles indicate groups within the boundaries of the Northern Coastal Stock. The 20 and 200-m isobaths are shown.*

Research on coastal stocks is limited. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay and Lemon Bay, Florida, 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. These findings support an earlier report by Irvine *et al.* (1981) of increased use of pass and coastal waters by

Sarasota Bay dolphins in winter. 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. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, and the coastal Gulf of Mexico (1-12km 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 estuary stocks from those occurring in adjacent Gulf coastal waters, as suggested by Wells (1986).

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, 285km north, in May 1992 and May 1993 (Lynn and Würsig 2002).

POPULATION SIZE

The best abundance estimate available for the northern Gulf of Mexico Northern Coastal Stock of bottlenose dolphins is 2,473 (CV=0.25), and is a result of aerial surveys conducted during summer 2007.

Earlier abundance estimates

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 9km past the 18m isobath. Approximately 5% of the total survey area was visually searched. The previous bottlenose dolphin abundance estimate for the Northern Coastal Stock based on the 1993 survey was 4,191 (CV=0.21).

Recent surveys and abundance estimates

Current abundance estimates for the Northern and Eastern Coastal Stocks were derived from aerial surveys conducted during 17 July to 8 August 2007. Survey effort covered waters from the shoreline to 200m depth and was stratified such that the majority of effort was expended in the 0-20m depth range of the coastal stocks. The survey team consisted of an observer stationed at each of two forward bubble windows and a third observer stationed at a belly window that monitored the trackline. Surveys were typically flown during favorable sighting conditions at Beaufort sea state less than or equal to 3 (surface winds <10 knots). Abundance estimates were derived using Distance analysis including environmental covariates that had a significant influence on sighting probability (Buckland *et al.*, 2001), but these estimates were not corrected for *g(0)* and are thus negatively biased. The resulting abundance estimate for the Northern Coastal Stock was 2,473 (CV = 0.25).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Northern Coastal Stock of bottlenose dolphins is 2,473 (CV=0.25). The minimum population estimate for the Northern Coastal Stock is 2,004 bottlenose dolphins.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (Wade and Angliss 1997). The minimum population size is 2,004. 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 Northern Coastal Stock of bottlenose dolphins is 20.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Northern Coastal Stock of bottlenose dolphins during 2006–2010 is unknown.

Fisheries Information

The commercial fisheries which potentially could interact with the Northern Coastal Stock in the northern Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, gillnet, shark bottom longline, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

Shrimp Trawl Fishery

A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Four bottlenose dolphin mortalities were observed in the shrimp trawl fishery during 2003, 2007, 2008 and 2010. The 2003 mortality occurred off the coast of Alabama and could have belonged to the Northern Coastal Stock or a bay, sound and estuary stock (Mobile Bay, Bonsecour Bay Stock or Mississippi Sound, Lake Borgne, Bay Boudreau Stock). During 1992-2008 the observer program recorded an additional 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have belonged to the Eastern or Northern Coastal Stocks, and it is likely that 3-4 of the animals belonged to the Continental Shelf Stock or the Atlantic spotted dolphin (*Stenella frontalis*) stock. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed because there was no necropsy.

Blue and Stone Crab Trap/Pot Fisheries

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. Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots. There have been no reported mortalities for the Northern Coastal Stock to date. However, mortalities have been reported for the Eastern Coastal Stock, Western Coastal Stock, and bay, sound and estuary stocks.

Menhaden Purse Seine Fishery

There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery. These takes likely affected the following stocks: Western Coastal Stock; Northern Coastal Stock; Mississippi Sound, Lake Borgne, Bay Boudreau Stock; Mississippi River Delta Stock; and Barataria Bay Estuarine System Stock. One take of a single bottlenose dolphin was reported in Louisiana waters during 2001 (likely belonged to Mississippi River Delta Stock or Northern Coastal Stock). Three takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentified) in Louisiana waters (likely belonged to Western Coastal Stock and either Mississippi River Delta Stock or Northern Coastal Stock), and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters (likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock). The menhaden purse seine 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.

Gillnet Fishery

No marine mammal mortalities associated with gillnet fisheries have been reported for the Northern Coastal Stock, but stranding data suggest that gillnet and marine mammal interaction does occur in the Gulf of Mexico, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in

Texas and Louisiana. Additionally, in 2008, 1 dolphin was entangled in a fisheries research gillnet in Texas. All of these animals likely belonged to bay, sound and estuary stocks. In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.

Shark Bottom Longline Fishery

The shark bottom longline fishery has been observed since 1994, and no interactions have been reported for the Northern Coastal Stock. However, 3 interactions with bottlenose dolphins were recorded during 1999, 2002 and 2003 (Burgess and Morgan 2003a,b) which likely involved animals from the Eastern Coastal and Continental Shelf Stocks. No interactions with any bottlenose dolphin stock were observed during 2004-2010 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009; 2010; 2011).

Hook and Line Fisheries

There have been no recent documented interactions between hook and line fisheries and the Northern Coastal Stock. However, mortalities and entanglements have been documented for the Eastern Coastal Stock, Western Coastal Stock, and bay, sound and estuary stocks.

Strandings

A total of 75 bottlenose dolphins were found stranded in Northern Coastal Stock waters of the Gulf of Mexico from 2006 through 2010 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 4 of these dolphins. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

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 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and 7 of these have occurred within the boundaries of the Northern Coastal Stock and may have affected the stock. 1) 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). 2) In 1993-1994 an UME of bottlenose dolphins likely 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. 3) 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. 4) 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, *Mesoplodon densirostris*, and 4 unidentified dolphins). 5) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 105 bottlenose dolphins and 2 unidentified 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). 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 April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins). 7) An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the

event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 14 animals from this stock were considered to be part of the UME.

Table 1. Bottlenose dolphin strandings occurring in Northern Coastal Stock waters of the northern Gulf of Mexico from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that strandings in coastal waters have been separated by coastal stock and separated from bay, sound and estuary stocks; therefore, the annual totals below will differ from those reported previously. Finally, there were an additional 24 dolphins not included in this or any other table that stranded either in bay, sound and estuary waters or in coastal waters that could not be assigned definitively to a stock due to bad location data. If/when the location data are resolved, the numbers below could increase.

Stock	Category	2006	2007	2008	2009	2010	Total
Northern Coastal Stock	Total Stranded	27[a]	18	7	8	15[b]	75
	Human Interaction						
	---Yes	1	1	0	1	1	4
	---No	3	3	1	3	3	13
	---CBD	23	14	6	4	11	58

[a] This total includes 15 animals that were part of the 2005-2006 UME
[b] This total includes 14 animals that are part of the ongoing UME in the northern Gulf of Mexico

Other Mortality

The problem of dolphin depredation of fishing gear is increasing in the Gulf of Mexico. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second 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. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). 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, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). 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 (Powell and Wells 2011). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under the MMPA.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT

2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

The nearshore habitat occupied by the 3 coastal 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 PCBs 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 16-46µg/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 the Northern Coastal 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.

There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury is insignificant and approaching zero mortality and serious injury rate. Additionally, there is no systematic monitoring of all fisheries that may take this stock. 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. Because an UME of unprecedented size and duration (began 1 February 2010 and is ongoing) has impacted the Northern Coastal Stock area, NMFS considers this stock to be strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (i.e., U.S. 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 climatic, coastal and/or 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 outer bay boundaries to the 20m isobath (Figure 1). The Western Coastal bottlenose dolphin stock area extends from the Mississippi River Delta to the Texas-Mexico border. This region 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 freshwater input.

The Western Coastal Stock is trans-boundary with Mexico; however, there is no information available for abundance estimation, nor for estimating fishery-related mortality in Mexican waters.

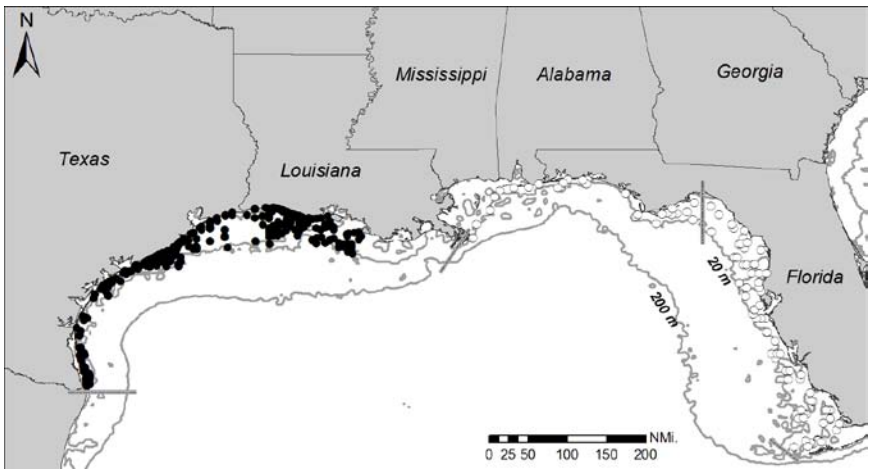

Figure 1. *Locations (circles) of bottlenose dolphin groups sighted in coastal waters during aerial surveys conducted in the Western Coastal Stock area in 1992 and 1996, and in the Northern Coastal Stock and Eastern Coastal Stock areas in 2007. Dark circles indicate groups within the boundaries of the Western Coastal Stock. The 20 and 200-m isobaths are shown.*

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico Continental Shelf Stock and bay, sound and estuary stocks. The seaward boundary for coastal stocks, the 20m 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" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (Vollmer 2009), 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; Rosel *et al.* 2009). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34km from shore. The offshore ecotype was found exclusively seaward of 34km 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. Fazioli *et al.* (2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay and Lemon Bay, Florida, 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. These findings support an earlier report by Irvine *et al.* (1981) of increased use of pass and coastal waters by

Sarasota Bay dolphins in winter. 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. Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, and the coastal Gulf of Mexico (1-12km 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 estuary stocks from those occurring in adjacent Gulf coastal waters, as suggested by Wells (1986).

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, 285km north, in May 1992 and May 1993 (Lynn and Würsig 2002).

POPULATION SIZE

Population size estimates for this stock are greater than 8 years old and therefore the current population size for the stock is considered unknown (Wade and Angliss 1997).

Abundance estimates

The most recent 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 18-m isobath. Approximately 5% of the total survey area was visually searched. The bottlenose dolphin abundance estimate for the Western Coastal Stock based on the 1992 survey was 3,499 (CV=0.21).

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the Western Coastal Stock of bottlenose dolphins is unknown. Therefore, the minimum population estimate for the northern Gulf of Mexico Western Coastal Stock is unknown.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (Wade and Angliss 1997). The 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 Western Coastal Stock of bottlenose dolphins is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Western Coastal Stock of bottlenose dolphins during 2006–2010 is unknown.

Fisheries Information

The commercial fisheries which potentially could interact with the Western Coastal Stock in the northern Gulf of

Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, gillnet, shark bottom longline, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

Hook and Line Fisheries

During 2010 there was 1 mortality in Texas for which hook and line gear entanglement was documented. The mortality was included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011) and is included in the stranding totals presented in Table 1.

Shrimp Trawl Fishery

A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Four bottlenose dolphin mortalities were observed in the shrimp trawl fishery during 2003, 2007, 2008 and 2010. The 2010 mortality occurred off the Louisiana coast and likely belonged to the Western Coastal Stock. The 2008 mortality occurred off the Texas coast and could have belonged to the Western Coastal Stock or Continental Shelf Stock. The 2007 mortality occurred off the Louisiana coast and could have belonged to the Western Coastal Stock or a bay, sound and estuary stock (Mobile Bay, Bonsecour Bay Stock or Mississippi Sound, Lake Borgne, Bay Boudreau Stock). During 2009, 1 bottlenose dolphin was released alive presumably with no serious injury after becoming entangled in the lazy line of a shrimp trawl. This animal could have belonged to the Continental Shelf Stock or the Western Coastal Stock. In 2008, a dolphin carcass was caught on the tickler chain of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal Stock or Continental Shelf Stock, or possibly to the Atlantic spotted dolphin stock.

Blue and Stone Crab Trap/Pot Fisheries

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. In 2008, a dolphin likely belonging to the Western Coastal Stock was disentangled from crab trap gear in Texas by a concerned citizen and swam away with no reported injuries (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Menhaden Purse Seine Fishery

There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery. These takes likely affected the following stocks: Western Coastal Stock; Northern Coastal Stock; Mississippi Sound, Lake Borgne, Bay Boudreau Stock; Mississippi River Delta Stock; and Barataria Bay Estuarine System Stock. Two takes of single bottlenose dolphins were reported in Louisiana waters during 2005 (both likely belonged to the Western Coastal Stock; 1 of the animals may have been dead prior to capture). Three takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentified) in Louisiana waters (likely belonged to Western Coastal Stock and either Mississippi River Delta Stock or Northern Coastal Stock), and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters (likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock). The menhaden purse seine 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.

Gillnet Fishery

No marine mammal mortalities associated with gillnet fisheries have been reported for the Western Coastal Stock, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana. Additionally, in 2008, 1 dolphin was entangled in a fisheries research gillnet in Texas. All of these animals likely

belonged to bay, sound and estuary stocks.

Shark Bottom Longline Fishery

The shark bottom longline fishery has been observed since 1994, and no interactions have been reported for the Western Coastal Stock. However, 3 interactions with bottlenose dolphins were recorded during 1999, 2002 and 2003 (Burgess and Morgan 2003a,b) which likely involved animals from the Eastern Coastal and Continental Shelf Stocks. No interactions with any bottlenose dolphin stock were observed during 2004-2010 (Hale and Carlson 2007; Hale *et al.* 2007; Richards 2007; Hale *et al.* 2009; 2010; 2011).

Strandings

A total of 566 bottlenose dolphins were found stranded in Western Coastal Stock waters of the northern Gulf of Mexico from 2006 through 2010 (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 20 of these stranded dolphins. For 3 of the dolphins from 2010, visible, external oil was present on the animals. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

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 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and 6 of these have occurred within the boundaries of the Western Coastal Stock and may have affected the stock. 1) 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). 2) 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. 3) In 1993-1994 an UME of bottlenose dolphins likely 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. 4) 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. 5) During February and March of 2008 an additional event was declared in Texas involving 113 bottlenose dolphin strandings. Most of the animals recovered were in a decomposed state. The event has been closed, however, the investigation is ongoing. 6) An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see “Habitat Issues” below), during the spill, and after. During 2010, 41 animals from this stock were considered to be part of the UME.

Table 1. Bottlenose dolphin strandings occurring in Western Coastal Stock waters of the northern Gulf of Mexico from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that strandings in coastal waters have been separated by coastal stock and separated from bay, sound and estuary stocks; therefore, the annual totals below will differ from those reported previously. Finally, there were an additional 24 dolphins not included in this or any other table that stranded either in bay, sound and estuary waters or in coastal waters that could not be assigned definitively to a stock due to bad location data. If/when the location data are resolved, the numbers below could increase.

Stock	**Category**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Western Coastal Stock	Total Stranded	79	112[a]	152[b]	92	131[c]	566
	Human Interaction						
	---Yes	3	5	1	3	7	20
	---No	15	27	29	4	18	93
	---CBD	61	80	122	85	106	453

[a] This total includes 59 animals that were part of the 2007 UME
[b] This total includes 1 mass stranding event (2 animals in August 2008)
[c] This total includes 41 strandings that are part of the ongoing UME in the northern Gulf of Mexico

Other Mortality

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. It is likely 2 of these animals belonged to the Western Coastal Stock (2005, 2007) and 2 belonged to bay, sound and estuary stocks (2003, 2006). An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally. It is likely this animal belonged to a bay, sound and estuary stock. All of the mortalities were included in the stranding database and the 2 most recent are included in the appropriate stranding tables under "Yes" for Human Interaction.

The problem of dolphin depredation of fishing gear is increasing in the Gulf of Mexico. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second 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. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and south of Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). 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, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). 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 (Powell and Wells 2011). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. Swimming with wild dolphins may cause harassment, and harassment is illegal under

the MMPA.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

The nearshore habitat occupied by the 3 coastal 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 PCBs 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 16-46µg/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 the Western Coastal 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. There are insufficient data to determine population trends for this stock. Total human-caused mortality and serious injury for this stock is not known and there is insufficient information available to determine whether the total fishery-related mortality and serious injury is insignificant and approaching zero mortality and serious injury rate. NMFS considers this stock to be a strategic stock for the following reasons: the stock size is currently unknown and PBR undetermined, and there are documented cases of human-related mortality from a number of sources; there is no systematic monitoring of all fisheries that may take this stock; and an UME of unprecedented size and duration (began 1 February 2010 and is ongoing) has impacted the Western Coastal Stock area.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Thirty-seven stocks have been provisionally identified for northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) bottlenose dolphins (Waring *et al.* 2001). Northern Gulf of Mexico inshore habitat has been separated into 32 bay, sound and estuarine stocks. Three northern Gulf of Mexico coastal stocks include nearshore waters from the shore to the 20m isobath. The northern Gulf of Mexico Continental Shelf Stock encompasses waters from 20 to 200m deep. The northern Gulf of Mexico Oceanic Stock encompasses the waters from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ; Figure 1).

Both "coastal" and "offshore" ecotypes of bottlenose dolphins (Mead and Potter 1995) occur in the Gulf of Mexico (Vollmer 2011), but the distribution of each is not known. The offshore and coastal ecotypes are genetically distinct based on both mitochondrial and nuclear markers (Hoelzel *et al.* 1998; Vollmer 2011). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34km from shore. The offshore ecotype was found exclusively seaward of 34km 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 better defining stock boundaries in coastal, continental shelf and oceanic waters of the Gulf of Mexico. Although the boundaries are not certain, the Oceanic Stock as currently defined is thought to be composed entirely of bottlenose dolphins of the offshore ecotype.

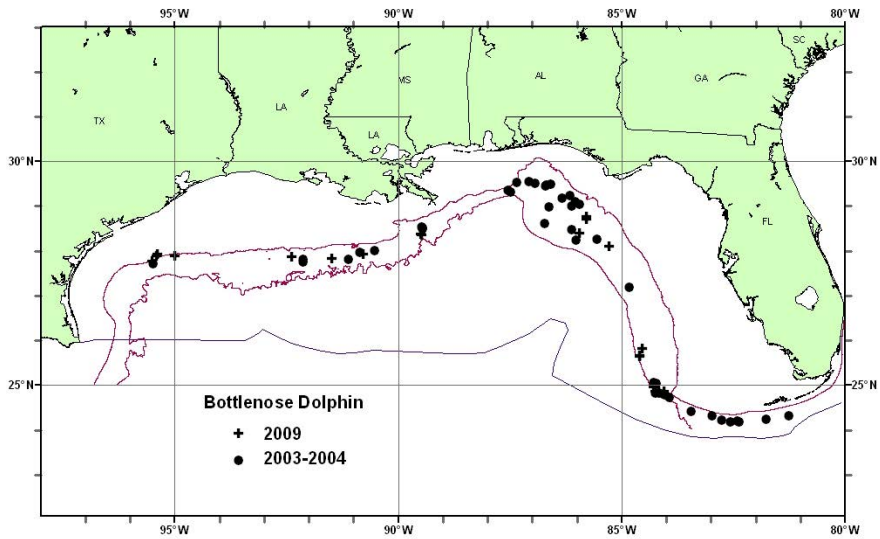

Figure 1. *Distribution of bottlenose dolphin sightings from SEFSC shipboard surveys during summer 2003 and spring 2004, and during summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Because there are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Ortega Ortiz 2002), bottlenose dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. 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 northern Gulf of Mexico Oceanic Stock of bottlenose dolphins is provisionally being considered separate from the Atlantic Ocean stocks of bottlenose dolphins for management purposes. One line of evidence to support this decision comes from Baron *et al.* (2008), who found that Gulf of Mexico bottlenose dolphin whistles (collected from oceanic waters) were significantly different from those in the western North Atlantic Ocean (collected from continental shelf and oceanic waters) in duration, number of inflection points and number of steps.

POPULATION SIZE

The best abundance estimate available for the northern Gulf of Mexico Oceanic Stock of bottlenose dolphins is 5,806 (CV=0.39; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m

isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1996 to 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of bottlenose dolphins for all surveys combined was estimated. For 1996 to 2001, the estimate was 2,239 (CV=0.41) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for bottlenose dolphins, pooled from 2003 to 2004, was 3,708 (CV=0.42) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for bottlenose dolphins in oceanic waters during 2009 was 5,806 (CV=0.39; Table 1).

Table 1. Summary of abundance estimates for the northern Gulf of Mexico oceanic 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
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	2,239	0.41
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	3,708	0.42
Jun-Aug 2009	Oceanic waters	5,806	0.39

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 5,806 (CV=0.39). The minimum population estimate for the northern Gulf of Mexico oceanic stock is 4,230 bottlenose dolphins.

Current Population Trend

Three point estimates of oceanic bottlenose dolphin abundance have been made based on data from surveys covering 1996-2009. The estimates vary by a maximum factor of more than two. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of oceanic bottlenose dolphin abundance. 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 (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 4,230. 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 42.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury to this stock during 2006–2010 was 0.6 bottlenose dolphins (CV=1.0; Table 2).

Fisheries Information

The commercial fisheries which potentially could interact with this stock in the Gulf of Mexico are the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery and the Gulf of Mexico butterfish trawl fishery (Appendix III). 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 northern Gulf of Mexico. One bottlenose dolphin serious injury was observed in the pelagic longline fishery in 1998, and estimated serious injuries attributable to the pelagic longline fishery in the Gulf of Mexico region during quarter 1 of that year were 22 (CV=1.00; Yeung 1999). There were no reports of mortality or serious injury to bottlenose dolphins by this fishery in the northern Gulf of Mexico during 1999-2008 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009). However, during 2009, 1 serious injury of a bottlenose dolphin was observed during the second quarter and estimated serious injuries attributable to the pelagic longline fishery in the Gulf of Mexico region during quarter 2 were 3.1 (CV=1.00; Garrison and Stokes 2010). The total estimated serious injury for 2009 was 3.1 animals (CV=1.0). During 2010, 1 serious injury was observed in the second quarter during experimental fishing to test the effectiveness of “weak” hooks as a potential bycatch mitigation tool. There was 100% observer coverage of all experimental sets, and the experimental fishing is not included in extrapolated bycatch estimates because it is not representative of the normal fishing effort (Garrison and Stokes 2011). The annual average serious injury and mortality attributable to the Gulf of Mexico pelagic longline fishery for the 5-year period from 2006 to 2010 was 0.6 animals (CV=1.0; Table 2). During 2007, 1 bottlenose dolphin was observed entangled and released alive in the northern Gulf of Mexico. All gear was removed and the animal was presumed to have no serious injuries.

A trawl fishery for butterfish was monitored by NMFS observers for a short period in the 1980's with no records of incidental take of marine mammals (Burn and Scott 1988; NMFS unpublished data), although an experimental set by NMFS resulted in the death of 2 bottlenose dolphins (Burn and Scott 1988). There are no other data available with regard to this fishery.

Table 2. Summary of the incidental mortality and serious injury of northern Gulf of Mexico oceanic bottlenose dolphins 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	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	06-10	47, 55, 53, 47, 46	Obs. Data Logbook	.08, .14, .25, .21, .26	0,0,0,1,0	0,0,0,0,0	0,0,0,3.2, 0	0,0,0,0,0	0,0,0,3.2, 0	NA, NA, NA,1.0 ,NA	0.6 (1.0)
TOTAL											0.6 (1.0)

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). Observer coverage in the GOM is dominated by very high coverage rates during April-June associated with efforts to improve estimates of Bluefin Tuna bycatch.

Other Mortality

A total of 1,340 bottlenose dolphins were found stranded in the northern Gulf of Mexico from 2006 through 2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Of these, 114 showed evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds). The vast majority of stranded bottlenose dolphins are assumed to belong to one of the coastal stocks or to bay, sound and estuary 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.)

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 221 bottlenose dolphins were considered to be part of the UME. The vast majority of stranded bottlenose dolphins are assumed to belong to one of the coastal stocks or to bay, sound and estuary stocks. Nevertheless, it is possible that some of the stranded bottlenose dolphins considered part of the UME belonged to the continental shelf or oceanic stocks.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for

some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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 associated with these activities (NMFS unpublished data).

STATUS OF STOCK

The status of bottlenose dolphins, relative to OSP, in the northern 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 stock. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

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

NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 32 bay, sound and estuary stocks of bottlenose dolphins that are included in this report. Until this effort is completed and this report is replaced by 32 individual reports, basic information for all individual bay, sound and estuary stocks will remain in this report.

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sound 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 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 32 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the northern Gulf of Mexico (i.e., U.S. 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 (>50% of associations) than with dolphins in adjacent waters. The term, as adapted from Wells *et al.* (1987) and applied in part by Urian *et al.* (2009), 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 if it were 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; F. Townsend, unpublished data), Tampa Bay (Wells 1986a; Wells *et al.* 1996b; Urian *et al.* 2009), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986a; Wells *et al.* 1987; Scott *et al.* 1990; Wells 1991; 2003), Lemon Bay (Wells *et al.* 1996a) and Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996a; Wells *et al.* 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 estuary populations 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; 2003). A span of at least 5 generations of identifiable residents currently inhabits the region, including some 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 travelling between regions have been reported, with patterns ranging from travelling through adjacent communities (Wells 1986b; Wells *et al.* 1996a; 1996b) 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 14-17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987; Fazioli *et al.* 2006). Similar mixing of inshore residents and non-residents has been seen off San Luis Pass, Texas (Maze and Würsig 1999), the Cedar Keys, Florida (Quintana-Rizzo and Wells 2001), 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 *et al.* 2008). 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 *et al.* 2008).

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. As information becomes available, combination or division of these provisional stocks may be warranted. For example, unpublished research suggests that Block B-21, Lemon Bay, can be subsumed under Charlotte Harbor, and B36, Caloosahatchee River, can be considered a part of Pine Island Sound. Additionally, 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 remains undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a; 1996b; 1997; Lynn and Würsig 2002; Urian 2002). For Tampa Bay, Urian *et al.* (2009) recently described fine-scale population structuring into 5 discrete communities (including the adjacent Sarasota Bay community) that differed in their social interactions and ranging patterns. Structure was found despite a lack of physiographic barriers to movement within this large, open embayment. Urian *et al.* (2009) further suggested that fine-scale structure may be a common element among populations of bottlenose dolphins in the southeast U.S. and recommended that management should account for fine-scale structure that exists within current stock designations.

Understanding the full complement of the stock complex using the bay, sound and estuary waters of the Gulf of Mexico will require much additional information. The development of biologically-based criteria to better define and mange 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 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 north 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 northern Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, most estimates are considered unknown or undetermined for management purposes. Blocks refer to aerial survey blocks illustrated in Figure 1. PBR – Potential Biological Removal; UNK – unknown; UND – undetermined.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	UNK	UND	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	UNK	UND	1992	A
B50	Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	UNK	UND	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	UNK	UND	1992	A
B55	West Bay	32	0.15	UNK	UND	2000	E
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	UNK	UND	1992	A
B57	Sabine Lake	0[a]	-		UND	1992	A
B58	Calcasieu Lake	0[a]	-		UND	1992	A
B59	Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[a]	-		UND	1992	A
B60	Terrebonne Bay, Timbalier Bay	100	0.53	UNK	UND	1993	A
B61	Barataria Bay[d]	138	0.08	UNK	UND	2001	D
B30	Mississippi River Delta	0[a]	-		UND	1993	A
B02-05,	Mississippi Sound, Lake Borgne, Bay	1,401	0.13	UNK	UND	1993	A

29, 31	Boudreau						
B06	Mobile Bay, Bonsecour Bay	122	0.34	UNK	UND	1993	A
B07	Perdido Bay	0[a]	-		UND	1993	A
B08	Pensacola Bay, East Bay	33	0.80	UNK	UND	1993	A
B09	Choctawhatchee Bay[d]	179	0.04	173	1.7	2007	H
B10	St. Andrew Bay	124	0.57	UNK	UND	1993	A
B11	St. Joseph Bay[d]	146	0.18	126	1.3	2005-07	F
B12-13	St. Vincent Sound, Apalachicola Bay, St. George Sound	439	0.14	390	3.9	2007-08	G
B14-15	Apalachee Bay	491	0.39	UNK	UND	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	UNK	UND	1994	A
B17	St. Joseph Sound, Clearwater Harbor	37	1.06	UNK	UND	1994	A
B32-34	Tampa Bay	559	0.24	UNK	UND	1994	A
B20, 35	Sarasota Bay, Little Sarasota Bay	160	na[c]	160	1.6	2007	B
B21	Lemon Bay	0[a]	-		UND	1994	A
B22-23	Pine Island Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	UNK	UND	1994	A
B36	Caloosahatchee River	0[a,b]	-		UND	1985	C
B24	Estero Bay	104	0.67	UNK	UND	1994	A
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	UNK	UND	1994	A
B27	Whitewater Bay	242	0.37	UNK	UND	1994	A
B28	Florida Keys (Bahia Honda to Key West)	29	1.00	UNK	UND	1994	A

References: A – Blaylock and Hoggard 1994; B – Wells 2009; C – Scott *et al.* 1989; D – Miller 2003; E – Irwin and Würsig 2004; F – Balmer *et al.* 2008; G – Tyson *et al.* 2011; H – Conn *et al.* 2011

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 N_{BEST} was a direct count of known individuals.

[d] These stocks have their own individual stock assessment reports.

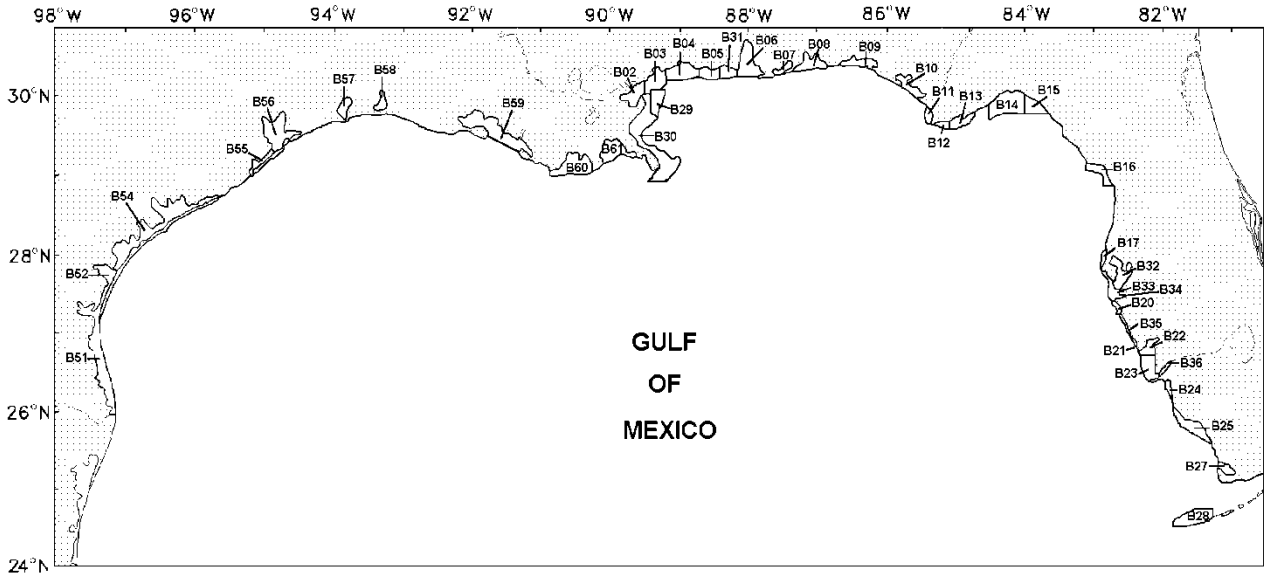

Figure 1. *Northern Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to one of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique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

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population size for each of these stocks is considered unknown (Wade and Angliss 1997). Recent mark-recapture population size estimates are available for Choctawhatchee Bay, St. Joseph Bay and Apalachicola Bay, Florida, and a direct count is available for Sarasota Bay, Florida (Table 1). Previous population size for most other stocks (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. Analyses are currently underway that should provide updated abundance estimates for Lemon Bay, Gasparilla Sound, Charlotte Harbor, and Pine Island Sound during 2011 (Wells, pers. comm.).

Minimum Population Estimate

The population size for all but 4 stocks is currently unknown and the minimum population estimates are given for those 4 stocks in Table 1. In most cases, 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. Eleven unusual mortality events have occurred among portions of these dolphin communities between 1990 and 2008; however, it is not possible to accurately partition the mortalities between bay and coastal stocks, thus the impact of these mortality events on communities is not known.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the dolphin communities that constitute 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 undetermined 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

The total annual human-caused mortality and serious injury for these stocks during 2006–2010 is unknown.

Some of the bay, sound and estuary 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 1972-1989, 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 1982-1988 were females. The impact of these removals on the stocks is unknown.

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 purse seine, gillnet, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III).

Hook and Line Fisheries

During 2006 there were 8 mortalities for which hook and line gear entanglement or ingestion were documented in the stranding database, and attempts were made to disentangle 2 live animals from hook and line gear. During 2007, there were 4 mortalities, and during 2008, 2 mortalities, for which hook and line gear entanglement or ingestion were documented. During 2009, there were 2 mortalities for which hook and line gear entanglement or ingestion were documented, and attempts were made to disentangle 2 live animals from hook and line gear. Finally, during 2010, there were 4 mortalities for which hook and line gear entanglement or ingestion were documented, and an attempt was made to disentangle 1 live animal from hook and line gear. In total, during 2006–2010, for 20 mortalities for which hook and line gear entanglement were documented, 15 occurred in Florida, 4 in Texas and 1 in Mississippi; and for 5 attempted disentanglements from hook and line gear, 3 occurred in Texas and 2 in Florida. The mortalities and live entanglements were included in the stranding database (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011) and are included in the stranding totals presented in Table 1.

Shrimp Trawl Fishery

A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. Four bottlenose dolphin mortalities were observed in the shrimp trawl fishery during 2003, 2007, 2008 and 2010. The 2007 mortality occurred off the Louisiana coast and could have belonged to the Western Coastal Stock or a bay, sound and estuary stock (Vermilion Bay, West Cote Blanche Bay, Atchafalaya Bay Stock or Terrebonne Bay, Timbalier Bay Stock). The 2003 mortality occurred off the coast of Alabama and could have belonged to the Northern Coastal Stock or a bay, sound and estuary stock (Mobile Bay, Bonsecour Bay Stock or Mississippi Sound, Lake Borgne, Bay Boudreau Stock).

Blue and Stone Crab Trap/Pot Fisheries

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. In 2010, a calf likely belonging to the Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock was disentangled by stranding network personnel from a crab trap line wrapped around its peduncle. The animal swam away with no obvious injuries. In 2008 there was a report of a live dolphin in the Caloosahatchee River in Florida entangled in pot line without a buoy attached. This animal was likely a member of the Caloosahatchee River Stock (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). In 2002 there was a calf stranded near Clearwater, Florida, with blue crab trap line wrapped around its rostrum, through its mouth and looped around its tail (NMFS unpublished data). This animal was likely a member of the St. Joseph Sound, Clearwater Harbor Stock. Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab traps/pots.

Menhaden Purse Seine Fishery

There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in

northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery. These takes likely affected the following stocks: Western Coastal Stock; Northern Coastal Stock; Mississippi Sound, Lake Borgne, Bay Boudreau Stock; Mississippi River Delta Stock; and Barataria Bay Estuarine System Stock. One take of a single bottlenose dolphin was reported in Louisiana waters during 2004 (likely belonged to the Mississippi River Delta Stock). Two takes of single unidentified dolphins were reported during 2002 (1 in Mississippi and 1 in Louisiana waters; likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock and Barataria Bay Estuarine System Stock). One take of a single bottlenose dolphin was reported in Louisiana waters during 2001 (likely belonged to Mississippi River Delta Stock or Northern Coastal Stock). Three takes were reported in 2000, 2 of which were for single dolphins (1 bottlenose, 1 unidentified) in Louisiana waters (likely belonged to Western Coastal Stock and either Mississippi River Delta Stock or Northern Coastal Stock), and the third was for 3 bottlenose dolphins in a single purse seine in Mississippi waters (likely belonged to Mississippi Sound, Lake Borgne, Bay Boudreau Stock). The menhaden purse seine 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.

Gillnet Fishery

No marine mammal mortalities associated with gillnet fisheries have been reported in recent years, but stranding data suggest that gillnet and marine mammal interactions do occur, causing mortality and serious injury. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana and an additional research gillnet entanglement occurred during 2008 in Texas (see "Other Mortality" below for details). All of the research-related interactions were likely with animals belonging to the following bay, sound and estuary stocks: Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock (2 mortalities); Mississippi River Delta Stock (1 mortality); and Matagorda Bay, Tres Palacios Bay, Lavaca Bay Stock (1 mortality, 1 released alive). In 1995, a Florida state constitutional amendment banned gillnets and large nets from bays, sounds, estuaries and other inshore waters.

Strandings

A total of 554 bottlenose dolphins were found stranded in bays, sounds and estuaries of the northern Gulf of Mexico from 2006 through 2010 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions (e.g., gear entanglement, mutilation, gunshot wounds) was detected for 75 of these dolphins. For 3 of the dolphins from 2010, visible, external oil was present on the animals. Bottlenose dolphins are known to become entangled in, or ingest recreational and commercial fishing gear (Wells and Scott 1994; Gorzelany 1998; Wells *et al.* 1998; Wells *et al.* 2008), and some are struck by vessels (Wells and Scott 1997; Wells *et al.* 2008).

There are a number of difficulties associated with the interpretation of stranding data. Except in rare cases, such as Sarasota Bay, Florida, where residency can be determined, 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 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico. 1) 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 number of 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). 2) An unusual mortality event was declared for Sarasota Bay, Florida, in 1991, but the cause was not determined. 3) 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. 4) In 1993-1994 an UME of bottlenose dolphins likely 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. 5) 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. 6) 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, *Mesoplodon densirostris*, and 4 unidentified dolphins. 7) In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 105 bottlenose dolphins and 2 unidentified 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). 8) 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 November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins (plus strandings of 1 Atlantic spotted dolphin, *S. frontalis*, and 24 unidentified dolphins). The evidence suggests the effects of a red tide bloom contributed to the cause of this event. 9) 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 April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins). 10) 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. 11) During February and March of 2008 an additional event was declared in Texas involving 113 bottlenose dolphin strandings. Most of the animals recovered were in a decomposed state. The investigation is closed and a direct cause could not be identified. However, there were numerous, co-occurring harmful algal bloom toxins detected during the time period of this UME which may have contributed to the mortalities (Fire *et al.*, in press). 12) An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 144 animals from bay, sound and estuary stocks were considered to be part of the UME.

Table 2. Bottlenose dolphin strandings occurring in bays, sounds and estuaries in the northern Gulf of Mexico from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that this table does not include strandings from Barataria Bay Estuarine System, Choctawhatchee Bay or St. Joseph Bay Stocks. Finally, there were an additional 24 dolphins not included in this or any other table that stranded either in bay, sound and estuary waters or in coastal waters that could not be assigned definitively to a stock due to bad location data. If/when the location data are resolved, the numbers below could increase.

Stock	**Category**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
Bay, Sound and Estuary	Total Stranded	125[a,b]	68[c]	69[d]	98[e]	194[f]	554
	Human Interaction						
	---Yes	22	10	5	18	20	75
	---No	29	11	15	9	10	74
	---CBD	74	47	49	71	164	405

[a] This total includes 2 mass stranding events in Florida (2 animals in July 2006, 3 animals in November 2006)
[b] This total includes 75 animals that were part of 2 different UMEs in Florida
[c] This total includes 4 animals that were part of an UME in Texas
[d] This total includes 3 animals that were part of an UME in Texas
[e] This total includes a mass stranding of 6 animals in Louisiana in June 2009
[f] This total includes 144 animals that are part of the ongoing UME in the northern Gulf of Mexico

Other Mortality

Two dolphin research-related mortalities have occurred. During November 2002 in Sarasota Bay, Florida, a 35-year-old male 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 41-year period on Florida's central west coast. Another research-related mortality occurred during July 2006 in St. Joseph Bay, in the Florida Panhandle, during a NMFS health assessment research project to investigate a series of UMEs 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.

During 2009 in Mobile Bay, Alabama, near the entrance to the Gulf of Mexico, a bottlenose dolphin mortality resulted from an entanglement in the lazy line of a trawl net during an educational trawling cruise operated by a marine science education and research laboratory. This animal likely belonged to the Mobile Bay and Bonsecour Bay Stock of bay, sound and estuary bottlenose dolphins.

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. It is likely that 2 of these animals belonged to the Western Coastal Stock (2005, 2007) and 2 animals belonged to bay, sound and estuary stocks (2003, 2006). An additional incident occurred during 2006 in which the dolphin became free during net retrieval and was observed swimming away normally. It is likely this animal belonged to a bay, sound and estuary stock. All of the mortalities were included in the stranding database and the 2 most recent are included in the appropriate stranding tables under "Yes" for Human Interaction.

Four mortalities resulted from gillnet entanglements in research gear off Texas and Louisiana during 2003, 2004, 2006 and 2007. Three of the mortalities were a result of fisheries sampling and research in Texas, and 1 mortality (2006) occurred during a gulf sturgeon research project in Louisiana. Additionally, in 2008, 1 dolphin was entangled in a fisheries research gillnet in Texas. The floatline was wrapped around the dolphin's tail; the net released itself upon retrieval and the dolphin appeared in good condition as it swam away. All of these animals likely belonged to the following bay, sound and estuary stocks: Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock (2003, 2004 mortalities); Mississippi River Delta Stock (2006 mortality); and Matagorda Bay, Tres Palacios Bay, Lavaca Bay Stock (2007 mortality, 2008 released alive). The mortalities were included in the stranding database and the 2 most recent are included in Table 2 under "Yes" for Human Interaction.

The problem of dolphin depredation of fishing gear is increasing in Gulf of Mexico coastal and estuary waters. There have been 3 recent cases of fishermen illegally "taking" dolphins due to dolphin depredation of recreational and commercial fishing gear. In 2006 a charter boat fishing captain was charged under the MMPA for shooting at a dolphin that was swimming around his catch in the Gulf of Mexico, off Panama City, Florida. In 2007 a second 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. A commercial fisherman was indicted in November 2008 for throwing pipe bombs at dolphins off Panama City, Florida, and charged in March 2009 for "taking" dolphins with an explosive device.

Illegal feeding or provisioning of wild bottlenose dolphins has been documented in Florida, particularly near Panama City Beach in the Panhandle (Samuels and Bejder 2004) and in and near Sarasota Bay (Cunningham-Smith *et al.* 2006; Powell and Wells 2011), and also in Texas near Corpus Christi (Bryant 1994). 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, a high rate of uncontrolled provisioning was observed near Panama City Beach in 1998 (Samuels and Bejder 2004), and provisioning has been observed south of Sarasota Bay since 1990 (Cunningham-Smith *et al.* 2006; Powell and Wells 2011). 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, at least 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (Powell and Wells 2011). Swimming with wild bottlenose dolphins has also been documented. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to illegal provisioning. Swimming with wild dolphins may cause harassment, and

harassment is illegal under the MMPA.

As noted previously, bottlenose dolphins are known to be struck by vessels (Wells and Scott 1997). During 2006–2010, 12 stranded bottlenose dolphins (of 550 total strandings) showed signs of a boat collision (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). It is possible some of the instances were post-mortem collisions. In addition to vessel collisions, the presence of vessels may also impact bottlenose dolphin behavior in bays, sounds and estuaries. Nowacek *et al.* (2001) reported that boats pass within 100m of each bottlenose dolphin in Sarasota Bay once every 6 minutes on average, leading to changes in dive patterns and group cohesion. Buckstaff (2004) noted changes in communication patterns of Sarasota Bay dolphins when boats approached. Miller *et al.* (2008) investigated the immediate responses of bottlenose dolphins to "high-speed personal watercraft" (i.e., boats) in Mississippi Sound. They found an immediate impact on dolphin behavior demonstrated by an increase in traveling behavior and dive duration, and a decrease in feeding behavior for non-traveling groups. The findings suggested dolphins attempted to avoid high-speed personal watercraft. It is unclear whether repeated short-term effects will result in long-term consequences like reduced health and viability of dolphins. Further studies are needed to determine the impacts throughout the Gulf of Mexico.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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 estuary dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

STATUS OF STOCKS

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 12 unusual mortality events among bottlenose dolphins along the northern 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, in large part because it has not been possible to assign mortalities to specific stocks due to a lack of empirical information on stock identification.

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 fishery-related mortality and serious injury exceeds 10% of the total known PBR or previous PBR, and therefore, it is probably not insignificant and not approaching the zero mortality and serious injury rate. NMFS considers each of these stocks to be strategic because most of the stock sizes are currently unknown, but likely small and relatively few mortalities and serious injuries would exceed PBR, and because stock areas in Louisiana, Mississippi, Alabama and the western Florida panhandle have been impacted by an UME of unprecedented size and duration (began 1 February 2010 and is ongoing).

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Barataria Bay Estuarine System Stock

NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 32 bay, sound and estuary stocks of bottlenose dolphins in the Gulf of Mexico. Until this effort is completed and 32 individual reports are available, some of the basic information presented in this report will also be included in the report: "Northern Gulf of Mexico Bay, Sound and Estuary Stocks".

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sounds and estuaries of the Gulf of Mexico (Mullin 1988). Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico (e.g., Irvine and Wells 1972; Shane 1977; Gruber 1981; Irvine *et al.* 1981; Wells 1986; Wells *et al.* 1987; Scott *et al.* 1990; Shane 1990; Wells 1991; Bräger 1993; Bräger *et al.* 1994; Fertl 1994; Wells *et al.* 1996a,b; Wells *et al.* 1997; Weller 1998; Maze and Würsig 1999; Lynn and Würsig 2002; Wells 2003; Hubard *et al.* 2004; Irwin and Würsig 2004; Shane 2004; Balmer *et al.* 2008; Urian *et al.* 2009). In many cases, residents predominantly use the bay, sound or estuary waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; Shane 1990; Gruber 1981; Irvine *et al.* 1981; Shane 1990; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). Early studies indicating year-round residency to bays in both the eastern and western Gulf of Mexico led to the delineation of 33 bay, sound and estuary stocks, including Barataria Bay, with the first stock assessment reports in 1995.

More recently, genetic data also support the concept of relatively discrete bay, sound and estuary stocks (Duffield and Wells 2002; Sellas *et al.* 2005). Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, Texas, 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 identification of bay, sound and estuary populations distinct from those occurring in adjacent Gulf coastal waters. Differences in reproductive seasonality from site to site also suggest genetic-based distinctions among areas (Urian *et al.* 1996). Photo-ID and genetic data from several inshore areas of the southeastern United States also support the existence of resident estuarine animals and a differentiation between animals biopsied along the Atlantic coast and

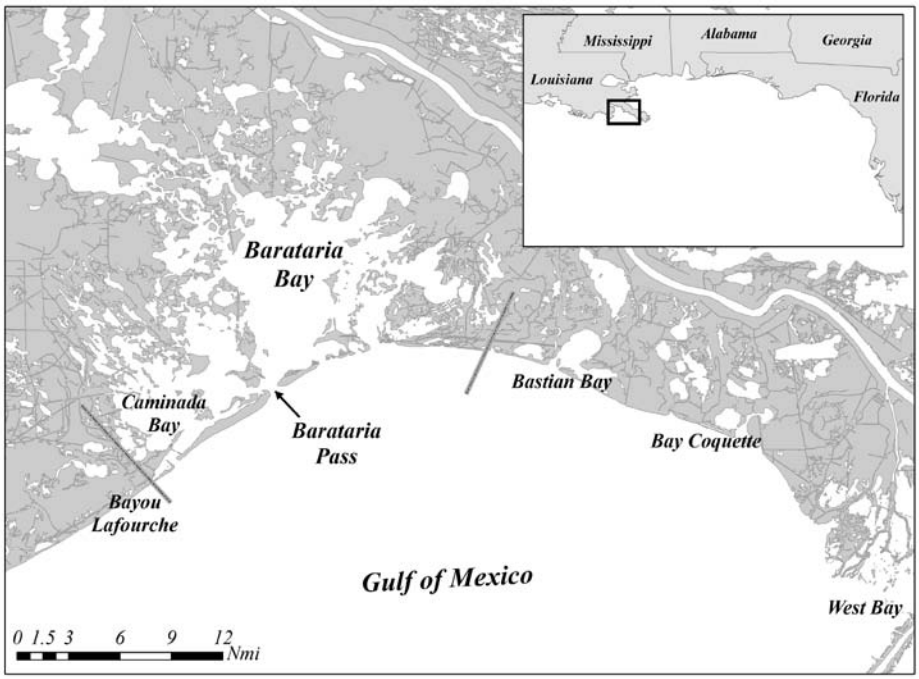

Figure 1. *Geographic extent of the Barataria Bay Estuarine System (BBES) Stock, located on the coast of Louisiana. The borders are denoted by solid lines.*

those biopsied within estuarine systems at the same latitude (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007; Rosel *et al*. 2009; NMFS unpublished).

Barataria Bay is a shallow (mean depth=2m) estuarine system located in central Louisiana. It is bounded in the west by Bayou Lafourche, in the east by the Mississippi River delta and in the south by the Grand Terre barrier islands. Barataria Bay is approximately 110km in length and 50km in width at its widest point where it opens into the Gulf of Mexico (Connor and Day 1987). This estuarine system is connected to the Gulf of Mexico by a series of passes: Caminada Pass, Barataria Pass, Pass Abel and Quatre Bayou Pass. It is fringed by a complex system of canals, bayous, small embayments and channels. Bay waters are turbid, and salinity varies widely from south to north with the more saline, tidally influenced portions in the south and lakes in the north (U.S. EPA 1999; Moretzsohn *et al.* 2010). Miller and Baltz (2009) reported salinity varied seasonally and averaged 22.77psu (practical salinity unit) in lower Barataria and Caminada Bays (data collected during dolphin sightings). Barataria Bay, in conjunction with the Timbalier-Terrebone Bay system, has been selected as an estuary of national significance by the Environmental Protection Agency National Estuary Program. The bay is characterized by marshes and swamp forests which supply a nursery and breeding ground for migratory birds and a variety of commercially and recreationally important species, such as finfish, shellfish, alligators, songbirds, geese and ducks (U.S. EPA 1999; Moretzsohn *et al.* 2010). The Barataria basin also produces a significant part of U.S. petroleum resources and is an important commercial harbor. High industrial and commercial use of the area and human alteration have resulted in environmental degradation and habitat loss. The most serious environmental issues facing the estuarine system include loss of coastal wetlands, eutrophication, barrier island erosion, saltwater intrusion and introduction of toxic substances (Connor and Day 1987; Barras *et al.* 2003).

The Barataria Bay Estuarine System (BBES) Stock area includes Caminada Bay and Barataria Bay (Figure 1). During June 1999 – May 2002, Miller (2003) conducted 44 boat-based, photo-ID surveys in lower Barataria and Caminada Bays. Dolphins were present year-round, and 133 individual dolphins were identified. One individual was sighted 6 times, but most individuals, 58%, were sighted only once. Using a fine-scale microhabitat approach, Miller and Baltz (2009) described foraging habitat of bottlenose dolphins in Barataria Bay. Significant differences in temperature, group size, season and turbidity differentiated foraging sites from non-foraging sites. Foraging was more often observed in waters 200-500m from shore in 4-6m depth and at salinity values of approximately 20psu. Additional study is needed to further describe the population of bottlenose dolphins inhabiting the BBES. The current stock boundary does not include any coastal waters outside of the barrier islands. Further research is needed to determine the degree to which dolphins of this stock utilize nearshore coastal waters outside Barataria Bay. This stock boundary is subject to change upon further study of dolphin residency patterns in estuarine waters of Louisiana. Information on the use of coastal waters will be important when considering exposure to coastal fisheries as estuarine animals that make use of nearshore coastal waters would be at risk of entanglement in fishing gear while moving along the coast. Ongoing NOAA photo-ID surveys initiated in 2010, as well as data from tracking of 25 bottlenose dolphins tagged with satellite-linked transmitters in and around Barataria Bay in August 2011 will address some of these issues as the data become available.

Dolphins residing in the estuaries southeast of this stock between BBES and the Mississippi River mouth (Bastian Bay, Bay Coquette and West Bay) are not currently covered in any stock assessment report. There are insufficient data to determine whether animals in this region exhibit affiliation to the BBES stock or should be delineated as their own stock. Further research is needed to establish affinities of dolphins in this region. It should be noted that in this region during 2006–2010, 2 bottlenose dolphins were reported stranded in the Bastian Bay area. It could not be determined if there was evidence of human interactions for these 2 strandings. Both strandings were considered to be part of the ongoing Unusual Mortality Event (see Other Mortality).

POPULATION SIZE

The total number of bottlenose dolphins residing within the BBES Stock is unknown. Miller (2003) conducted boat-based, photo-ID surveys in lower Barataria and Caminada Bays from June 1999 to May 2002. Miller (2003) identified 133 individual dolphins, and using closed-population unequal catchability models in program CAPTURE, produced an abundance estimate of 138-238 (128-297, 95% CI). Miller's (2003) estimate covers a large portion of the area covered by the BBES stock; however, these data are considered expired due to being more than 8 years old.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate for the BBES Stock of bottlenose

dolphins.

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. 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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the BBES stock of bottlenose dolphins is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for this stock of bottlenose dolphins is undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the BBES bottlenose dolphin stock during 2006–2010 is unknown.

Fishery Information

The commercial fisheries which potentially could interact with this stock are the shrimp trawl, menhaden purse seine, blue crab trap/pot, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III). During 2005-2009, menhaden, brown shrimp, white shrimp and blue crab fisheries were all important commercial fisheries in Barataria Bay, comprising 4 of the top 5 commercial fisheries each year, both by weight and value of landings (based on data from the Louisiana Department of Wildlife and Fisheries Trip Ticket Program, M. Harden, pers. comm.). There have been no documented interactions between BBES bottlenose dolphins and the shrimp trawl fishery, nor any documented interactions with hook and line fisheries. There have been no documented mortalities of BBES bottlenose dolphins in crab trap/pot fisheries. There is no systematic observer coverage of crab trap/pot fisheries; therefore, it is not possible to quantify total mortality.

Menhaden Purse Seine Fishery

The menhaden purse seine fishery was the top commercial fishery for Barataria Bay in terms of landings by weight for each year from 2005 to 2009 (M. Harden, pers. comm.). There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). Through the Marine Mammal Authorization Program, there have been 11 self-reported incidental takes (all mortalities) of bottlenose dolphins in northern Gulf of Mexico coastal and estuarine waters by the menhaden purse seine fishery, 1 of which occurred in Barataria Bay during 2002 and was a single “unidentified” dolphin (assumed to be a bottlenose dolphin). 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.

Other Mortality

From 2006 to 2010, 25 bottlenose dolphins were reported stranded within the BBES (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions was detected for 1 stranded dolphin, which stranded alive visibly oiled during December 2010. Stranding data probably underestimate the extent of human-caused mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other human interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interactions.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1

February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 20 stranded dolphins from this stock were considered to be part of the UME.

Table 1. Bottlenose dolphin strandings occurring in the Barataria Bay Estuarine System Stock area from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death.

Stock	Category	2006	2007	2008	2009	2010	Total
Barataria Bay Estuarine System Stock	Total Stranded	1	0	4	0	20[a]	25
	Human Interaction						
	---Yes	0	0	0	0	1	1
	---No	0	0	2	0	1	3
	---CBD	1	0	2	0	18	21

[a] All strandings from 2010 are part of the ongoing UME event in the northern Gulf of Mexico.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune

suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

STATUS OF STOCK

The status of the BBES stock 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 population trends for this stock. The total human-caused mortality and serious injury for this stock is unknown and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Because an UME of unprecedented size and duration (began 1 February 2010 and is ongoing) has impacted Barataria Bay, NMFS considers this stock to be strategic.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
Choctawhatchee Bay Stock

NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 32 bay, sound and estuary stocks of bottlenose dolphins in the Gulf of Mexico. Until this effort is completed and 32 individual reports are available, some of the basic information presented in this report will also be included in the report: "Northern Gulf of Mexico Bay, Sound and Estuary Stocks".

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sounds and estuaries of the Gulf of Mexico (Mullin 1988). Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico (e.g., Irvine and Wells 1972; Shane 1977; Gruber 1981; Irvine *et al.* 1981; Wells 1986a; Wells *et al.* 1987; Scott *et al.* 1990; Shane 1990; Wells 1991; Bräger 1993; Bräger *et al.* 1994; Fertl 1994; Wells *et al.* 1996a,b; Wells *et al.* 1997; Weller 1998; Maze and Würsig 1999; Lynn and Würsig 2002; Wells 2003; Hubard *et al.* 2004; Irwin and Würsig 2004; Shane 2004; Balmer *et al.* 2008; Urian *et al.* 2009). In many cases, residents predominantly use the bay, sound or estuary waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; Shane 1990; Gruber 1981; Irvine *et al.* 1981; Shane 1990; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). Early studies indicating year-round residency to bays in both the eastern and western Gulf of Mexico led to the delineation of 33 bay, sound and estuary stocks, including Choctawhatchee Bay, with the first stock assessment reports in 1995.

More recently, genetic data also support the concept of relatively discrete bay, sound and estuary stocks (Duffield and Wells 2002; Sellas *et al.* 2005). Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, Texas, 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 differentiation 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 identification of bay, sound and estuary populations distinct from those occurring in adjacent Gulf coastal waters. Differences in reproductive seasonality from site to site also suggest genetic-based distinctions among areas (Urian *et al.* 1996). Additionally, photo-ID and genetic data from several

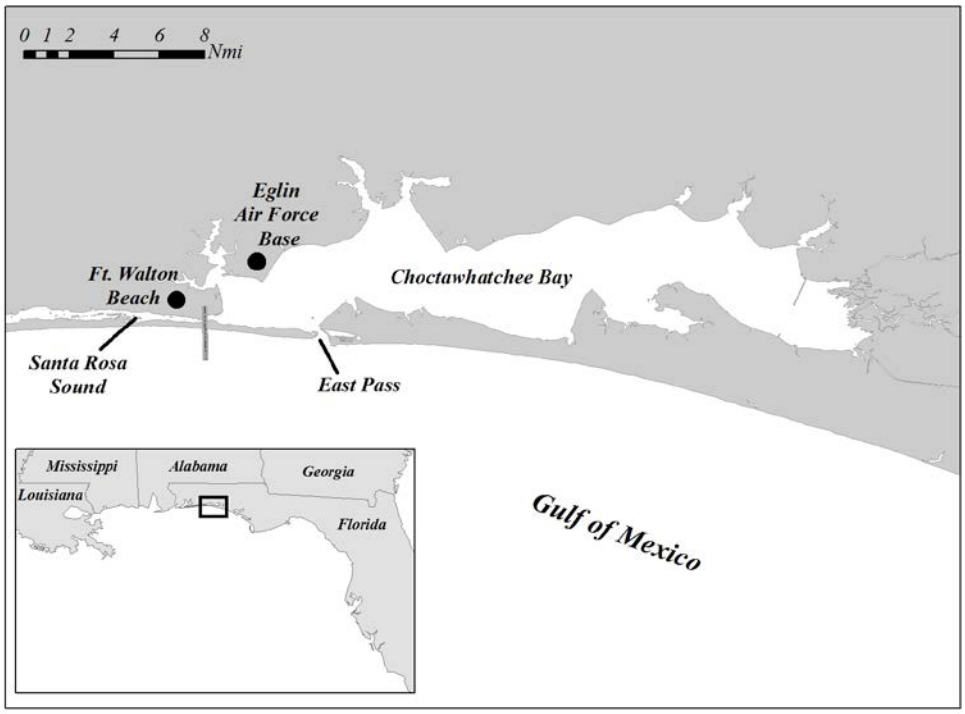

Figure 1. *Geographic extent of the Choctawhatchee Bay Stock, located in the Florida panhandle. The western border (with Santa Rosa Sound) is denoted by a solid line.*

inshore areas of the southeastern United States also support the existence of resident estuarine animals and a differentiation between animals biopsied along the Atlantic coast and those biopsied within estuarine systems at the same latitude (Caldwell 2001; Gubbins 2002; Zolman 2002; Mazzoil *et al.* 2005; Litz 2007; Rosel *et al*. 2009; NMFS unpublished).

Choctawhatchee Bay is located in the Florida panhandle and connected to the Gulf of Mexico by a single pass, East Pass (Figure 1). The bay is approximately 348km^2 in surface area, 43km in length and 2-10km in width (Florida Department of Environmental Protection 2010; Conn *et al.* 2011). The bay is relatively shallow with steep slopes. Water depth averages 8m in western portions and 3m in eastern portions, with an overall mean depth of 3.8m. Fresh water flows into Choctawhatchee Bay from the Choctawhatchee River primarily (90% of freshwater input), and from numerous small creeks and bayous as well. Salinity varies from 0 to 34ppt on an east to west basis from the river delta in the east to East Pass in the west. Choctawhatchee Bay is bordered by forested wetlands and marshes (FL Department of Environmental Protection 2010). To the north and east, development is limited, partly due to the presence of Eglin Air Force Base. To the south and west are well-developed tourist areas (Conn *et al.* 2011). Both commercial and recreational fishing, as well as oyster harvesting, occur in Choctawhatchee Bay. Environmental concerns for this area include eutrophication and its associated problems (e.g., harmful algal blooms, hypoxia) and loss of seagrass beds and tidal marshes (FL Department of Environmental Protection 2010).

Bottlenose dolphins utilizing Choctawhatchee Bay are of particular concern to the NMFS due to the potential impacts of recent Unusual Mortality Events (UMEs) on the population (Conn *et al.* 2011; see 'Other Mortality' section). Partly as a result of elevated stranding levels in recent years, Choctawhatchee Bay was chosen by the NMFS as the first in a series of north-central Gulf of Mexico bay, sound and estuary stocks to produce abundance estimates for bottlenose dolphins. Photo-ID surveys were conducted during July–August 2007 and mark-recapture models were used to generate abundance estimates for residents and for residents plus transients (Conn *et al.* 2011).

The boundaries of this stock include waters of Choctawhatchee Bay from Point Washington and Jolly Bay in the east to Fort Walton Beach in the west as this is the area surveyed during the most recent mark-recapture photo-ID abundance surveys. The boundaries are likely to change as additional research is conducted. Some animals sighted multiple times in Choctawhatchee Bay have also been sighted in Santa Rosa Sound and/or Pensacola Bay to the west (Shippee 2010), suggesting the geographic area encompassing this stock may have to be expanded westward to include some or all of these areas as well. Further research is needed to fully determine the degree of overlap between dolphins inhabiting primarily Choctawhatchee Bay and those inhabiting primarily Pensacola Bay and waters in between, and the degree of genetic exchange between dolphins in these areas. Dolphins have been observed leaving Choctawhatchee Bay through the pass and entering nearshore coastal waters (Shippee 2010). Further information is needed to determine how often this stock utilizes these waters. Information on the use of nearshore waters will be important when considering exposure to coastal fisheries as estuarine animals that make use of nearshore coastal waters would be at risk of entanglement in fishing gear while moving along the coast.

POPULATION SIZE

In order to estimate abundance of residents and of residents plus transients, photo-ID mark-recapture surveys were conducted during July–August 2007 in Choctawhatchee Bay using "racetrack" (sampling the perimeter of the bay, taking about 3 days to complete) and "zigzag" (sampling open waters and sections of the racetrack, taking about 4 days to complete) tracklines (Conn *et al.* 2011). Each survey was conducted in Beaufort Sea State 3 or less, in good weather, at a survey speed of 12-14kts. Twenty-one percent of dolphins photographed had non-distinctive dorsal fins, and 188 individuals were identified overall. Conn *et al.* (2011), averaging over all fitted models, estimated resident abundance as 179 (CV=0.04) and resident plus transient abundance as 232 (CV=0.06). Therefore, the best available abundance estimate of the resident Choctawhatchee Bay Stock is 179 (CV=0.04). Because this estimate does not account for the proportion of the population with unmarked fins, it is negatively biased. A reanalysis of the data using a method that accounts for unmarked fins is required for a less negatively biased estimate.

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 for the Choctawhatchee Bay Stock is 179 (CV=0.04). The resulting minimum population estimate is 173.

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. 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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the Choctawhatchee Bay Stock of bottlenose dolphins is 173. 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 this stock of bottlenose dolphins is 1.7.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury of the Choctawhatchee Bay Stock of bottlenose dolphins during 2006–2010 is unknown.

Fishery Information

The commercial fisheries which potentially could interact with this stock are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III). There have been no documented interactions between Choctawhatchee Bay bottlenose dolphins and the shrimp trawl fishery. There have been no documented mortalities of Choctawhatchee Bay bottlenose dolphins in crab trap/pot fisheries. There is no systematic observer coverage of crab trap/pot fisheries; therefore, it is not possible to quantify total mortality. There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery. The menhaden fishery in this area is very limited. During 2010, there was only 1 fishing trip for Walton County, Florida, and none for Okaloosa County, Florida (Florida Fish and Wildlife Conservation Commission 2011).

Hook and Line Fisheries

During 2008 there was 1 mortality resulting from a rescue attempt to disentangle a calf from monofilament line. Also during 2008, an additional live entanglement was documented. The mortality and live entanglement were included in the stranding database and are included in the stranding totals presented in Table 1.

Other Mortality

From 2006 to 2010, 47 bottlenose dolphins were reported stranded within the Choctawhatchee Bay Stock area (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). It was not possible to make any determination of possible human interaction for 31 of these strandings. For 12 dolphins, no evidence of human interactions was detected. For the remaining 4 dolphins, evidence of human interactions was found, 3 of which were fishery interactions. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals that die or are seriously injured in fishery interactions are discovered, reported or investigated, nor will all of those that are found 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.

Choctawhatchee Bay has been affected by 4 recent unusual mortality events (UMEs). First, between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. This UME started in St. Joseph Bay, Florida, and was concurrent spatially and temporally with a *K. brevis* bloom that spread east to west. There were 62 bottlenose dolphin strandings within Choctawhatchee Bay during this event, which accounted for about 41% of the total bottlenose dolphin strandings associated with this UME. Second, in March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 105 bottlenose dolphins and 2

unidentified dolphins stranded dead (NOAA 2004). This event also started in St. Joseph Bay, and the majority (76%) of animals stranded in the St. Joseph Bay Stock area with only 2 strandings within Choctawhatchee Bay. 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). Third, 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 April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins), with 44 (49%) occurring within Choctawhatchee Bay. Finally, an UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 2 animals from this stock were considered to be part of the UME.

Table 1. Bottlenose dolphin strandings occurring in the Choctawhatchee Bay Stock area from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death.

Stock	Category	2006	2007	2008	2009	2010	Total
Choctawhatchee Bay Stock	Total Stranded	32[a]	8	4	1	2	47
	Human Interaction						
	---Yes	1	0	3	0	0	4
	---No	7	4	0	1	0	12
	---CBD	24	4	1	0	2[b]	31

[a] This total includes 31 animals that were part of the 2005-2006 UME event.
[b] The 2 strandings from 2010 are part of the ongoing UME event in the northern Gulf of Mexico.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks

in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

STATUS OF STOCK

The status of the Choctawhatchee Bay Stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. The high number of bottlenose dolphin deaths associated with unusual mortality events in the Florida panhandle since 1999 suggests that this stock may be stressed. There are insufficient data to determine population trends for this stock. The total human-caused mortality and serious injury for this stock is unknown and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Because the stock size and PBR are small, and 2 mortalities or serious injuries would exceed PBR, the NMFS considers this stock to be strategic.

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BOTTLENOSE DOLPHIN (*Tursiops truncatus truncatus*)
St. Joseph Bay Stock

NOTE – NMFS is in the process of writing individual stock assessment reports for each of the 32 bay, sound and estuary stocks of bottlenose dolphins in the Gulf of Mexico. Until this effort is completed and 32 individual reports are available, some of the basic information presented in this report will also be included in the report: "Northern Gulf of Mexico Bay, Sound and Estuary Stocks".

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sounds and estuaries of the Gulf of Mexico (Mullin 1988). Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification (photo-ID) or tagging studies have been conducted in the Gulf of Mexico (e.g., Irvine and Wells 1972; Shane 1977; Gruber 1981; Irvine *et al.* 1981; Wells 1986a; Wells *et al.* 1987; Scott *et al.* 1990; Shane 1990; Wells 1991; Bräger 1993; Bräger *et al.* 1994; Fertl 1994; Wells *et al.* 1996a,b; Wells *et al.* 1997; Weller 1998; Maze and Würsig 1999; Lynn and Würsig 2002; Wells 2003; Hubard *et al.* 2004; Irwin and Würsig 2004; Shane 2004; Balmer *et al.* 2008; Urian *et al.* 2009). In many cases, residents predominantly use the bay, sound or estuary waters, with limited movements through passes to the Gulf of Mexico (Shane 1977; Shane 1990; Gruber 1981; Irvine *et al.* 1981; Shane 1990; Maze and Würsig 1999; Lynn and Würsig 2002; Fazioli *et al.* 2006). Early studies indicating year-round residency to bays in both the eastern and western Gulf of Mexico led to the delineation of 33 bay, sound and estuary stocks, including St. Joseph Bay, with the first stock assessment reports in 1995.

More recently, genetic data also support the concept of relatively discrete bay, sound and estuary stocks (Duffield and Wells 2002; Sellas *et al.* 2005). Sellas *et al.* (2005) examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, Texas, 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 differentiation 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 identification of bay, sound and estuary populations distinct from those occurring in adjacent Gulf coastal waters. Differences in reproductive seasonality from site to site also suggest genetic-based distinctions among areas (Urian *et al.* 1996). Photo-ID and genetic data from several inshore areas of the southeastern United States also support the existence of resident estuarine animals and a differentiation between animals biopsied along the Atlantic coast and those biopsied within estuarine systems at the same latitude (Caldwell 2001; Gubbins 2002; Zolman 2002;

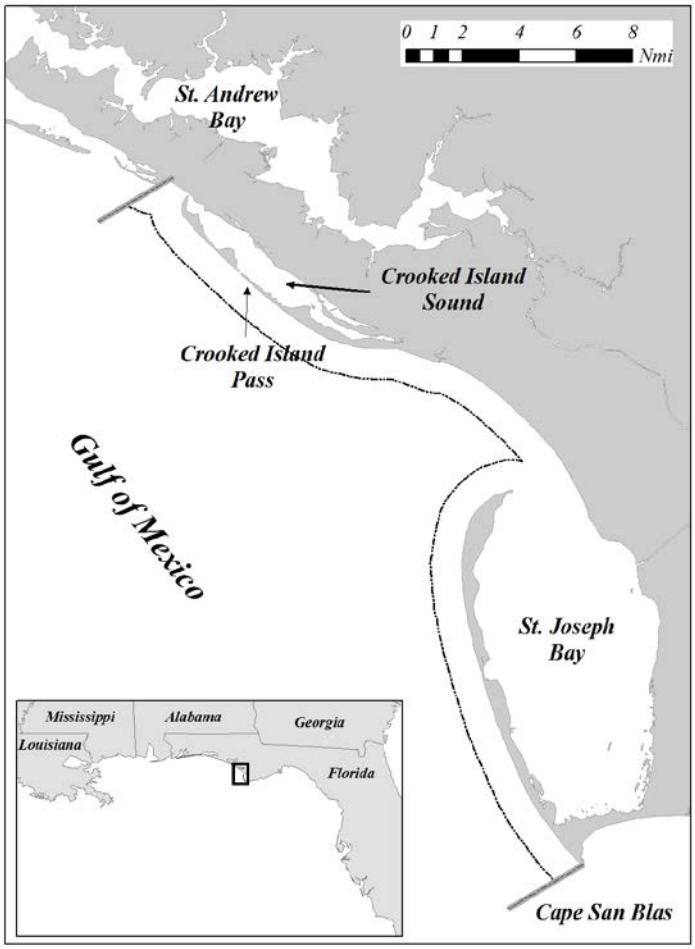

Figure 1. *Geographic extent of the St. Joseph Bay Stock, located in the Florida panhandle. The stock boundaries are denoted by dashed and solid lines.*

Mazzoil *et al.* 2005; Litz 2007; Rosel *et al*. 2009; NMFS unpublished).

St. Joseph Bay is a relatively small embayment of 170km^2 in area, located just west of Apalachicola in the central panhandle of Florida (Figure 1). The bay is bounded in the south by Cape San Blas, in the west by the St. Joseph Peninsula and opens in the north to the Gulf of Mexico. St. Joseph Bay extends 21km in length and 10km in width at its widest point, and is characterized by extensive seagrass beds and salt marshes. The southern quarter of the bay is 1m or less deep whereas the deepest portions are in the northwest region at ~10m deep. Most of St. Joseph Bay has been designated as an aquatic preserve by the state of Florida. There is minimal freshwater inflow into the bay (U.S. EPA 1999; Balmer 2007; Moretzsohn *et al.* 2010). To the northwest of St. Joseph Bay, Crooked Island Sound (also known as St. Andrew Sound) extends 12km in length and 2km in width at its widest point. It varies in depth from 1m around the margins of the sound to 6-7m at the sound's entrance (Balmer 2007). The greatest environmental concerns for this area are declining water quality (mainly due to eutrophication), coastal development, loss of seagrass and saltmarsh habitats and beach erosion (Florida Department of Environmental Protection 2008).

In response to 3 unusual mortality events along the Florida panhandle which all impacted the St. Joseph Bay area, Balmer *et al.* (2008) conducted photo-ID surveys from April 2004 to July 2007 to examine seasonal abundance, distribution patterns and site fidelity of bottlenose dolphins in St. Joseph Bay and along the coast northwest to and inside Crooked Island Sound. In addition, during April 2005 and July 2006, NOAA and the Sarasota Dolphin Research Program along with other partners, conducted health assessments of bottlenose dolphins in the St. Joseph Bay area. Photo-ID data strongly suggested a movement of dolphins into the St. Joseph Bay region during spring and fall with lower abundance during winter and summer. Dolphins sighted in winter and summer displayed higher site fidelity, whereas the majority of dolphins sighted during spring and fall displayed the lowest site fidelity (Balmer *et al.* 2008). Radio-tracking results supported these findings, with animals tagged in spring 2005 (April) ranging the farthest of all dolphins tagged, extending outside the St. Joseph Bay Stock region. Overall, Balmer *et al.* (2008) found abundance to vary seasonally in the St. Joseph Bay area, and suggested the St. Joseph Bay area supports a resident community of bottlenose dolphins as well as seasonal visitors during spring and fall seasons.

The St. Joseph Bay Stock area includes St. Joseph Bay, Crooked Island Sound and coastal waters out to 2km from shore in between St. Joseph Bay and Crooked Island Sound, and coastal waters out to 2km from shore from Cape San Blas along St. Joseph Peninsula and along Crooked Island (Figure 1). The boundaries of this stock are based on photo-ID and radio-tracking studies conducted during 2004-2007 (Balmer 2007; Balmer *et al.* 2008), which support the inclusion of nearshore coastal waters within the boundaries for this particular stock. The boundaries are subject to change as additional research is conducted. There is strong support from the findings of Balmer *et al.* (2008) to include Crooked Island Sound in the St. Joseph Bay Stock. However, animals from nearby St. Andrew Bay, located to the northwest of St. Joseph Bay (see Figure 1) and surrounding Panama City, have also been sighted in Crooked Island Sound, suggesting Crooked Island Sound is an area of overlap for dolphins inhabiting both St. Joseph Bay and St. Andrew Bay. An example of overlap with St. Andrew Bay is given by Balmer *et al.* (2010), who show the sightings for a particular animal, tracked simultaneously via satellite-linked transmitter and VHF radio transmitter, sighted in both Crooked Island Sound and St. Andrew Bay as well as adjacent coastal waters.

POPULATION SIZE

In order to estimate seasonal abundance, Balmer *et al.* (2008) conducted photo-ID mark-recapture surveys across multiple seasons from February 2005 through July 2007 in St. Joseph Bay and along the coast to the northwest including Crooked Island Sound (St. Andrew Sound). Line and contour transects were used to cover the study area, and each survey was only conducted if Beaufort Sea State was 3 or less. Balmer *et al.* (2008) also calculated a distinctiveness rate, which was the proportion of distinctive (marked) dolphins to non-distinctive (un-marked) dolphins, for each survey season. Mark-recapture estimates factored in the distinctiveness rate and included animals with distinctive and non-distinctive fins. Seasonal abundance estimates using the robust 'Markovian Emigration' model ranged from 122 dolphins (CV=0.09) for summer 2007 to 340 dolphins (CV=0.09) for fall 2006. Summer and winter estimates provide the best estimate of the resident population as spring and fall estimates also include transient animals. Therefore, the best available abundance estimate for the St. Joseph Bay Stock is the average of estimates for winter 2005, summer 2005, winter 2006 and summer 2007, which is 146 dolphins (CV=0.18).

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 for the St. Joseph Bay Stock is 146 (CV=0.18). The resulting minimum population estimate is 126.

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. 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 (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size of the St. Joseph Bay Stock of bottlenose dolphins is 126. 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 this stock of bottlenose dolphins is 1.3.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human-caused mortality and serious injury to the St. Joseph Bay Stock of bottlenose dolphins during 2006–2010 is unknown.

Fishery Information

The commercial fisheries which potentially could interact with this stock are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden purse seine, and Atlantic Ocean commercial passenger fishing vessel (hook and line) fisheries (Appendix III). There have been no documented interactions between St. Joseph Bay bottlenose dolphins and the shrimp trawl fishery, nor any documented interactions with hook and line fisheries. There have been no documented mortalities of St. Joseph Bay bottlenose dolphins in crab trap/pot fisheries. There is no systematic observer coverage of crab trap/pot fisheries; therefore, it is not possible to quantify total mortality. There are no recent observer program data for the Gulf of Mexico menhaden purse seine fishery. The menhaden fishery in this area is very limited, with only 2 fishing trips for Gulf County, Florida, during 2010 (Florida Fish and Wildlife Conservation Commission 2011).

Other Mortality

From 2006 to 2010, 9 bottlenose dolphins were reported stranded within the St. Joseph Bay Stock area (Table 1; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). This particular bay, sound and estuary stock includes nearshore coastal waters within its boundaries, and hence strandings that occurred along the coast within the bounds of this stock are also included in the total (Table 1). However, because much of the stock area is contiguous, without physical barriers, with the Northern Coastal Stock of bottlenose dolphins, the stock of origin for animals that strand within the St. Joseph Bay Stock area is uncertain. It was not possible to make a determination of possible human interactions for any of these strandings. Stranding data probably underestimate the extent of human-caused mortality and serious injury because not all of the marine mammals that die or are seriously injured in human interactions are discovered, reported or investigated, nor will all of those that are found necessarily show signs of entanglement or other human interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interactions.

St. Joseph Bay has been affected by 3 recent unusual mortality events (UMEs) and was the geographic focus of an UME in 2004. First, between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. This UME started in St. Joseph Bay and was concurrent spatially and temporally with a *K. brevis* bloom that spread east to west. There were 43 bottlenose dolphin strandings within the St. Joseph Bay Stock area during this event, which accounted for about 28% of the total bottlenose dolphin strandings for the 1999-2000 UME. Second, in March and April 2004, in another Florida Panhandle UME possibly related to *K.*

brevis blooms, 105 bottlenose dolphins and 2 unidentified dolphins stranded dead (NOAA 2004). This event also started in St. Joseph Bay, and 81 (76%) bottlenose dolphins stranded in the St. Joseph Bay Stock area. 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). Third, 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 April 2006 when the event was officially declared over, a total of 90 bottlenose dolphin strandings occurred (plus strandings of 3 unidentified dolphins), with 12 (13%) occurring within the St. Joseph Bay Stock area. Health assessments of dolphins in the stock area found an eosinophilia syndrome, which could over the long-term produce organ damage and alter immunological status and thereby increase vulnerability to other challenges (Schwacke *et al.* 2010). However, the significance of the high prevalence of the syndrome to the observed mortality events in the St. Joseph Bay area is unclear. An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

One research-related mortality occurred during July 2006 in St. Joseph Bay during a NMFS health assessment research project to investigate the above-mentioned UMEs 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.

Dolphins within the boundaries of this stock, primarily within Crooked Island Sound, have been observed to approach vessels in the area and beg for food (Balmer 2007; Balmer, pers. comm.). Begging behaviors are a result of being illegally fed. It is believed that the animals observed begging within Crooked Island Sound are members of the St. Andrew Bay Stock (the St. Andrew Bay Stock encompasses Panama City, an area where illegal feeding has been documented [Samuels and Bejder 2004]). Three dolphins, which were captured in Crooked Island Sound during the April 2005 health assessment, were observed begging during the 3 months of subsequent radio tracking (Balmer 2007; Balmer, pers. comm.). Two of these individuals, a mom/calf pair, were sighted exclusively within the boundaries of the St. Andrew Bay Stock during all radio tracking surveys. Both of these individuals were found stranded within 2 days of each other on 1 November and 3 November 2005 near Panama City and Panama City Beach. The other individual, an adult male, which was documented in Balmer *et al.* (2010), was sighted frequently in the waters from St. Andrew Bay to Crooked Island Sound and in association with individuals from both the St. Andrew Bay and St. Joseph Bay Stocks. Thus, the begging behaviors and overlap by individuals of the St. Andrew Bay Stock are likely affecting the behavior of individuals in the St. Joseph Bay Stock.

Table 1. Bottlenose dolphin strandings occurring in the St. Joseph Bay Stock area from 2006 to 2010, as well as number of strandings for which evidence of human interaction was detected and number of strandings for which it could not be determined (CBD) if there was evidence of human interaction. Data are from the NOAA National Marine Mammal Health and Stranding Response Database (unpublished data, accessed 16 November 2011). Please note human interaction does not necessarily mean the interaction caused the animal's death. Please also note that some animals included in this table may belong to the Gulf of Mexico Northern Coastal Stock since the boundaries for this stock include coastal waters.

Stock	Category	2006	2007	2008	2009	2010	Total
St. Joseph Bay Stock	Total Stranded	7[a]	1	1	0	0	9
	Human Interaction						
	---Yes	0	0	0	0	0	0
	---No	0	0	0	0	0	0
	---CBD	7	1	1	0	0	9

[a] This total includes 5 animals that were part of the 2005-2006 UME event.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the

response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

A substantial number of beaches and wetlands along the Louisiana coast experienced heavy or moderate oiling (OSAT-2 2011). The heaviest oiling in Louisiana occurred west of the Mississippi River on the Mississippi Delta and in Barataria and Terrebonne Bays, and to the east of the river on the Chandeleur Islands. Some heavy to moderate oiling occurred on Alabama and Florida beaches, with the heaviest stretch occurring from Dauphin Island, Alabama, to Gulf Breeze, Florida. Light to trace oil was reported along the majority of Mississippi barrier islands, from Gulf Breeze to Panama City, Florida, and outside of Atchafalaya and Vermilion Bays in western Louisiana (OSAT-2 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing. For coastal and estuarine dolphins, the NOAA-led efforts include: active surveillance to detect stranded animals in remote locations; aerial surveys to document the distribution, abundance, species and exposure of marine mammals and sea turtles relative to oil from DWH spill; assessment of sublethal and chronic health impacts on coastal and estuarine bottlenose dolphins in Barataria Bay, Louisiana, and a reference site in Sarasota Bay, Florida; and assessment of injuries to dolphin stocks in Barataria Bay and Chandeleur Sound, Louisiana, Mississippi Sound, and as a reference site, St. Joseph Bay, Florida.

Coastal dolphins have been observed with tar balls attached to them and seen swimming through oil slicks close to shore and inland bays (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

STATUS OF STOCK

The status of the St. Joseph Bay Stock relative to OSP is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. The high number of bottlenose dolphin deaths which occurred during the mortality events in the Florida panhandle since 1999 suggests that this stock may be stressed. There are insufficient data to determine population trends for this stock. The total human-caused mortality and serious injury for this stock is unknown and there is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Because the stock size and PBR are small, and 2 mortalities or serious injuries would exceed PBR, the NMFS considers this stock to be strategic.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are 2 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 2 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 200m 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 10-200m deep to slope waters <500m deep (Figure 1; Fulling *et al.* 2003; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). Atlantic spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico (i.e., U.S. 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).

The Gulf of Mexico population is being considered a separate stock for management purposes. 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

The current population size for the Atlantic spotted dolphin in the northern Gulf of Mexico is unknown because the survey data are more than 8 years old (Wade and Angliss 1997).

Abundance Estimates

All 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 line-transect survey data collected from ships in the northern Gulf of Mexico and are summarized in Appendix IV.

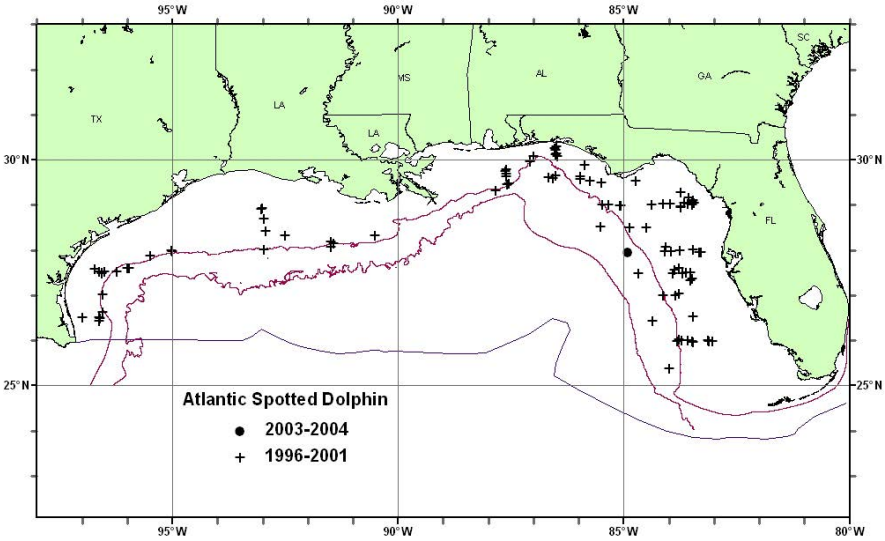

Figure 1. *Distribution of Atlantic spotted dolphin sightings from SEFSC spring and fall vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring in oceanic waters (i.e., 200m isobath to seaward extent of the U.S. EEZ) along a fixed plankton sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Atlantic spotted dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 3,213 (CV=0.44) (Hansen *et al.* 1995), and for 1996 to 2001, 175 (CV=0.84) (Mullin and Fulling 2004).

These were underestimates because the continental shelf was not covered during these surveys.

Data were also collected from 1998 to 2001 during fall plankton surveys. Tracklines, which were perpendicular to the bathymetry, covered shelf waters from the 20m to the 200m isobaths. The estimated abundance of Atlantic spotted dolphins, pooled from 2000 through 2001, for the fall outer continental shelf surveys was 37,611 (CV=0.28) (Table 1; see Fulling *et al.* 2003).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted in oceanic waters along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Atlantic spotted dolphins in oceanic waters, pooled from 2003 to 2004, was 0 (Mullin 2007).

The most recent best abundance estimate for the Atlantic spotted dolphin in the northern Gulf of Mexico was 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 was 37,611 (CV=0.28) (Table 1). Because these data are more than 8 years old, the current best population estimate is unknown.

Table 1. Most recent abundance estimates (N_{best}) and coefficient of variation (CV) of Atlantic spotted dolphins in the northern Gulf of Mexico outer continental shelf (OCS) (waters 20-200m deep) during fall 2000-2001 and oceanic waters (200m to the offshore extent of the EEZ) during spring/summer 2003-2004.

Month/Year	**Area**	**N_{best}**	**CV**
Fall 2000-2001	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 current minimum population estimate is unknown. 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).

Current Population Trend

There are insufficient data to determine the population trend 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 (PBR) is currently undetermined. 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 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Annual human-caused mortality and serious injury is unknown for this stock. There has been no reported fishing-related mortality or serious injury of an Atlantic spotted dolphin during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). 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. This mortality was included in the stranding database and is included in Table 2.

Fisheries Information

The commercial fisheries which potentially could interact with this stock in the Gulf of Mexico are the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery and the Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery (Appendix III).

Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There has been no reported mortality or serious injury of an Atlantic spotted dolphin in the pelagic longline fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

A voluntary observer program for the shrimp trawl fishery began in 1992 and became mandatory in 2007. During 1992-2008 the shrimp trawl fishery observer program recorded 6 unidentified dolphins caught in a lazy line or turtle excluder device, and 1 or more of these animals may have been an Atlantic spotted dolphin. In 2 of the 6 cases, an observer report indicated the animal may have already been decomposed, but this could not be confirmed in the absence of a necropsy. In 2008, an additional dolphin carcass was caught on the tickler chain of a shrimp trawl; however, the animal's carcass was severely decomposed and may have been captured in this state. It is likely the unidentified carcass belonged to the bottlenose dolphin Western Coastal Stock or Continental Shelf Stock, or possibly to the Atlantic spotted dolphin stock.

Other Mortality

A total of 16 Atlantic spotted dolphins were reported stranded in the Gulf of Mexico during 2006–2010 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions was detected for 2 stranded animals, no evidence of human interactions was detected for 2 animals, and for the remaining 12 animals, it could not be determined if there was evidence of human 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.

Since 1990, there have been 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and 3 of these included Atlantic spotted dolphins. 1) Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *Karenia 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, *Mesoplodon densirostris*, and 4 unidentified dolphins. 2) 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 November 2006. A total of 190 dolphins were involved, primarily bottlenose dolphins plus strandings of 1 Atlantic spotted dolphin and 24 unidentified dolphins. The evidence suggests the effects of a red tide bloom contributed to the cause of this event. 3) An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 3 animals from this stock were considered to be part of the UME.

Table 2. Atlantic spotted dolphin (*Stenella frontalis*) strandings along the northern Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	1	0	0	0	1
Florida	1	7	0	4	3*	15
Louisiana	0	0	0	0	0	0

Mississippi	0	0	0	0	0	0
Texas	0	0	0	0	0	0
TOTAL	1	8	0	4	3	16
*These strandings are included in the Northern Gulf of Mexico UME						

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Despite an undetermined PBR and unknown population size, this is not a strategic stock because previous estimates of population size have been large compared to the number of cases of documented human-related mortality and serious injury.

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PANTROPICAL SPOTTED DOLPHIN (*Stenella attenuata 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 200m 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 (i.e., U.S. Gulf of Mexico) (Figure 1; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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). Because there are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), pantropical spotted dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico pantropical spotted dolphins is 50,880 (CV=0.27; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix

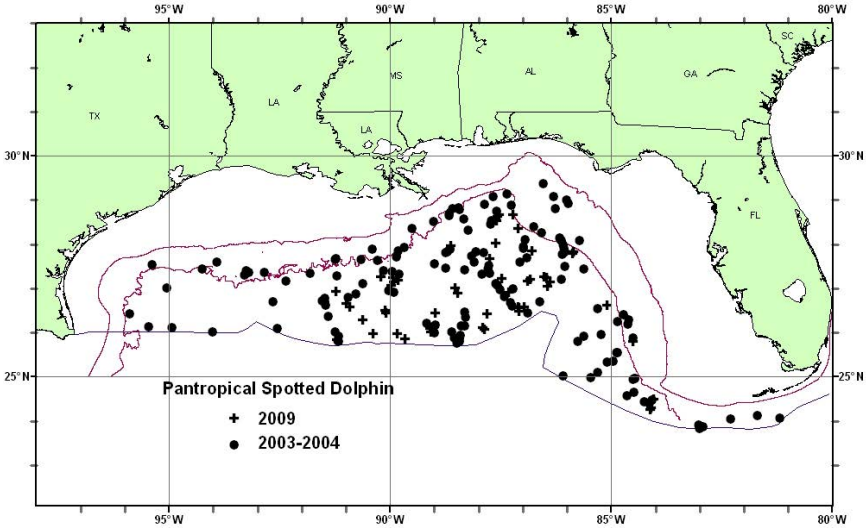

Figure 1. *Distribution of pantropical spotted dolphin sightings from SEFSC vessel surveys during summer 2003 and spring 2004, and during summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of pantropical spotted dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 31,320 (CV=0.20) (Hansen *et al.* 1995), and for 1996 to 2001, 91,321 (CV=0.16) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for pantropical spotted dolphins, pooled from 2003 to 2004, was 34,067 (CV=0.18) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for pantropical spotted dolphins in oceanic waters during 2009 was 50,880 (CV=0.27; Table 1).

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

Month/Year	Area	N_{best}	CV
Apr-Jun 1991-1994	Oceanic waters	31,320	0.20
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	91,321	0.16
Jun-Aug 2003, Apr-Jun 2004 (pooled)	Oceanic waters	34,067	0.18
Jun-Aug 2009	Oceanic waters	50,880	0.27

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 50,880 (CV=0.27). The minimum population estimate for the northern Gulf of Mexico is 40,699 pantropical spotted dolphins.

Current Population Trend

Four point estimates of pantropical spotted dolphin abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of pantropical spotted dolphin abundance. 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 life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 40,699. 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 stock is 407.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury for this stock during 2006–2010 is 3.2 pantropical spotted dolphins (CV=0.69; Table 2).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to pantropical spotted dolphins by this fishery during 1998-2008 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009). However, during 2009, 4 pantropical spotted dolphins were observed to be seriously injured (3 during quarter 2 and 1 during quarter 4) and 1 pantropical spotted dolphin was released alive with no presumed serious injury after entanglement interactions with the pelagic longline fishery (Garrison and Stokes 2010). Estimated serious injuries of pantropical spotted dolphins attributable to the pelagic longline fishery in the Gulf of Mexico region totaled 15.9 (CV=0.69) in 2009. During 2010, 2 pantropical spotted dolphins were released alive with no presumed serious injuries after entanglement interactions with the pelagic longline fishery (Garrison and Stokes 2011). One of the entanglements occurred during experimental fishing to test the effectiveness of "weak" hooks as a potential bycatch mitigation tool. There was 100% observer coverage of all experimental sets. The average annual serious injury and mortality in the Gulf of Mexico pelagic longline fishery for the 5-year period from 2006 to 2010 is 3.2 (CV=0.69; Table 2).

Table 2. Summary of the incidental mortality and serious injury of northern Gulf of Mexico pantropical spotted dolphins 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	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	06-10	47, 55, 53, 47, 46	Obs. Data Logbook	.08, .14, .25, .21, .26	0,0,0,4,0	0,0,0,0,0	0,0,0,16.0, 0	0,0,0,0,0	0,0,0,16.0, 0	NA, NA ,NA, .69, NA	3.2 (0.69)
TOTAL											3.2 (0.69)

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). Observer coverage in the GOM is dominated by very high coverage rates during April-June associated with efforts to improve estimates of Bluefin Tuna bycatch.

Other Mortality

Five pantropical spotted dolphins were reported stranded in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). There was 1 stranding of a pantropical spotted dolphin during 2008 (in Florida), 3 strandings during 2009 (in Florida, Texas and Alabama) and 1 stranding during 2010 (in Texas). No evidence of human interactions was detected for 2 of these stranded animals, and for the remaining 3 animals, it could not be determined if there was evidence of human

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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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 stock. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. Gulf of Mexico) occur in oceanic waters (Figure 1; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), striped dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico striped dolphins is 1,849 (CV=0.77; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ.

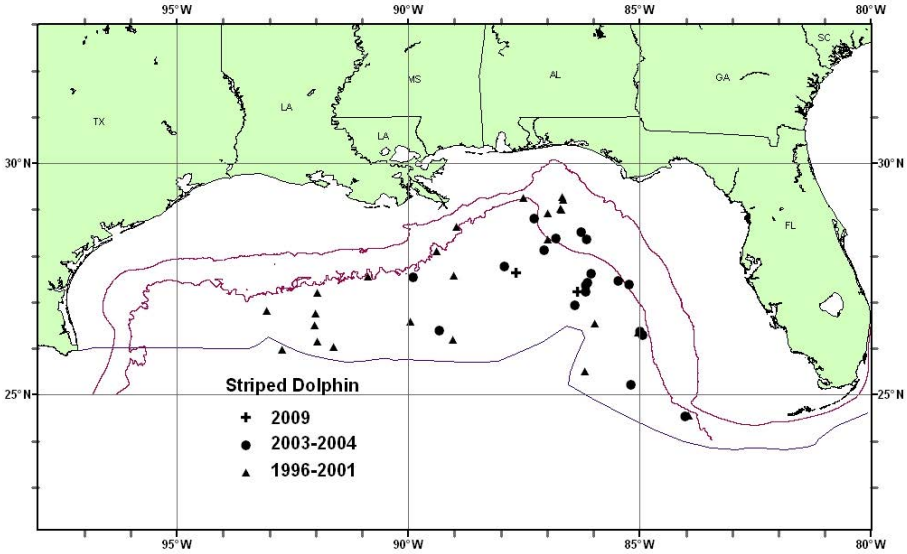

Figure 1. *Distribution of striped dolphin sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of striped dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 4,858 (CV=0.44) (Hansen *et al.* 1995), and for 1996 to 2001, 6,505 (CV=0.43) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for striped dolphins, pooled

from 2003 to 2004, was 3,325 (CV=0.48) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for striped dolphins in oceanic waters during 2009 was 1,849 (CV=0.77; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico 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
Apr-Jun 1991-1994	Oceanic waters	4,858	0.44
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	6,505	0.43
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	3,325	0.48
Jun-Aug 2009	Oceanic waters	1,849	0.77

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 1,849 (CV=0.77). The minimum population estimate for the northern Gulf of Mexico is 1,041 striped dolphins.

Current Population Trend

Four point estimates of striped dolphin abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of more than three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of striped dolphin abundance. 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 (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 1,041. 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 10.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of striped dolphins during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to striped dolphins by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

Three striped dolphins were reported stranded in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). One striped dolphin stranded during 2006 in Florida, 1 stranded during 2007 in Louisiana, and 1 stranded during 2008 in Mississippi. Evidence of human interactions was detected for 1 of the stranded animals, and for the remaining 2, it could not be determined if there was evidence of human 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

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SPINNER DOLPHIN (*Stenella longirostris 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 (i.e., U.S. Gulf of Mexico) occur in oceanic waters and generally east of the Mississippi River (Figure 1; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), spinner dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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.

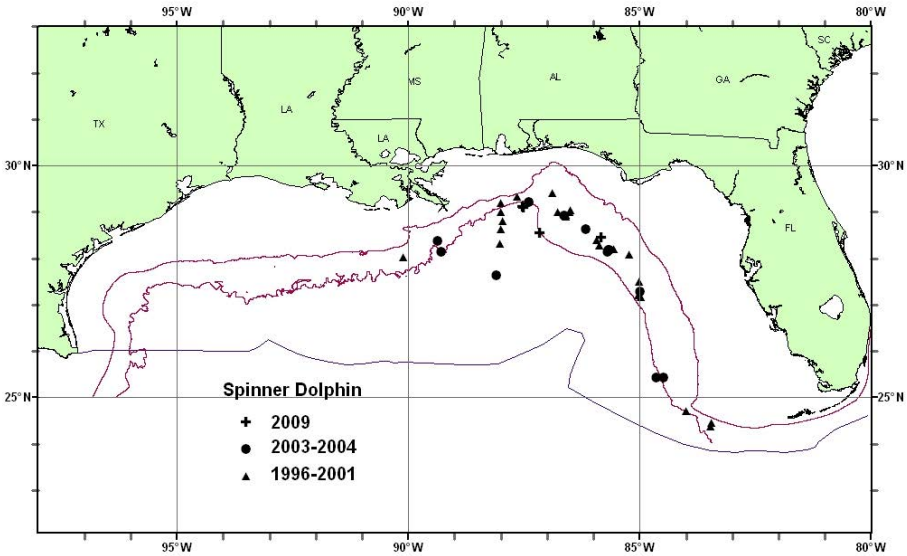

Figure 1. *Distribution of spinner dolphin sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico spinner dolphins is 11,441 (CV=0.83; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of spinner dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 6,316 (CV=0.43) (Hansen *et al.* 1995), and for 1996 to 2001, 11,971 (CV=0.71) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for spinner dolphins, pooled

from 2003 to 2004, was 1,989 (CV=0.48) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for spinner dolphins in oceanic waters during 2009 was 11,441 (CV=0.83; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico spinner 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
Apr-Jun 1991-1994	Oceanic waters	6,316	0.43
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	11,971	0.71
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	1,989	0.48
Jun-Aug 2009	Oceanic waters	11,441	0.83

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 11,441 (CV=0.83). The minimum population estimate for the northern Gulf of Mexico is 6,221 spinner dolphins.

Current Population Trend

Four point estimates of spinner dolphin abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of six. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of spinner dolphin abundance. 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 (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 6,221. 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 62.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of spinner dolphins during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to spinner dolphins by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

Eleven spinner dolphins were reported stranded in the Gulf of Mexico during 2006–2010 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions was detected for 1 stranded spinner dolphin, which stranded alive visibly oiled during June 2010 near Pensacola, Florida. No evidence of human interaction was detected for 1 stranded spinner dolphin, and for the remaining 9 spinner dolphins, it could not be determined if there was evidence of human 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 7 animals from this stock were considered to be part of the UME.

Table 2. Spinner dolphin (*Stenella longirostris longirostris*) strandings along the northern Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	3	0	3
Florida	0	0	0	0	7*	7
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	0	0	0	0	1	1
TOTAL	0	0	0	3	8	11

*These strandings are included in the Northern Gulf of Mexico UME

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the

spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. For large whales, oil can foul the baleen they use to filter-feed. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 oceanic and to a lesser extent continental shelf waters in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) (Figure 1; Fulling *et al.* 2003; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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 to 112 days. A report after 5 months indicated that the animals returned to, and remained in, Gulf waters averaging about 195m deep offshore of the original stranding site (Wells *et al.* 1999).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), rough-toothed dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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), nor information on whether more than 1 stock may exist in the Gulf of Mexico. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The current population size for the rough-toothed dolphin in the northern Gulf of Mexico is 624 (CV=0.99; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ.

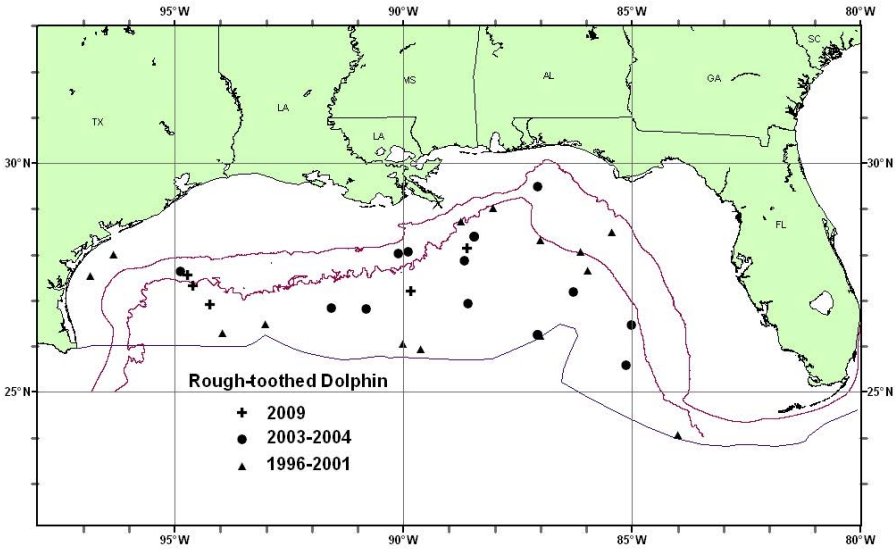

Figure 1. *Distribution of rough-toothed dolphin sightings from SEFSC vessel surveys during spring and fall 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the northern Gulf of Mexico, and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring in oceanic waters (i.e., 200m isobath to seaward extent of the U.S. EEZ) along a fixed plankton sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of rough-toothed dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 852 (CV=0.31) (Hansen *et al.* 1995), and for

1996 to 2001, 985 (CV=0.44) (Mullin and Fulling 2004). These may be underestimates because the continental shelf was not covered during these surveys, although the extent to which rough-toothed dolphins use continental shelf waters and any seasonal component to use are not well known.

Data were also collected from 1998 to 2001 during fall plankton surveys. Tracklines, which were perpendicular to the bathymetry, covered shelf waters from the 20m to the 200m isobaths. The estimated abundance of rough-toothed dolphins, pooled from 2000 through 2001, for the fall outer continental shelf surveys was 1,145 (CV=0.83) (Table 1; see Fulling *et al.* 2003).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted in oceanic waters along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for rough-toothed dolphins in oceanic waters, pooled from 2003 to 2004, was 1,508 (CV=0.39) (Mullin 2007).

The previous best abundance estimate for the rough-toothed dolphin in the northern Gulf of Mexico was 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 was 2,653 (CV=0.42).

Recent surveys and abundance estimates

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for rough-toothed dolphins in oceanic waters during 2009 was 624 (CV=0.99; Table 1). This is the most reliable current estimate for the northern Gulf of Mexico. Rough-toothed dolphins are uncommon in Gulf of Mexico continental shelf waters and their use of these waters may be seasonal. A previous abundance estimate for continental shelf waters was based on sightings of two groups off Texas off during fall surveys conducted during 2000-2001 (Fulling *et al.* 2003; Figure 1; Table 1). During a similar survey of continental shelf waters west of Cape San Blas, Florida (about -85 degrees W) during summer 2007, no rough-toothed dolphin groups were sighted (NMFS 2007).

Table 1. Most recent abundance estimates (N_{best}) and coefficient of variation (CV) of rough-toothed dolphins in the northern Gulf of Mexico outer continental shelf (OCS) waters (20-200m deep) during fall 2000-2001 and oceanic waters (200m to the offshore extent of the EEZ) during spring/summer 2003-2004 and summer 2009.

Month/Year	Area	N_{best}	CV
Fall 2000-2001	Outer Continental Shelf	1,145	0.83
Spring/Summer 2003 -2004	Oceanic	1,508	0.39
Summer 2009	Oceanic	624	0.99

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 624 (CV=0.99). The minimum population estimate for northern Gulf of Mexico rough-toothed dolphins is 311.

Current Population Trend

Two point estimates of rough-toothed dolphin abundance have been made based on data from oceanic surveys during 2003-2004 and 2009. The estimates vary by a factor of more than two. To determine whether changes in oceanic abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of rough-toothed dolphin abundance. 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. Additionally, the extent to which rough-toothed dolphins inhabit continental shelf waters and whether there is movement between these waters and oceanic waters needs to be resolved.

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 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 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 rough-toothed dolphin is 3.1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of rough-toothed dolphins during 1992-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to rough-toothed dolphins by this fishery in the northern Gulf of Mexico during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were 6 stranded rough-toothed dolphins in the northern Gulf of Mexico during 2006–2010 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). No evidence of human interactions was detected 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see “Habitat Issues” below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

Table 2. Rough-toothed dolphin (*Steno bredanensis*) strandings along the northern Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	0	0	0
Florida	1	1	1	1	1	5
Louisiana	0	0	0	0	0	0

Mississippi	0	0	0	0	0	0
Texas	1	0	0	0	0	1
TOTAL	2	1	1	1	1	6

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. Gulf of Mexico) occur primarily over the deeper waters off the continental shelf and primarily west of the Mississippi River (Mullin *et al.* 1994; Maze-Foley and Mullin 2006; Figure 1). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997), Clymene dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico Clymene dolphins is 129 (CV=1.00; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

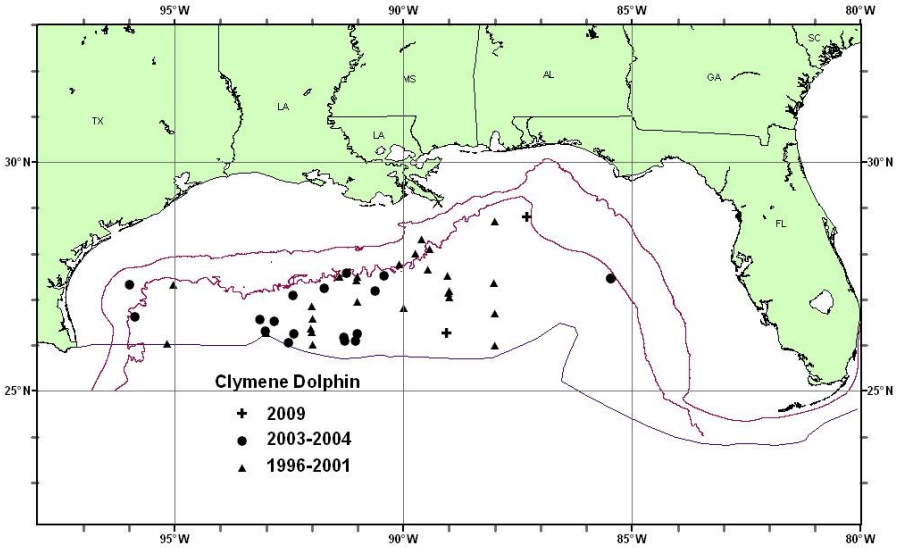

Figure 1. *Distribution of Clymene dolphin sightings from SEFSC shipboard surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Clymene dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 5,571 (CV=0.37) (Hansen *et al.* 1995), and for 1996 to 2001, 17,355 (CV=0.65) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Clymene dolphins, pooled from 2003 to 2004, was 6,575 (CV=0.36) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for Clymene dolphins in oceanic waters during 2009 was 129 (CV=1.00; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico Clymene 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
Apr-Jun 1991-1994	Oceanic waters	5,571	0.37
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	17,355	0.65
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	6,575	0.36
Jun-Aug 2009	Oceanic waters	129	1.00

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 129 (CV=1.00). The minimum population estimate for the northern Gulf of Mexico is 64 Clymene dolphins.

Current Population Trend

Four point estimates of Clymene dolphin abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of more than 100. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of Clymene dolphin abundance. 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 (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 64. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Clymene dolphin is 0.6.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of Clymene dolphins during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Clymene dolphins by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were no reported strandings of Clymene dolphins in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. The total level of fishery-related 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 (i.e., U.S. Gulf of Mexico) occur in oceanic waters (>200m) (Figure 1; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), Fraser's dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico Fraser's dolphins is unknown (Table 1). No sightings of groups of Fraser's dolphins were made during a summer 2009 survey. Nevertheless, a small number of Fraser's dolphins probably continually inhabit the northern Gulf of Mexico. Historically, sightings have been consistently made every 3-4 years since the early 1990's but have not occurred or have been rare during any given survey.

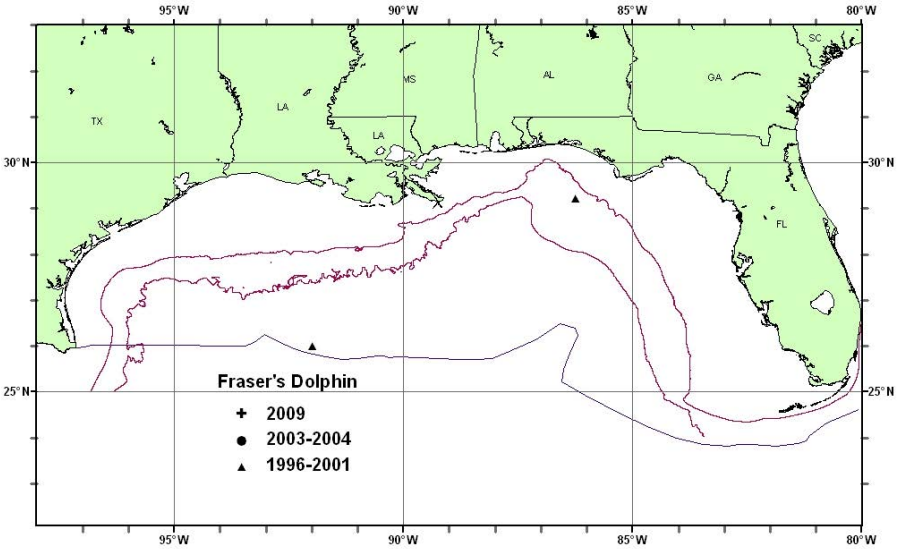

Figure 1. *Distribution of Fraser's dolphin sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Fraser's dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 127 (CV=0.90) (Hansen *et al.* 1995), and for 1996 to 2001, 726 (CV=0.70) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Fraser's dolphins, pooled

from 2003 to 2004, was 0 (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for Fraser's dolphins in oceanic waters during 2009 was 0 (Table 1). 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 2009 but were not encountered.

Table 1. Summary of abundance estimates for northern Gulf of Mexico Fraser's 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
Apr-Jun 1991-1994	Oceanic waters	127	0.90
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	726	0.70
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	0	-
Jun-Aug 2009	Oceanic waters	0	-

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. The large relative changes in the total abundances of Fraser's dolphin are probably due to a number of factors. Fraser's dolphin is most certainly a resident species in the Gulf of Mexico but probably occurs in low numbers and the survey effort is not sufficient to estimate the abundance of uncommon or rare species with precision. Also, these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Fraser's dolphin abundance. Fraser's dolphin, like all the other oceanic cetacean species in the Gulf, is a mobile predator and this stock is most likely a transboundary stock. 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 (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 undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Fraser's dolphin during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Fraser's dolphins by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were no reported strandings of Fraser's dolphins in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an

animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Despite an undetermined 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 (i.e., U.S. Gulf of Mexico) during 1921-1995 occurred primarily in oceanic waters ranging from 256 to 2,652 m (averaging 1,242m) in the north-central Gulf of Mexico (O'Sullivan and Mullin 1997). More recent sightings from NMFS vessel surveys have also occurred in oceanic waters of the north-central Gulf (Figure 1). 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; Maze-Foley and Mullin 2006) and recorded in May, August, September and November by earlier opportunistic ship-based sources (O'Sullivan and Mullin 1997).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), killer whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

Different stocks have been identified in the northeastern Pacific based on morphological, behavioral and genetic characteristics (Bigg *et al.* 1990; Hoelzel 1991). There is no information on stock differentiation for the Atlantic 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 in the northern Gulf of Mexico, 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 1,100km (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

The best abundance estimate available for northern Gulf of Mexico killer whales is 28 (CV=1.02; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward

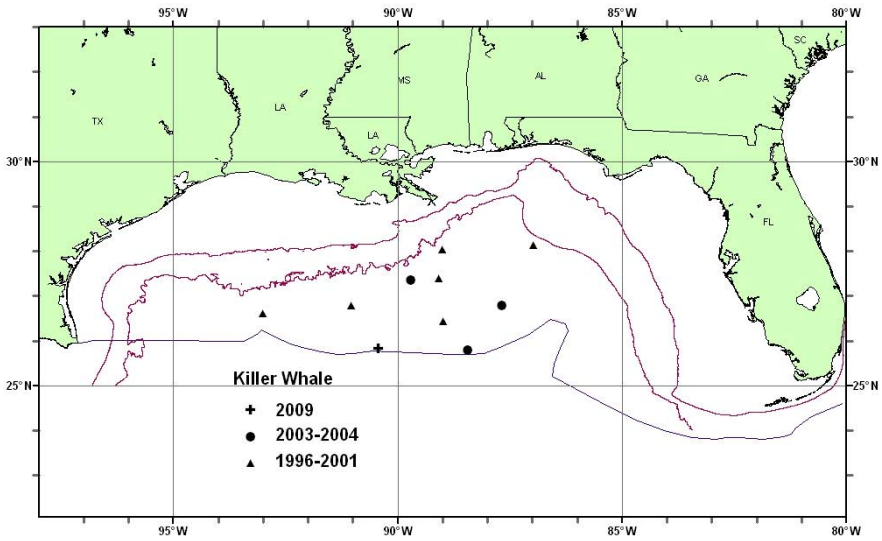

Figure 1. *Distribution of killer whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of killer whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 277 (CV=0.42) (Hansen *et al.* 1995), and for 1996 to 2001, 133 (CV=0.49) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for killer whales, pooled from 2003 to 2004, was 49 (CV=0.77) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for killer whales in oceanic waters during 2009 was 28 (CV=1.02; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico killer 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
Apr-Jun 1991-1994	Oceanic waters	277	0.42
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	133	0.49
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	49	0.77
Jun-Aug 2009	Oceanic waters	28	1.02

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 28 (CV=1.02). The minimum population estimate for the northern Gulf of Mexico is 14 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). The large relative changes in the total abundances of killer whales are probably due to a number of factors. The killer whale is most certainly a resident species in the Gulf of Mexico but probably occurs in low numbers and the survey effort is not sufficient to estimate the abundance of uncommon or rare species with precision. Also, these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of killer whale abundance. The killer whale, like all the other oceanic cetacean species in the Gulf, is a mobile predator and this stock is most likely a transboundary stock. 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 (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 14. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico killer whale is 0.1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a killer whale during 1998-2010 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2008 there was 1 killer whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to killer whales by this fishery during 1998-2010 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, on 17 May 2008 there was 1 killer whale released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Garrison *et al.* 2009). This was the second observed interaction between a killer whale and this fishery and the first observed interaction within the Gulf of Mexico. During 15 April – 15 June 2008 observer coverage in the Gulf of Mexico was greatly enhanced to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Resulting observer coverage for this time and area was dramatically higher than typical for previous years (Garrison *et al.* 2009).

Other Mortality

There were no reported strandings of killer whales in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see “Habitat Issues” below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the

distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. Gulf of Mexico) occur in oceanic waters, primarily in the eastern Gulf (Figure 1; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Because there are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), false killer whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The current population size for the false killer whale in the northern Gulf of Mexico is unknown because the survey data are more than 8 years old (Wade and Angliss 1997).

Abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

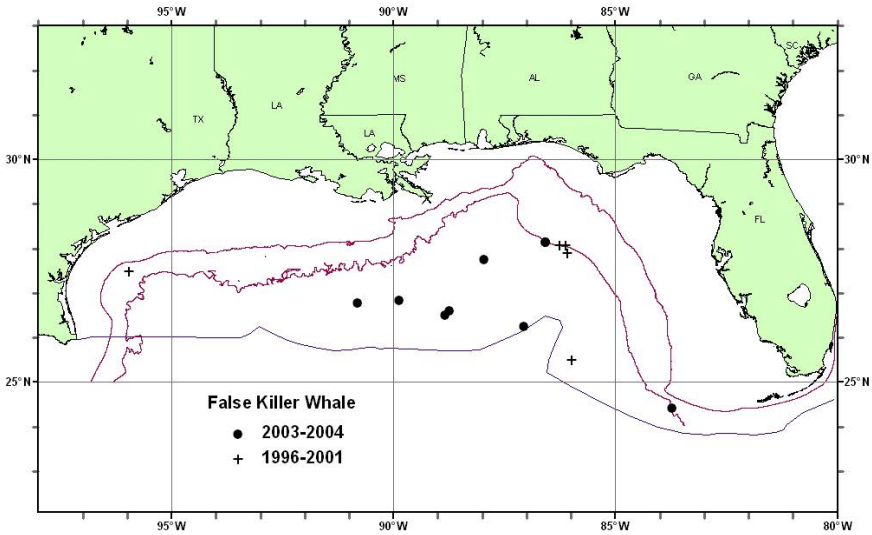

Figure 1. *Distribution of false killer whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of false killer whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 381 (CV=0.62) (Hansen *et al.* 1995), and for 1996 to 2001, 1038 (CV=0.71) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The most recent abundance estimate for false killer whales, pooled from 2003 to 2004, was 777 (CV=0.56) (Mullin 2007; Table 1). Because these data are more than 8 years old, the current best population estimate is unknown.

Recent survey

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. One group of false killer whales was sighted during the 2009 survey on an effort segment that was not included in the line-transect analysis. Therefore, false killer whale abundance could not be estimated from the 2009 survey.

Table 1. Summary of abundance estimates for northern Gulf of Mexico false killer 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
Apr-Jun 1991-1994	Oceanic waters	381	0.62
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	1,038	0.71
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	777	0.56

Minimum Population Estimate

The minimum population estimate is unknown. 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 unknown. The minimum population estimate for the northern Gulf of Mexico is unknown.

Current Population Trend

Three point estimates of false killer whale abundance have been made based on data from surveys covering 1991-2004. The estimates vary by a maximum factor of nearly three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of false killer whale abundance. 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 (PBR) is undetermined. 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.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of a false killer whale during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to false killer whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were two reported stranded false killer whales in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Two animals mass stranded in Florida during 2009. It could not be determined if there was evidence of human 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Despite an undetermined PBR, this is not a strategic stock because there is no documented human-related mortality and serious injury.

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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 (i.e., U.S. Gulf of Mexico) occur in oceanic waters (Figure 1; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Ortega Ortiz 2002), pygmy killer whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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.

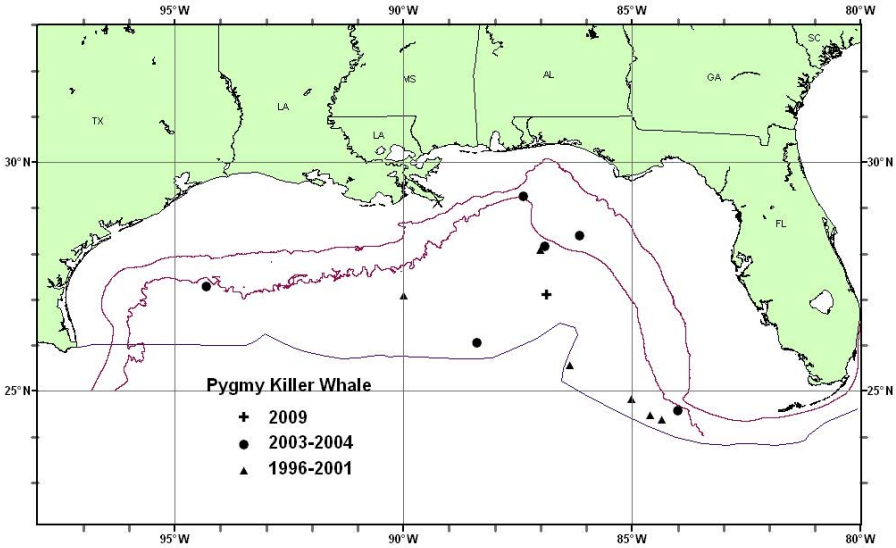

Figure 1. *Distribution of pygmy killer whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico pygmy killer whales is 152 (CV=1.02; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of pygmy killer whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 518 (CV=0.81) (Hansen *et al.* 1995), and for 1996 to 2001, 408 (CV=0.60) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for pygmy killer whales, pooled from 2003 to 2004, was 323 (CV=0.60) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for pygmy killer whales in oceanic waters during 2009 was 152 (CV=1.02; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico pygmy killer 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
Apr-Jun 1991-1994	Oceanic waters	518	0.81
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	408	0.60
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	323	0.60
Jun-Aug 2009	Oceanic waters	152	1.02

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 152 (CV=1.02). The minimum population estimate for the northern Gulf of Mexico is 75 pygmy killer whales.

Current Population Trend

Four point estimates of pygmy killer whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of more than three. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of pygmy killer whale abundance. 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 (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 75. 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 0.8.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a pygmy killer whale during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and

Caldwell 1971). The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to pygmy killer whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were 4 reported strandings of pygmy killer whales in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Four pygmy killer whales stranded in 2008 (2 animals mass stranded in Florida, 1 in Mississippi, 1 in Texas). Evidence of human interaction was detected for 1 of these stranded animals. A plastic, office sheet protector was crumpled up and lodged in the esophagus of the animal. For 2 stranded animals, it could not be determined if there was evidence of human interactions, and for the remaining stranded animal, no evidence of human interaction was detected. 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see “Habitat Issues” below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde’s whales.

Aerial surveys have observed Risso’s dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal’s ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. Gulf of Mexico) occur primarily in oceanic waters (Figure 1; Mullin *et al.* 1991; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Ortega Ortiz 2002), dwarf sperm whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico dwarf and pygmy sperm whales is 186 (CV=1.04; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

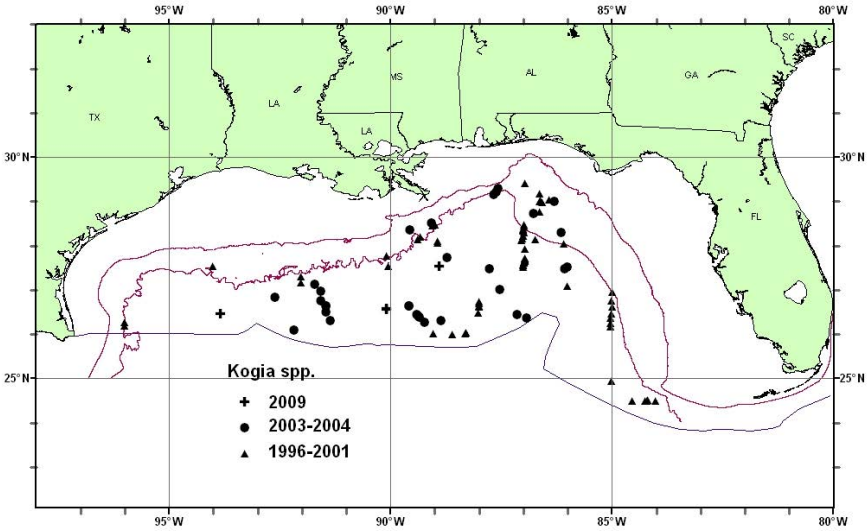

Figure 1. *Distribution of dwarf and pygmy sperm whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of dwarf and pygmy sperm whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 547 (CV=0.28) (Hansen *et al.* 1995), and for 1996 to 2001, 742 (CV=0.29) (Mullin and Fulling 2004; Table 1). 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, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. 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; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for dwarf and pygmy sperm whales in oceanic waters during 2009 was 186 (CV=1.04; Table 1).

Table 1. Summary of combined abundance estimates for northern Gulf of Mexico dwarf and pygmy sperm 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
Apr-Jun 1991-1994	Oceanic waters	547	0.28
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	742	0.29
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	453	0.35
Jun-Aug 2009	Oceanic waters	186	1.04

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 186 (CV=1.04). 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 90 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. Four point estimates of *Kogia* spp. abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly four. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. 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 (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 90. 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 0.9. 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 sperm whales during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to dwarf sperm whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

At least 9 dwarf sperm whale strandings were documented in the northern Gulf of Mexico during 2006–2010 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). Evidence of human interactions was detected for 1 of these stranded animals; no evidence of human interactions was detected for 6 animals; for 2 animals, it could not be determined if there was evidence of human interactions. An additional 3 *Kogia* spp. stranded during 2006–2010. Evidence of human interactions was detected for 1 of the *Kogia* sp. strandings; it could not be determined if there was evidence of human interactions for the remaining 2 *Kogia* sp. strandings. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see “Habitat Issues” below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

Table 2. Dwarf sperm whale (*Kogia sima*) strandings along the northern Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	0[e]	0	0
Florida	2[a,b]	2	0	1[f]	0	5
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	0	2[c]	2[d]	0	0	4
TOTAL	2	4	2	1	0	9

[a] 1 additional *Kogia* sp. stranded
[b] Previously reported incorrectly as 1 stranded animal
[c] Mass stranding of 2 animals in August 2007
[d] A mom/calf pair stranding together

[e] 1 *Kogia* sp. stranded [f] 1 additional *Kogia* sp. stranded

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Despite an unknown PBR for this species, this is not a strategic stock because it is assumed that average annual human-related mortality and serious injury does not exceed combined PBR for dwarf and pygmy sperm whales. However, the continuing inability to distinguish between species of *Kogia* raises concerns about the possibility of mortalities of 1 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; Bloodworth and Odell 2008). Sightings of these animals in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) occur primarily in oceanic waters (Figure 1; Mullin *et al.* 1991; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Ortega Ortiz 2002), pygmy sperm whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico pygmy and dwarf sperm whales is 186 (CV=1.04; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to

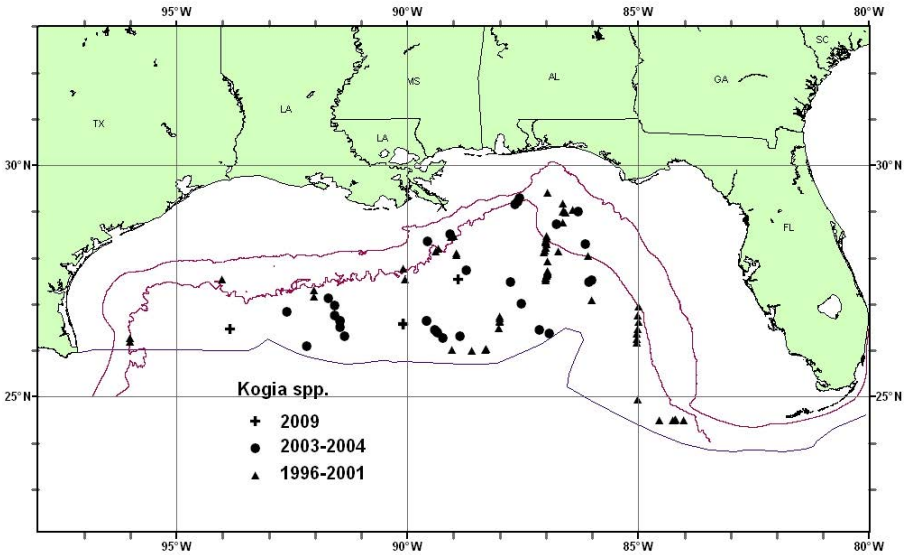

Figure 1. *Distribution of pygmy and dwarf sperm whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of dwarf and pygmy sperm whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 547 (CV=0.28) (Hansen *et al.* 1995), and for 1996 to 2001, 742 (CV=0.29) (Mullin and Fulling 2004; Table 1). 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, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. 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; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The estimate of abundance for dwarf and pygmy sperm whales in oceanic waters during 2009 was 186 (CV=1.04; Table 1).

Table 1. Summary of combined abundance estimates for northern Gulf of Mexico pygmy and dwarf sperm 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
Apr-Jun 1991-1994	Oceanic waters	547	0.28
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	742	0.29
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	453	0.35
Jun-Aug 2009	Oceanic waters	186	1.04

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 186 (CV=1.04). 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 90 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. Four point estimates of *Kogia* spp. abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly four. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. 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 (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 90. 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 0.9. It is not possible to determine the PBR for only pygmy sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury to this stock during 2006–2010 was 0.3 pygmy sperm whales (CV=1.0; Table 2).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to pygmy sperm whales by this fishery during 1998-2009 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010); however, during 2010, 1 mortality of a pygmy sperm whale (a portion of the carcass was retrieved and species identification was confirmed through genetic analyses) was observed during quarter 2 and estimated mortalities attributable to the pelagic longline fishery in the Gulf of Mexico region during quarter 2 were 1.2 (CV=1.00; Garrison and Stokes 2011). The total estimated mortality for 2010 was 1.2 animals (CV=1.0). The annual average serious injury and mortality attributable to the Gulf of Mexico pelagic longline fishery for the 5-year period from 2006 to 2010 was 0.3 animals (CV=1.0; Table 2).

Table 2. Summary of the incidental mortality and serious injury of northern Gulf of Mexico pygmy sperm whale (*Kogia breviceps*) 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	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	06-10	47, 55, 53, 47, 46	Obs. Data Logbook	.08, .14, .25, .21, .26	0,0,0,0,0	0,0,0,0,1	0,0,0,0,0	0,0,0,0,1.4	0,0,0,0,1.4	NA, NA, NA, NA,1.0	0.3 (1.0)
TOTAL											0.3 (1.0)

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). Observer coverage in the GOM is dominated by very high coverage rates during April-June associated with efforts to improve estimates of Bluefin Tuna bycatch.

Other Mortality

At least 14 pygmy sperm whale strandings were documented in the northern Gulf of Mexico during 2006–2010 (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). For 7 of the strandings, no evidence of human interactions was detected, and for the remaining 7, it could not be determined if there was evidence of human interactions. An additional 3 *Kogia* spp. stranded during 2006–2010. Evidence of human interactions was detected for 1 of the *Kogia* sp. strandings; it could not be determined if there was evidence of human interactions for the remaining 2 *Kogia* sp. strandings. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which

die or are seriously injured 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 1 animal from this stock was considered to be part of the UME.

Table 3. Pygmy sperm whale (*Kogia breviceps*) strandings along the northern Gulf of Mexico coast, 2006-2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	0[b]	0	0
Florida	1[a]	1	2	3[c,d]	0	7
Louisiana	0	0	0	0	1*	1
Mississippi	0	0	0	0	0	0
Texas	1	0	3	2	0	6
TOTAL	2	1	5	5	1	14

[a] 1 additional *Kogia* sp. stranded
[b] 1 *Kogia* sp. stranded
[c] Two of the animals were a mom/calf pair stranding together
[d] 1 additional *Kogia* sp. stranded
*This stranding is included in the Northern Gulf of Mexico UME

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an

animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. Despite an unknown PBR for this species, this is not a strategic stock because it is assumed that average annual human-related mortality and serious injury does not exceed combined PBR for dwarf and pygmy sperm whales. However, the continuing inability to distinguish between species of *Kogia* raises concerns about the possibility of mortalities of 1 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.* 2008). Sightings in the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico) have generally occurred in water depths >800m and west of Mobile Bay, Alabama (Figure 1; Mullin *et al.* 1994; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Ortega Ortiz 2002), melon-headed whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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

The best abundance estimate available for northern Gulf of Mexico melon-headed whales is 2,235 (CV=0.75; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

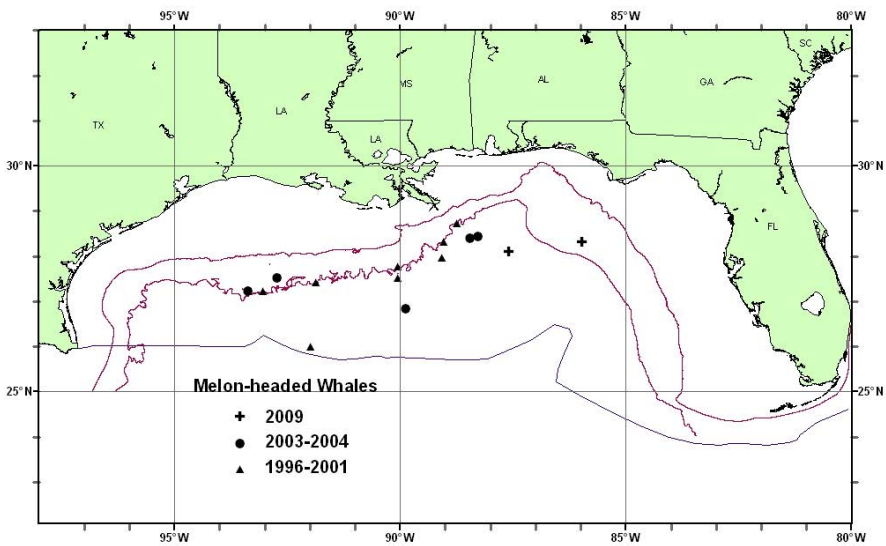

Figure 1. *Distribution of melon-headed whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of melon-headed whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 3,965 (CV=0.39) (Hansen *et al.* 1995), and for 1996 to 2001, 3,451 (CV=0.55) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for melon-headed whales,

pooled from 2003 to 2004, was 2,283 (CV=0.76) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for melon-headed whales in oceanic waters during 2009 was 2,235 (CV=0.75; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico melon-headed 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
Apr-Jun 1991-1994	Oceanic waters	3,965	0.39
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	3,451	0.55
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	2,283	0.76
Jun-Aug 2009	Oceanic waters	2,235	0.75

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 2,235 (CV=0.75). The minimum population estimate for the northern Gulf of Mexico is 1,274 melon-headed whales.

Current Population Trend

Four point estimates of melon-headed whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly two. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of melon-headed whale abundance. 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 (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 1,274. 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 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Fisheries Information

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell *et al.* 1976). The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to melon-headed whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011).

Other Mortality

There were 11 reported strandings of melon-headed whales in the Gulf of Mexico during 2006–2010 (Table 2; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). No evidence of human interactions was detected for 6 of these stranded animals, and for the remaining 5, it could not be determined if there was evidence of human 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, 2 animals from this stock were considered to be part of the UME.

Table 2. Melon-headed whale (*Peponocephala electra*) strandings along the northern Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	0	1*	1
Florida	0	0	0	0	0	0
Louisiana	0	0	0	0	1*	1
Mississippi	0	0	0	0	0	0
Texas	1	2	1	0	5	9
TOTAL	1	2	1	0	7	11

* This stranding is included in the Northern Gulf of Mexico UME

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the

spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known but none has been documented. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the average annual human-related mortality and serious injury does not exceed PBR.

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Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp.

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 (i.e., U.S. Gulf of Mexico) occur throughout oceanic waters but are concentrated in continental slope waters (Figure 1; Baumgartner 1997; Maze-Foley and Mullin 2006). 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).

Although there are only a few records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), Risso's dolphins almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

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 *et al.* 2009). During September 2007 – January 2008, tracking of an adult female Risso's dolphin that had been rehabilitated and released by Mote Marine Laboratory after stranding on the southwest coast of Florida documented movements throughout the northern Gulf of Mexico. The dolphin, released with its young calf, traveled as far as Bahia de Campeche, Mexico, and waters off Texas and Louisiana before returning to the shelf edge southwest of its stranding site off Florida (Wells *et al.* 2008a). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The best abundance estimate available for northern Gulf of Mexico Risso's dolphins is 2,442 (CV=0.57; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ.

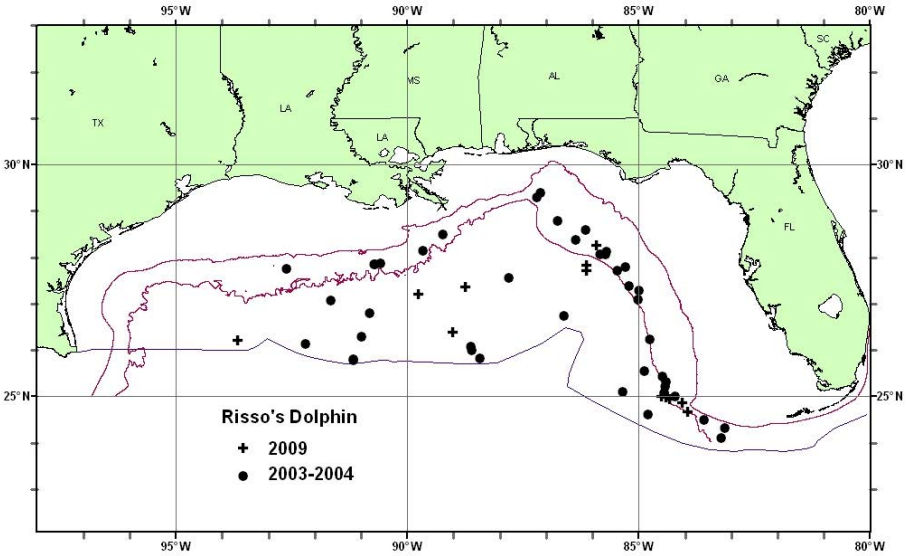

Figure 1. *Distribution of Risso's dolphin sightings from SEFSC vessel surveys during summer 2003 and spring 2004, and during summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100-m and 1,000-m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed

plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of Risso's dolphins for all surveys combined was estimated. For 1991 to 1994, the estimate was 2,749 (CV=0.27) (Hansen *et al.* 1995), and for 1996 to 2001, 2,169 (CV=0.32) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along a grid of uniformly-spaced transect lines from a random start. The abundance estimate for Risso's dolphins, pooled from 2003 to 2004, was 1,589 (CV=0.27) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for Risso's dolphins in oceanic waters during 2009 was 2,442 (CV=0.57; Table 1).

Table 1. Summary of abundance estimate for northern Gulf of Mexico Risso's 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
Apr-Jun 1991-1994	Oceanic waters	2,749	0.27
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	2,169	0.32
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	1,589	0.27
Jun-Aug 2009	Oceanic waters	2,442	0.57

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 2,442 (CV=0.57). The minimum population estimate for the northern Gulf of Mexico is 1,563 Risso's dolphins.

Current Population Trend

Four point estimates of Risso's dolphin abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly two. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of Risso's dolphin abundance. The 2 cases of satellite-linked tracking of Risso's dolphins in the Gulf of Mexico both showed movements out of the U.S. Gulf of Mexico EEZ (Wells *et al.* 2008a, 2009). 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 (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 1,563. 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 16.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury for this stock during 2006–2010 is 1.7 Risso's dolphins (CV=0.63; Table 2).

Fisheries Information

The commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to Risso's dolphins in the northern Gulf of Mexico by this fishery during 1998-2007 or during 2009-2010 (Yeung 1999; 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison and Stokes 2010; 2011). Between 2006 and 2010, 1 mortality and 2 serious injuries of Risso's dolphins were observed during interactions with the pelagic longline fishery. These interactions occurred during the first and second quarters of 2008 (Table 2; Garrison *et al.* 2009; Garrison and Stokes 2010; Garrison and Stokes 2011). For the 5-year period, the estimated annual combined serious injury and mortality attributable to the pelagic longline fishery in the northern Gulf of Mexico was 1.7 (CV=0.63). During 15 April – 15 June, in 2008-2010, observer coverage in the Gulf of Mexico was greatly enhanced to collect more robust information on the interactions between pelagic longline vessels and spawning bluefin tuna. Resulting observer coverage for this time and area is very high (approaching 55%). Therefore, the high observer coverage during 2008-2010 primarily reflects high coverage rates during the second quarter of the year. During 2005, 1 Risso's dolphin was observed entangled and released alive in the northern 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). There is a high likelihood that releases of dolphins that have ingested gear or with multi-wrap entanglements of appendages near their insertions will lead to mortality (Wells *et al.* 2008b).

Table 2. Summary of the incidental mortality and serious injury of northern Gulf of Mexico Risso's dolphins 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	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	06-10	47, 55, 53, 47, 46	Obs. Data Logbook	.08, .14, .25, .21, .26	0,0,2,0,0	0,0,1,0,0	0,0,3.9,0,0	0,0,4.4,0,0	0,0,8.3,0,0	NA,NA,.63,NA,NA	1.7 (0.63)
TOTAL											1.7 (0.63)

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). Observer coverage in the GOM is dominated by very high coverage rates during April-June associated with efforts to improve estimates of Bluefin Tuna bycatch.

Other Mortality

There were 10 reported strandings of Risso's dolphins in the Gulf of Mexico during 2006–2010 (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). This includes one mass stranding of 4 animals in Florida during May 2007 (2 were rehabilitated and released by Mote Marine Laboratory) and one mass stranding of 2 animals in Florida during January 2009. No evidence of human interactions was detected for 2 of the stranded animals, and it could not be determined if there was evidence of human

interactions for the remaining 8 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.

Since 1990, there have been 12 bottlenose dolphin die-offs or Unusual Mortality Events (UMEs) in the northern Gulf of Mexico, and 1 of these included a Risso's dolphin. Between August 1999 and May 2000, 152 bottlenose dolphins died coincident with *Karenia 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, *Mesoplodon densirostris*, and 4 unidentified dolphins. An UME was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see "Habitat Issues" below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

Table 3. Risso's dolphin (*Grampus griseus*) strandings along the northern Gulf of Mexico coast, 2006–2010.

STATE	2006	2007	2008	2009	2010	TOTAL
Alabama	0	0	0	0	0	0
Florida	0	6[a]	0	2[b]	0	8
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	1	1
Texas	0	0	0	1	0	1
TOTAL	0	6	0	3	1	10

[a] Includes Florida mass stranding of 4 animals in May 2007
[b] Includes Florida mass stranding of 2 animals in January 2009

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde's whales.

Aerial surveys have observed Risso's dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount, frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile

petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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 (i.e., U.S. Gulf of Mexico) occur primarily on the continental slope west of 89˚W (Figure 1; Mullin and Fulling 2004; Maze-Foley and Mullin 2006). 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).

Because there are many confirmed records from Gulf of Mexico waters beyond U.S. boundaries (e.g., Jefferson and Schiro 1997, Ortega Ortiz 2002), short-finned pilot whales almost certainly occur throughout the oceanic Gulf of Mexico (Jefferson *et al.* 2008), which is also composed of waters belonging to Mexico and Cuba where there is currently little information on cetacean species abundance and distribution. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. Exclusive Economic Zone (EEZ).

The Gulf of Mexico population is 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

The best abundance estimate available for northern Gulf of Mexico short-finned pilot whales is 2,415 (CV=0.66; Table 1). This estimate is from a summer 2009 oceanic survey covering waters from the 200m isobath to the seaward extent of the U.S. EEZ.

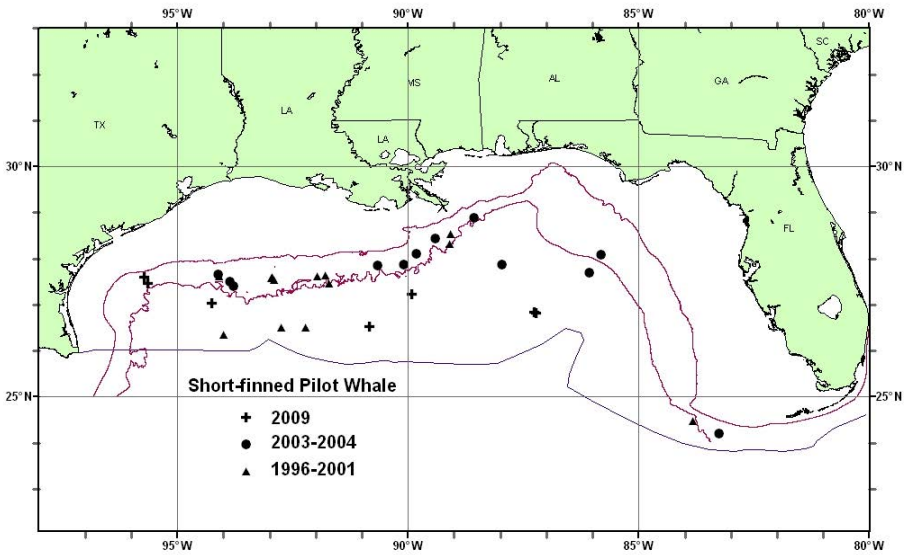

Figure 1. *Distribution of short-finned pilot whale sightings from SEFSC vessel surveys during spring 1996-2001, summer 2003 and spring 2004, and summer 2009. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the offshore extent of the U.S. EEZ.*

Earlier abundance estimates

All 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 line-transect survey data collected from ships in the oceanic northern Gulf of Mexico (i.e., 200m isobath to seaward extent of the U.S. EEZ) and are summarized in Appendix IV.

From 1991 through 1994, and from 1996 through 2001 (excluding 1998), annual surveys were conducted during spring along a fixed plankton-sampling trackline. Due to limited survey effort in any given year, the survey effort-weighted estimated average abundance of short-finned pilot whales for all surveys combined was estimated. For 1991 to 1994, the estimate was 353 (CV=0.89) (Hansen *et al.* 1995), and for 1996 to 2001, 2,388 (CV=0.48) (Mullin and Fulling 2004; Table 1).

During summer 2003 and spring 2004, surveys dedicated to estimating cetacean abundance were conducted along

a grid of uniformly-spaced transect lines from a random start. The abundance estimate for short-finned pilot whales, pooled from 2003 to 2004, was 716 (CV=0.34) (Mullin 2007; Table 1).

Recent survey and abundance estimate

During summer 2009, a line-transect survey dedicated to estimating the abundance of oceanic cetaceans was conducted in the northern Gulf of Mexico. Survey lines were stratified in relation to depth and the location of the Loop Current. The abundance estimate for short-finned pilot whales in oceanic waters during 2009 was 2,415 (CV=0.66; Table 1).

Table 1. Summary of abundance estimates for northern Gulf of Mexico short-finned pilot 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
Apr-Jun 1991-1994	Oceanic waters	353	0.89
Apr-Jun 1996-2001 (excluding 1998)	Oceanic waters	2,388	0.48
Jun-Aug 2003, Apr-Jun 2004	Oceanic waters	716	0.34
Jun-Aug 2009	Oceanic waters	2,415	0.66

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 2,415 (CV=0.66). The minimum population estimate for the northern Gulf of Mexico is 1,456 short-finned pilot whales.

Current Population Trend

Four point estimates of short-finned pilot whale abundance have been made based on data from surveys covering 1991-2009. The estimates vary by a maximum factor of nearly seven. To determine whether changes in abundance have occurred over this period, an analysis of all the survey data needs to be conducted which incorporates covariates (e.g., survey conditions, season) that could potentially affect estimates. Nevertheless, differences in temporal abundance estimates will still be difficult to interpret without a Gulf of Mexico-wide understanding of short-finned pilot whale abundance. 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 (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 1,456. 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 15.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality or serious injury of a short-finned pilot whale during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh

and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). However, during 2006 there was 1 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 commercial fishery which potentially could interact with this stock in the Gulf of Mexico is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the northern Gulf of Mexico. There were no reports of mortality or serious injury to short-finned pilot whales by this fishery during 1998-2010 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield-Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010; 2011). During 2006, 1 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 stranding events of short-finned pilot whales in the Gulf of Mexico during 2006–2010 (NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 16 November 2011). One short-finned pilot whale stranded during 2006 in Florida; no evidence of human interactions was detected for this animal. Four short-finned pilot whales mass stranded during 2008 in Florida; it could not be determined if there was evidence of human 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.

An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 February 2010; and, as of early 2012, the event is still ongoing. It includes cetaceans that stranded prior to the Deepwater Horizon oil spill (see “Habitat Issues” below), during the spill, and after. During 2010, no animals from this stock were considered to be part of the UME.

HABITAT ISSUES

The Deepwater Horizon (DWH) MC252 drilling platform, located approximately 50 miles southeast of the Mississippi River Delta in waters about 1500m deep, exploded on 20 April 2010. The rig sank, and for 87 days millions of barrels of oil and gas were discharged from the wellhead until it was capped on 15 July 2010. During the response effort dispersants were applied extensively at the seafloor and at the sea surface (Lehr *et al.* 2010; OSAT 2010). In-situ burning, or controlled burning of oil at the surface, was also used extensively as a response tool (Lehr *et al.* 2010). The oil, dispersant and burn residue compounds present ecological concerns. The magnitude of this oil spill was unprecedented in U.S. history, causing impacts to wildlife, natural habitats and human communities along coastal areas from western Louisiana to the Florida Panhandle (NOAA 2011). It could be years before the entire scope of damage is ascertained (NOAA 2011).

Shortly after the oil spill, the Natural Resource Damage Assessment (NRDA) process was initiated under the Oil Pollution Act of 1990. A variety of NRDA research studies are being conducted to determine potential impacts of the spill on marine mammals. These studies have focused on identifying the type, magnitude, severity, length and impact of oil exposure to oceanic, coastal and estuarine marine mammals. The research is ongoing and likely will continue for some time. For continental shelf and oceanic cetaceans, the NOAA-led efforts include: aerial surveys to document the distribution, abundance, species and exposure of marine mammals and turtles relative to oil from DWH spill; and ship surveys to evaluate exposure to oil and other chemicals and to assess changes in animal behavior and distribution relative to oil exposure through visual and acoustic surveys, deployment of passive acoustic monitoring systems, collection of tissue samples, and deployment of satellite tags on sperm and Bryde’s whales.

Aerial surveys have observed Risso’s dolphins, spinner dolphins, pantropical spotted dolphins, striped dolphins, bottlenose dolphins and sperm whales swimming in oil in offshore waters (NOAA 2010a). The effects of oil exposure on marine mammals depend on a number of factors including the type and mixture of chemicals involved, the amount,

frequency and duration of exposure, the route of exposure (inhaled, ingested, absorbed, or external) and biomedical risk factors of the particular animal (Geraci 1990; NOAA 2010b). In general, direct external contact with petroleum compounds or dispersants with skin may cause skin irritation, chemical burns and infections. Inhalation of volatile petroleum compounds or dispersants may irritate or injure the respiratory tract, which could lead to pneumonia or inflammation. Ingestion of petroleum compounds may cause injury to the gastrointestinal tract, which could affect an animal's ability to digest or absorb food. Absorption of petroleum compounds or dispersants may damage kidney, liver and brain function in addition to causing immune suppression and anemia. Long term chronic effects such as lowered reproductive success and decreased survival may occur (Geraci 1990; NOAA 2010b).

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. Total human-caused mortality and serious injury for this stock is not known. There is insufficient information available to determine whether the total fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because it is assumed that the 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. Marine mammal species with zero (0) observed SI&M are not shown in this table. (unk = unknown).

Category, Fishery, 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						
Harbor porpoise - after Take Reduction Plan	2006-2010	.04, .07, .05, .04, .17		514(.31), 395(.38), 666 (.48), 591(.23), 387(.30)	511(.17)	*
Atlantic white sided dolphin	2006-2010	.04, .07, .05, .04, .17		41(.71), 0, 81(.57), 0, 66(1.0)	38(.46)	*
Short-beaked common dolphin	2006-2010	.04, .07, .05, .04, .17		20(1.05), 11(0.94), 34(.77), 43(.77), 42 (.94)	30(.42)	529
Bottlenose dolphin (offshore)	2002-2006	.02, .03, .06, .07, .04		0, 0, 0, unk, unk	unk	566
Harbor seal	2006-2010	.04, .07, .05, .04, .17		87(.58), 93 (.49), 243(.41), 516(.28), 461(.30)	280(.17)	undet.
Gray seal	2006-2010	.04, .07, .05, .04, .17		248(.47), 889(0.24), 618(.23), 1063(.26), 1,115(.31)	794(.13)	unk
Harp seal	2006-2010	.04, .07, .05, .04, .17		65(.66), 119(.35), 238(.38), 415(.27), 253(.62)	218(.20)	unk
Gillnet Fisheries:US Mid-Atlantic gillnet						
Harbor porpoise - after Take Reduction Plan	2006-2010	.04, .06, .03, .03, 04		511(.32), 58(1.03), 350(.75), 201(.55), 257(.89)	275(.29)	*
Bottlenose dolphin (offshore)	2002-2006	.01, .01, .02, .03, .04		unk, 0, 0, unk, unk	unk	566
Short-beaked common dolphin	2006-2010	.04, .06, .03, .03, 04		11(1.03), 0, 0, 0, 31(.65)	8.4(.55)	529
Risso's dolphin	2006-2010	.04, .06, .03, .03, 04		0, 34(.73), 0, 0, 0	6.8(.73)	*
Harbor seal	2006-2010	.04, .06, .03, .03, 04		26 (.98), 0, 88(.74), 47(.68), 88(.41)	50(.34)	undet.
Harp Seal	2006-2010	.04, .06, .03, .03, 04		0, 38(.9), 176(.74), 70(.67), 32(.93)	63(.46)	unk
Gray Seal	2006-2010	.04, .06, .03, .03, 04		0, 0, 0, 0, 265(.76)	53(.76)	unk
Longline Fisheries: Pelagic longline (excluding NED-E)						
Risso's dolphin	2006-2010	.07, .07, .07, .10, .08	0, 9 (.65), 17(.73), 11(.71), 0	0, 0, 0, 0, 0	7.4(.71)	*

Long and short-finned pilot whale [a]	2006-2010	.07, .07, .07, .10, .08	212(.21), 169(.50), 57(.65), 98(.42), 17(.70)	0, 16 (1.0), 0, 0, 0	114 (.20)	172/93[c]
Short-beaked common dolphin	2006-2010	.07, .07, .07, .10, .08	0, 0, 0, 0, 0	0, 0, 0, 8.5(1.0), 0	1.7(1.0)	529
CATEGORY II						
Mid-Atlantic Mid-Water Trawl – Including Pair Trawl						
Risso's dolphin	2006-2010	.089, .039, .13, .13, .25	0, 0, 0, 0, 0	0, 0, 0.2 (unexpanded), 0, 0	0.2	*
White-sided dolphin	2006-2010	.089, .039, .13, .13, .25	0, 0, 0, 0, 0	29(.74), 12(.98), 15(.73), 4.3(.92), 0	12(0.45	*
Short-beaked common dolphin	2006-2010	.089, .039, .13, .13, .25	0, 0, 0, 0, 0	0, 3.2(.70), 0, 0, 0	0.6 (.70)	529
Long and short-finned pilot whale	2006-2010	.089, .039, .13, .13, .25	0, 0, 0, 0, 0	0, 0, 12 (.99), 0, 0	2.4(.99)	172/93[c]
Gray Seal	2006-2010	.089, .039, .13, .13, .25	0, 0, 0, 0, 0	0, 0, 0, 0, unk	unk	unk
Trawl Fisheries:Northeast bottom trawl						
Harp seal	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	unk, 0, 0, 0, unk	unk	unk
Harbor seal	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	unk, 0, unk, 0, unk, 0	0.8	undet.
Gray Seal	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	0, unk, unk, unk, unk	unk	unk
Long and short-finned pilot whale [a]	2005-2009	.12, .06, .06, .08, .09	0, 0, 0, 0, 0	15(.30), 14(.28), 12 (.35), 10(.34), 8.6(.35)	12(0.14)	172/93[c]
Short-beaked common dolphin	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	25(.28), 24(.28), 17(.29), 19(.30), 17(.28)	20 (.13)	529
Atlantic white-sided dolphin	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	164(.34), 147(.35), 147(.32), 131(.26), 119(.39)	142(.15)	*
Minke whale	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	3.7 (.73), 3.2(.72), 2.9(.73), 2.9(.75), 0	2.6(.46)	*
Harbor porpoise	2006-2010	.06, .06, .08, .09, .16	0, 0, 0, 0, 0	6.5(.49), 5.6(.46), 5.3(.47), 5.1(.50), 0	4.5(.30)	*
Mid-Atlantic Bottom Trawl						
Atlantic white-sided dolphin	2006-2010	.02, .03, .03, .05, .06	0, 0, 0, 0, 0	26(.25), 21(.24), 16(.18), 16(.16), 22(.14)	20(.09)	*
Long and short-finned pilot whale [a]	2005-2009	.03, .02, .03, .03, .05	0, 0, 0, 0, 0	31(.31), 37(.34), 36(.38), 24(.36). 23(.36)	30(.16)	172/93[c]
Short-beaked common dolphin	2006-2010	.02, .03, .03, .05, .06	0, 0, 0, 0, 0	131(.28), 66(.27), 108(.28), 104(.29), 104(.29)	103 (.13)	529
Risso's Dolphin	2006-2010	.02, .03, .03, .05, .06	0, 0, 0, 0, 0	0, 0, 0, 0, 3 (unexpanded)	3	*
Northeast Mid-Water Trawl Including Pair Trawl						

Long and short-finned pilot whale	2005-2009	.199, .031, .08, .20, .42	0, 0, 0, 0,0	0, 0, 0, 16(.61), 0	3.2(.61)	172/93[c]
Short-beaked common dolphin	2006-2010	.031, .08, .20, .42, .54	0, 0, 0,0 ,0	0, 0, 0,0 ,na	na	529
Harbor seal	2006-2010	.031, .08, .20, .42, .54	0, 0, 0,0 ,0	0, 0, 0, 1.3 (.81), na	0.7(.81)	undet.

NOTES:
* PBR under review.
a. As of 2010, the PBR for pilot whales has been split. Short-finned pilot whale PBR is 172 and long-finned pilot whale is 93.

Appendix II. Summary of the confirmed human-caused mortality and serious injury (SI) events involving baleen whale stocks along the Gulf of Mexico Coast, US East Coast, and adjacent Canadian Maritimes, 2006-2010, with number of events attributed to entanglements or vessel collisions by year.

Stock	**Mean annual mortality and SI rate** (PBR[1] for reference)	**Entanglements**			**Vessel Collisions**		
		Annual rate **(US waters / Canadian waters)**	**Confirmed mortalities** **(2005, 2006, 2007, 2008, 2009)**	**Confirmed SIs** **(2005, 2006, 2007, 2008, 2009)**	**Annual rate** **(US waters / Canadian waters)**	**Confirmed mortalities** **(2005, 2006, 2007, 2008, 2009)**	**Confirmed SIs** **(2005, 2006, 2007, 2008, 2009)**
Western North Atlantic right whale *(Eubalaena glacialis)*	**2.8** (0.9)	**1.8** (1.6/ 0.2)	(1, 1, 0, 0, 2)	(0, 0, 1, 2, 2)	**1.2** (0.8 / 0.4)	(4, 0, 0, 0, 1)	(1, 0, 0, 0, 0)
Gulf of Maine humpback whale *(Megaptera novaeangliae)*	**7.8** (2.7)	**5.8** (5.6 / 0.2)	(1, 1, 2, 2, 3)	(4, 2, 4, 3, 7)	**2.0** (2.0 / 0)	(3, 3, 1, 0, 3)	**0**
Western North Atlantic fin whale *(Balaenoptera physalus)*	This report is still under review.						
Nova Scotian sei whale *(B. borealis)*	This report is still under review.						
Western North Atlantic blue whale *(B. musculus)*	**0** (0.9)	**0**	**0**	**0**	**0**	**0**	**0**
Canadian East Coast minke whale *(B. acutorostrata)*	This report is still under review.						
Western North Atlantic Bryde's whale *(B. edeni)*	**0.2** (0.1)	**0**	**0**	**0**	**0.2** (0.2 / 0)	(0, 0, 0, 1, 0)	**0**

[1] Potential Biological Removal (PBR)

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 2012 List of Fisheries, is published in the *Federal Register*, (76 FR 73912;November 29, 2011). 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 6-9 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. Prior to 2007, this was a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program was funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. In 2007, the observer program was expanded, and it became mandatory for fishing vessels to take an observer if selected. The program now includes more systematic sampling of the fleet based upon reported landings and effort patterns. The total level of observer coverage for this program is approximately 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.

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 from Maine through 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 automatically registered under the Marine Mammal Authorization Program (MMAP) in order to lawfully take a non-endangered/threatened marine mammal incidental to fishing operations. These fishermen are required to carry an Authorization Certificate onboard while participating in the listed fishery and must be prepared to carry a fisheries observer if selected. All vessel owners, regardless of the category of fishery they are operating in, are required to report, within 48 hours of the incident even if an observer has recorded the take, 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 the Marine Mammal 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. Reporting forms are available online at http://www.nmfs.noaa.gov/pr/pdfs/interactions/mmap_reporting_form.pdf.

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; Canadian Department of Fisheries and Oceans (DFO)); and members of the Atlantic Large Whale Disentanglement Network.. These data, photographs, etc. are maintained by the Protected Species Division at the Northeast Regional Office (NERO), the Protected Species Branch at the Northeast Fisheries Science Center (NEFSC) and the Southeast Fisheries Science Center (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 generated 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.

9. Northeast At Sea Monitoring Program

At-sea monitors collect scientific, management, compliance, and other fisheries data onboard commercial fishing vessels through interviews of vessel captains and crew, observations of fishing operations, photographing catch, and measurements of selected portions of the catch and fishing gear. At-sea monitoring requirements are detailed under Amendment 16 to the NE Multispecies Fishery Management Plan with a planned implementation date of May 1st, 2010. At-sea monitoring coverage is an integral part of catch monitoring to ensure that Annual Catch Limits are not exceeded. At-sea monitors collect accurate information on catch composition and the data are used to estimate total discards by sectors (and common pool), gear type, and stock area. Coverage levels are expected around 30%.

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 2010, 1,266 federal northeast permit holders identified sink gillnet as a potential gear type.

Number of Active Permit Holders: In 2010, 233 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 2010 were 22,933, 18,681, 14,487, 14, 634, 15,201, 17,680, 19,080, 15.390, 14,950, 15,808, 18,808, 17,207, and 18,170 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, and 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 2006 to 2010, 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 is defined as a Category I fishery, and both the Northeast anchored float and Northeast drift gillnet fisheries as Category II fisheries, in the 2012 List of Fisheries 76 FR 73912;November 29, 2011). This gear is addressed by several federal and state FMPs that range North and East of the 72 degree 30 min line; the Atlantic Large Whale Take Reduction Plan (ALWTRP) and Harbor Porpoise Take

Reduction Plan (HPTRP). This fishery operates from the U.S./Canada border to Long Island, NY, at 72º 30' W long. south to 36º 33.03'N lat (corresponding with the Virginia-North Carolina border) and east to the eastern edge of the EEZ, excluding Long Island Sound or other waters where gillnet fisheries are listed as Category II or III. 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 1990-2010, estimated percent 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, 4, 7, 5, 4 and 17 respectively.

Comments: Effort patterns in this fishery are heavily influenced by fish time/area closures, and gear restrictions due to fish conservation measures, time/area closures and gear restrictions under the ALWTRP, and seasonal pinger requirements and time/area closures under the 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, humpback whale,minke whale, North Atlantic right whale and common dolphin were reported in this fishery. 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 percent 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 bottlenose dolphin, common dolphin, fin whale, gray seal, harbor porpoise, harbor seal, harp seal, hooded seal, humpback whale, minke whale, North Atlantic right whale, Risso's dolphin, white-sided dolphin and sea birds were reported in this fishery.

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 2010, 640 federal mid-Atlantic permit holders identified sink gillnet as a potential gear type.

Number of Active Permit Holders: In 2010, approximately 207 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 2010 were 15,494, 19,130, 16,333, 14,855, 13,389, 13,107, 15,124, 12, 994, 8,755, 9,359, 8,622, 8,703, and 10,725 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: This fishery operates year-round, extending from New York to North Carolina, not including waters where Category II and III inshore gillnet fisheries operate in bays, sounds, estuaries, and rivers. It is comprised of a combination of small vessels that target a variety of fish species. This fishery includes any residual large pelagic driftnet effort in the mid-Atlantic, shark and dogfish gillnet effort in the mid-Atlantic, and those North Carolina small and large mesh beach-anchored gillnets formerly placed in the Category II Mid-Atlantic haul/ beach seine fishery in the mid-Atlantic zone described. This fishery can be prosecuted right off the beach (6 feet) or in nearshore coastal waters to offshore waters (250 feet). The eastern boundary of this fishery is a line drawn at 72° 30' W long. from Long Island south to 36º 33.03' N lat., then east to the EEZ, and then south to the North Carolina/South Carolina border. The area does not include waters where Category II and III inshore gillnet fisheries operate in bays, estuaries, and rivers.Figures 6-10 document the distribution of sets and marine mammal interactions observed from 2006 to 2010 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 8,400 feet. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Mid-Atlantic Gillnet Fishery is defined as a Category I fishery in the 2012 List of Fisheries 76 FR 73912;November 29, 2011).. This gear is addressed by several federal FMPs, Inter-State Fishery Management Plans (ISFMP's) managed by the Atlantic States Marine Fisheries Commission (ASMFC), the ALWTRP, the HPTRP, and the Bottlenose Dolphin TRP (BDTRP). 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 1995-2010, the estimated percent observer coverage was 5, 4, 3, 5, 2, 2, 2, 1, 1, 2, 3, 4, 4, 3, and 3 and 4 respectively.

Comments: Effort patterns in this fishery are heavily influenced by marine mammal time/area closures and /or gear restrictions under the ALWTRP, HPTRP, and BDTRP; and gear restrictions due to fish conservation measures.

Protected Species Interactions: Documented interactions with harbor porpoise, white-sided dolphin, harbor seal, gray seal, harp seal, estuarine bottlenose dolphin, coastal bottlenose dolphin, offshore bottlenose dolphin, common dolphin, minke whale (Canadian East Coast stock), humpback whale (Gulf of Maine stock), Risso's dolphin, white- sided dolphin and long-finned and short-finned pilot whale were reported in this fishery. Not mentioned here are possible interactions with sea turtles and sea birds and interactions with large whale species in which the gear may not be

identified to a specific area or gear.

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 2010, 818 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 2010, approximately 359 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 2010 was 27,521, 26,525, 24,362, 27,890, 28,103, 25,725, 22,303, 15,070, 12,457, 11,279, 10,785, 10,497, and 10,849 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 2010 was 373, 278, 262, 102, 175, 310, 238, 231, 0, 117, 88, 0, 66 and 19 respectively (NMFS). Total effort, measured in trips, for the *Illex* Squid Fishery from 1998 to 2010 was 412, 141, 108, 51, 39, 103, 445, 181, 159, 103, 172, 177 and 231respectively (NMFS). Total effort, measured in trips, for the *Loligo* Squid Fishery from 1998 to 2010 was 1,048, 495, 529, 413, 3,585, 1,848, 1,124, 1,845, 3,058, 2,137, 2,578, 2,234 and 2.039 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 2006 to 2010 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 is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011). There are at least two 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. Mid-Atlantic Bottom Trawl Fisheries are all included in the Atlantic Trawl Gear Take Reduction Strategy which recommends voluntary measures to reduce incidental interactions with marine mammals.

Observer Coverage: During the period 1996-2010, estimated percent 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, 2, 3, 3, 5 and 5 respectively.

During the period 1996-2010, estimated percent observer coverage (trips) in the *Illex* Fishery was 3.7, 6.21, 0.97, 2.84, 11.11, 0, 0, 8.74, 5.07, 6, 15, 14, 5, 10 and 14 respectively. During the period 1996-2010, estimated percent 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, 3, 2, 2, 7 and 8 respectively. During the period 1997-2010, estimated percent 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, 3, 2, 0, 8 and 11 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 harbor seal, common dolphin, long-finned pilot whale, short-finned pilot whale, Risso's dolphin, offshore bottlenose dolphin, and white-sided dolphin were reported in this fishery. 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 2010, 1,227 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 2010, 218 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 Northeast Bottom Trawl Fishery from 1998 to 2010 was 13,263, 10,795, 12,625, 12,384, 12,711, 11,577, 10,354, 10,803, 8,603, 8,950, 8,900 and 6,791 respectively (NMFS).

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 2006 to 2010 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 is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011). This gear is managed by several federal and state FMPs that range from Maine to Connecticut and included in the Atlantic Trawl Gear Take Reduction Strategywhich recommends voluntary measures to reduce incidental interactions with marine mammals. 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 addressed 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 1994-2010, estimated percent observer coverage (measured in trips) was 0.4, 1.1, 0.2, 0.2, 0.1, 0.3, 1.0, 1.0, 3, 4, 5, 12, 6, 6, 8, 9 and 16 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 offshore bottlenose dolphin, common dolphin, harbor porpoise, gray seal, harbor seal, harp seal, long-finned pilot whale, short-finned pilot whale, Risso's dolphin and white-sided dolphin were reported in this fishery. 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 2010, 698 federal Northeast permit holders identified mid-water trawl as a potential gear type.

Number of Active Permit Holders: In 2010, 14 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 is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011). 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. Northeast Mid-Water Trawl Fishery is included in the Atlantic Trawl Gear Take Reduction Strategy which recommends voluntary measures to reduce incidental interactions with marine mammals..

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 2006 to 2010 respectively.

Total Effort: Total effort, measured in trips, for the Northeast Mid-Water Trawl Fishery (across all gear types) from 1997 to 2010 was 578, 289, 553, 1,312, 2,404, 1,736, 2,158, 1,564, 717, 590, 286, 236, 236 and 294 respectively (NMFS).

Observer Coverage: During the period 1997-2010, estimated percent observer coverage (trips) was 0, 0, 0.73, 0.46, 0.06, 0, 2.25, 11.48, 19.9, 3.1, 8.04, 19.92, 42 and 53 respectively. Observer coverage for 2010 includes both observers and at-sea monitors. 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 harbor seal, long-finned pilot whale, short-finned pilot whale, and white-sided dolphin were reported in this fishery. 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 2010, 498 federal mid-Atlantic permit holders identified mid-water trawl as a potential gear type.

Number of Active Permit Holders: In 2010, 17 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 is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011). This fishery is included in the Atlantic Trawl Gear Take Reduction Strategy which recommends voluntary measures to reduce incidental interactions with marine mammals.

Temporal and Spatial Distribution: Figures 26-30 document the distribution of tows and marine mammal interactions observed from 2006 to 2010 respectively.

Total Effort:. Total effort, measured in trips, for the Mid-Atlantic Mid-Water Trawl Fishery (across both gear types) from 1997 to 2010 was 331, 223, 374, 166, 408, 261, 428, 360, 359, 405, 312, 255, 280 and 173 respectively (NMFS).

Observer Coverage:. During the period 1997-2010, estimated percent observer coverage (trips) was 0, 0, 1.01, 8.43, 0, 0.77, 3.50, 12.16, 8.40, 8.90, 3.85, 13.33, 13.2 and 25 respectively. Observer coverage for 2010 includes both observers and at-sea monitors.

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 offshore bottlenose dolphin, common dolphin, long-finned pilot whale, Risso's dolphin, short-finned pilot whale and white-sided dolphin were reported in this fishery. 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 were reported in this fishery. Right whales are also vulnerable to entrapment, though very rarely.

Gulf of Maine Atlantic Herring Purse Seine Fishery

Target Species: Atlantic Herring.

Number of Permit Holders: In 2010, 365 northeast federal permit holders identified herring purse seine as a potential gear type.

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 2010 there were 11 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 is defined as a Category III fishery in the 2010 List of Fisheries (74 FR 58859, November 16, 2009).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 2006 to 2010, respectively.

Total Effort: Total metric tons of fish landed from 1998 to 2010 were 24,256, 39,866, 29,609, 20,691, 20,096, 17,939, 19,958, 16,306, 18,700, 31,019, 27,327, 22,547, and 8,566 respectively (NMFS, Unpbl.). Total effort, measured in trips, for the Gulf of Maine Atlantic Herring Purse Seine Fishery from 2002 to 2010 was 343, 339, 276, 202, 173, 249, 344, 249, 228 and 242 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 2010, percent observer coverage was 0.34, 9.8, 0.27, 0, 3.2, 12, 21 and 12 respectively.

Protected Species Interactions: Documented interactions with humpback whale, fin/sei whale, minke whale, harbor porpoise, harbor seal, gray seal and white-sided dolphin have been reported in this fishery, though generally the animals have been released from the net unharmed.

Northeast/Mid-Atlantic American Lobster Trap/Pot

Number of Permit Holders: In 2010, approximately 3,147 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 water.

Total Effort: American lobster is the most valuable fishery in the eastern US, with total landings of 116.9 million lbs. valued at $401.7 million in 2010. Combined landings from Maine and Massachusetts vessels comprised 93% of the landings for 2010, with Maine landing 96.2 million lbs. in 2010. 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.

Management and Regulations: 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. 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).

Temporal and Spatial Distribution: 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. 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.

Protected Species Interactions: harbor seal, humpback whale, minke whale, North Atlantic right whale.

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: < 100

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 for the entire Atlantic Ocean not including the Gulf of Mexico was 163. This declined to an annual average of 72 for the period between 2001 and 2007. Seventy-seven vessels reported pelagic

longline effort in the Atlantic during 2008. 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 2007, a mean of 4,551 sets (3.19 million hooks) was reported each year. During 2008, the total reported fishing effort in the Atlantic Ocean component of the fishery was 5,684 sets and 4.16 million hooks (Garrison *et al.* 2009).

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 2008, the majority of fishing effort in the Atlantic was reported in the Mid-Atlantic Bight (Virginia to New Jersey, 1,911 sets) and the South Atlantic Bight (Georgia to North Carolina, 1,126 sets) fishing areas (Garrison *et al.* 2009).

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 in the 2012 List of Fisheries (76 FR 73912;November 29, 2011). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP, 50 CFR Part 635) and the Pelagic Longline Take Reduction Plan. 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. As of 2009, the fishery also became managed under the Pelagic Longline Take Reduction Plan (http://www.nmfs.noaa.gov/pr/pdfs/fr/fr74-23349.pdf).

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. Between 2000 and 2010, observer coverage as a percentage of reported sets in the Atlantic component of the fishery was 4, 7, 9, 6, 7, 7, 7, 10, and 8. Observed longline sets and marine mammal interactions are shown for 2006-2010 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, Garrison *et al.* 2009). 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 (http://www.nmfs.noaa.gov/pr/pdfs/fr/fr74-23349.pdf).

Protected Species Interactions: Documented interactions with Risso's dolphin, long-finned pilot whale, short-finned pilot whale, common dolphin, Atlantic spotted dolphin, pantropical spotted dolphin, bottlenose dolphin, dwarf or pygmy sperm whale, pygmy sperm whale, sperm whale, killer whale, Cuvier's beaked whale, Mesoplodon beaked whale, and northern bottlenose whale were reported in this fishery. 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

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. In the reported logbook data, it is difficult to identify these different gear types and distinguish sets targeting sharks from those targeting finfish. 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. In 2007, a total of 85 drift net sets were observed with 4 of those targeting sharks and the remainder Spanish mackerel. A total of 112 sink net sets were observed, with 60 of those targeting sharks and the remainder targeting various fish species (Baremore *et al.* 2007). During 2008, there was very limited targeted fishing for sharks off the coast of Florida due to the closure of the large coastal shark fishery during the first half of the year, and there were no strike sets observed targeting sharks and only a few sink sets (Passerotti and Carlson 2009).

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 under the ALWTRP off the coast of Georgia (from 32° N latitude) and Florida to 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 under the ALWTRP to include the area between 32° N latitude west of 80° W longitude and within 35 nautical miles of the South Carolina coast (Southeast U.S. Restricted Area North) with a closure to all gillnet gear from November 15 to April 15. 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 fishing for shark is permitted with limited exemptions if special provisions are met (72 FR 34632, June 25, 2007).

Gear Characteristics: Historically, shark drift gillnet fishing was characterized by large-mesh (5-10 inches) nets that were typically greater than 1500 feet long with 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). Likewise, large mesh, long soak-time drift net fishing has largely ended. Drift gillnets targeting sharks (observed off the coast of North Carolina) are of much shorter duration with total fishing times averaging less than 3 hours (Passerotti and Carlson 2009).

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 in the 2012 List of Fisheries (76 FR 73912;November 29, 2011). 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) and the Bottlenose Dolphin Take Reduction Plan (BDTRP). The ALWTRP includes seasonal restriction of gillnet fishing in the Southeast U.S. Restricted Area North, special provisions for shark gillnet 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 for shark gillnets with webbing of 5" or greater stretched mesh in the newly created Southeast U.S. Monitoring Area (72 FR 57104, October 5, 2007) , and restrictions on setting shark gillnets with webbing of 5" or greater stretched mesh 3 nm from large whales in the newly created Other Southeast Gillnet Waters. 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 percent annual observer coverage of the drift gillnet fishery was 68, 85, 50, 66, 58, and 48, respectively. The percent 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). Due to these uncertainties, and continuing changes in the execution and observer coverage of the fishery, effort levels for the fishery and estimated observer coverage for 2007 and 2008 are not available. 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 were reported in this fishery. 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

Target Species: Atlantic blue crab

Number of Permit Holders: As of 2011, the fishery was estimated to have approximately 7,734 permits. This is likely an overestimate due to the fact that the state of Florida does not differentiate permits for blue crab between the Gulf and Atlantic coast.

Temporal and Spatial Distribution: The fishery occurs year-round from the south shore of Long Island at 72° 30'W. long. in the Atlantic and east of the fishery management demarcation line between the Atlantic Ocean and the Gulf of Mexico (50 CFR 600.105), including estuarine and nearshore coastal waters throughout the mid and south Atlantic.

Gear Characteristics: 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.

Management and Regulations: The fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912; November 29, 2011). It is managed under state Fishery Management Plans, the Bottlenose Dolphin Take Reduction Plan, and Atlantic Large Whale Take Reduction Plan.

Protected Species Interactions: Bottlenose dolphin, Northern North Carolina (NC) Estuarine System; Bottlenose dolphin, Southern NC Estuarine System; Bottlenose dolphin, Charleston Estuarine System; Bottlenose dolphin, Northern Georgia (GA)/Southern South Carolina (SC) Estuarine System; Bottlenose dolphin, Southern GA Estuarine System; Bottlenose dolphin, Jacksonville Estuarine System; Bottlenose dolphin, Indian River Lagoon Estuarine System; Bottlenose dolphin, Northern Migratory Coastal; Bottlenose dolphin, Southern Migratory Coastal; Bottlenose dolphin, Northern Florida (FL) Coastal; Bottlenose dolphin, Central FL Coastal; Bottlenose dolphin, SC/GA Coastal; West Indian manatee, FL

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 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; however, based on stranding data from 2004-2008, there have been 13 reports of interactions between bottlenose dolphins and blue crab trap/pot gear, and 4 interactions that were a result of pot fisheries that could not be definitively identified to a specific fishery.

Mid-Atlantic Haul/Beach Seine

Target Species: Striped bass, mullet, spot, weakfish, sea trout, bluefish, kingfish, and harvestfish.

Number of Permit Holders: 874

Temporal and Spatial Distribution: The fishery occurs in waters west of 72° 30′ W. long. and north of a line extending due east from the North Carolina/South Carolina border.

Gear Characteristics: This fishery uses seines with one end secured (e.g., swipe nets and long seines); both ends secured; or those anchored to hauled up on the beach. The beach seine system is generally constructed of a wash, wing, and bunt that are attached to the beach and extend into the surf and are traditionally used to encircle or encompass fish. The only haul/beach seine gear operating in North Carolina included in this Category II fishery is the ‘‘Atlantic Ocean striped bass beach seine fishery’’ during the winter, as regulated by North Carolina Marine Fisheries Commission rules (NCDMF) and NCDMF proclamations. NCDMF defines a beach seine operating under the Atlantic Ocean Striped Bass beach seine fishery as a ‘‘swipe net constructed of multifilament, multifiber webbing fished from the ocean beach that is deployed from a vessel launched from the ocean beach where the fishing operation takes place, and one end of the beach seine is attached to the shore at all times during the operation.’’

Observer Coverage: North Carolina beach-based fishing has been observed since April 7, 1998 by the NMFS Fisheries Sampling Program (Observer Program) based at the NEFSC. The numbers of observed beach seine sets from 1998 to 2008 were 63, 60, 52, 12, 6, 23, 36, 29, 9, 27, and 39.

Management and Regulations: The fishery is managed under several state and Interstate Fishery Management Plans and is an affected fishery under the BDTRP. Large mesh nets are regulated in North Carolina via North Carolina Marine Fisheries Commission rules and NCDMF proclamations. The fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912; November 29, 2011).

Protected Species Interactions: Bottlenose dolphin, Northern North Carolina Estuarine System; Bottlenose dolphin, Northern Migratory Coastal; Bottlenose dolphin, Southern Migratory Coastal.

North Carolina Inshore Gillnet Fishery

Target Species: Include, but are not limited to southern flounder, weakfish, bluefish, Atlantic croaker, striped mullet, spotted seatrout, Spanish mackerel, striped bass, spot, red drum, black drum, and shad.

Number of Permit Holders: 2,250

Temporal and Spatial Distribution: This fishery includes any gillnet effort for any target species inshore of the COLREGS demarcation lines in North Carolina (COLREGS demarcation lines delineate those waters upon which mariners shall comply with the International Regulations for Preventing Collisions at Sea and those waters upon which mariners shall comply with the Inland Navigation Rules).

Gear Characteristics: This fishery includes any fishing effort using any type of gillnet gear, including set (float and sink), drift, and runaround gillnet.

Observer Coverage: Observer coverage, up to 10% in some cases, is provided by the North Carolina Division of Marine Fisheries, primarily during the fall flounder fishery in Pamlico Sound. The Northeast Fishery Observer Program has observed the fishery at low levels, as well as the North Carolina Alternative Platform Observer Program.

Management and Regulations: This fishery is managed under state and Interstate Fishery Management Plans, applying net and mesh size regulations, and seasonal area closures in the Pamlico Sound Gillnet Restricted Area. It is an affected fishery under the BDTRP. The fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912; November 29, 2011).

Protected Species Interactions: Bottlenose dolphin, Northern North Carolina Estuarine System; Bottlenose dolphin, Southern North Carolina Estuarine System.

North Carolina Long Haul Seine

The Long Haul Seine is an estuarine fishery operating in North Carolina waters with 372 permits. The fishery includes fishing with long haul seine gear to target any species in waters off North Carolina, including estuarine waters in Pamlico and Core Sounds and their tributaries. 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 estuarine and coastal bottlenose dolphins have been reported. The fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011)and is managed under the Bottlenose Dolphin Take Reduction Plan.

North Carolina Roe Mullet Stop Net

The Stop Net Fishery is unique to Bogue Banks, North Carolina with approximately 13 participants. 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 estuarine and coastal bottlenose dolphins have been reported; however, the total number of interactions has not been estimated. There has not been Federal observer coverage in this fishery; however, the NMFS Beaufort laboratory observed this fishery in 2001-2002. The fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011) and is managed under the Bottlenose Dolphin Take Reduction Plan.

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, Spanish mackerel, Bluefish,and Croaker. There has not been formal observer coverage in this fishery; however, the Northeast Fishery Observer Program (NEFOP) has monitoring and characterization that occurs sporadically in this fishery. As of 2011, the fishery was estimated to have approximately 66 permits. In 2004 and 2005 an experimental fishery was conducted in an area of the Chesapeake Bay that was closed to commercial pound net fishing effort from May to July for sea turtle conservation. The results from these studies determined a modified pound net leader could be used for pound net fishing while providing sea turtle conservation benefits. Occasional interactions with coastal bottlenose dolphins have been observed while monitoring for sea turtle interactions in both the commercial and experimental fisheries. Three takes of coastal bottlenose dolphins

were observed in 2003, 2004, and 2009. Stranded bottlenose dolphins have also shown evidence of interactions with pound nets. From 2002 to 2009, 21 bottlenose dolphins were removed dead from Virginia pound nets, and 4 dolphins were disentangled alive (Sue Barco, Virginia Aquarium). 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. A recent study conducted by Barco *et al.* in 2009 examined the use of modified pound net leaders adopted for sea turtle conservation because they believed it would also be effective in reducing bottlenose dolphin interactions in pound net leads. The study took place in the lower Chesapeake Bay and evaluated the effect of modified pound net leaders on finfish bycatch to ensure it maintained catch efficiency. Results show modified pound net leaders had similar or greater catches of finfish compared to traditional leaders (e.g., leaders that were not modified for sea turtle conservation). The fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011) and is managed under the Bottlenose Dolphin Take Reduction Plan.

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. As of 2011, there are 56 participants. 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. Large vessels (up to 200 ft) carrying two small purse seine boats are used for fishing effort, with some smaller vessels (called snapper rigs) about 60-75 feet in length. Schools of menhaden are generally spotted from larger vessels and/or spotter planes. The purse seine is deployed over the school vertically from the large vessel or the two smaller boats. The net floatline and leadline has a series of rings threaded with a purse line that is winched closed around the school, and the net is retrieved by power block. The purse seine net is made of nylon fiber with a bar mesh from ¾ to 7/8 inch (about 1-3/4 inch stretched mesh). Net length ranges from 1,000-1,400 feet, with a net dept averaging 65-90 feet. Occasional interactions with coastal bottlenose dolphins have been recorded historically in this fishery. In 2008 and 2009, there was very limited observer coverage; however, there was no systematic coverage prior to these years and the level of incidental interactions with marine mammals is undocumented. The Mid-Atlantic Menhaden Purse Seine Fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011) and is affected under the Bottlenose Dolphin Take Reduction Plan.

Southeastern U.S. Atlantic/Gulf of Mexico Shrimp Trawl

The Shrimp Trawl Fishery operates from North Carolina through the Texas coast 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). As of 2010, there were an estimated 5,000 participants. The most commonly employed gear in this fishery is a double-rig otter trawl, which normally includes a lazy line attached to each bag's codend. The lazy line floats free during active trawling, and as the net is hauled back, it is retrieved with a boat- or grappling-hook to assist in guiding and emptying the trawl nets. Shrimp trawl soak time is about three hours. 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 was historically very sparse and non-systematic. However, in 2007, the observer coverage expanded and became mandatory for fishing vessels to take an observer if selected. Observer coverage currently averages about 1% of the total fishery effort. Occasional interactions with bottlenose dolphins have been observed in the Atlantic and Gulf of Mexico, and there is infrequent evidence of interactions from stranded animals. NMFS observed 12 dolphin takes (of which 11 were serious injuries or mortalities) since 1993; 11 of which were taken since 2002. Further, Marine Mammal Authorization Program (MMAP) records list 1 dolphin take in shrimp trawl gear in South Carolina in 2002. Lastly, 13 dolphin takes, 10 of which were taken since 2002, have been documented by NMFS in Southeast U.S. research trawl operations, and/or relocation trawls conducted. The Shrimp Trawl fishery is defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011), and is therefore, affected under the Bottlenose Dolphin Take Reduction Plan in the Atlantic portion of its range.

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., Risso's 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 35N to 41N and 69W to 72W. Approximately 50% of the total effort was within a one degree square at 39N, 72W, 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. Prior to 2007, this was a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program was funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. In 2007, the observer program was expanded, and it became mandatory for fishing vessels to take an observer if selected. The program now includes more systematic sampling of the fleet based upon reported landings and effort patterns. 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. 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 automatically registered under the Marine Mammal Authorization Program (MMAP) in order to lawfully take a non-endangered/threatened marine mammal incidental to fishing operations. These fishermen are required to carry an Authorization Certificate onboard while participating in the listed fishery and must be prepared to carry a fisheries observer if selected. All vessel owners, regardless of the category of fishery they are operating in, are required to report, within 48 hours of the incident even if an observer has recorded the take, 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 the Marine Mammal 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. Reporting forms are available online at http://www.nmfs.noaa.gov/pr/pdfs/interactions/mmap_reporting_form.pdf.

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: <100

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 64 for the period between 2001 and 2007. The total number of fishing vessels reporting effort in the Gulf of Mexico during 2008 was 53, 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. Between 2001 and 2007, a mean of 4,522 sets (3.40 million hooks) was reported each year. During 2008, the total reported fishing effort in the Gulf of Mexico component of the fishery was 3,246 sets and 2.39 million hooks (Garrison *et al.* 2009).

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's 2012 LOF due to frequently observed interactions with marine mammals ((76 FR 73912;November 29, 2011). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (Highly Migratory Species FMP, 50 CFR Part 635) and the Pelagic Longline Take Reduction Plan implementing regulations (74 FR 23349, May 19, 2009). 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 2007, percent observer coverage of reported sets in the Gulf of Mexico component of the fishery was 4, 4, 3, 5, 5, 7, 8, and 16. Observer coverage in the Gulf of Mexico during 2008 was 24.8% of reported sets. This high coverage rate reflects significantly elevated coverage during the second quarter (58.2%) associated with increased observer effort to document bluefin tuna interactions (Garrison *et al.* 2009). Observed longline sets and marine mammal interactions in the Gulf of Mexico are shown for 2006-2010 in Figures 41 through 45.

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). There have been more interactions with marine mammals observed recently in association with the very high observer coverage between April and June.

Protected Species Interactions: Gulf of Mexico stocks of Risso's dolphin, pantropical spotted dolphin, Atlantic spotted dolphin, pilot whales, pygmy sperm whales, unidentified beaked whales, sperm whales, killer whales, and offshore bottlenose dolphin.

Spiny Lobster Trap/Pot Fishery

Target Species: Caribbean spiny lobster (*Panulirus argus*), smooth tail spiny lobster (*Panulirus lauvicauda*) and spotted spiny lobster (*Panulirus guttatus*). These species are commonly referred to as crawfish.

Number of Permit Holders: As of May 19, 2009, there were 1,268 State of Florida issued spiny lobster permits (A. Herndon, NMFS, pers. comm., 2010). There are no federal permits for this fishery since the State of Florida issues permits that are also valid in federal waters.

Number of Active Permit Holders: The number of spiny lobster endorsements or licenses (also known as trap numbers) required for any person using traps to harvest spiny lobster in commercial quantities (F.A.C. Chapter 68B-24.0055(1) Florida Statutes) in state waters has declined from nearly 2,500 licenses in the 1998-1999 season to 1,241 licenses for the 2007-2008 season. In state waters, recreational fishers wishing to use traps to harvest spiny lobster are required to have a Special Recreational Crawfish License (SRCL). The number of SRCL holders has also decreased from over 350 licenses in the 1998-1999 season to approximately 200 in the 2007-2008 season.

Total Effort: Over the last 10 years, commercial trap fishing has been the dominant gear type in the spiny lobster

fishery, accounting for approximately 70 percent of all commercial landings (Robson 2006). The remaining landings are collected via divers by hand or via bully nets (which accounts for only a very small percentage). A trap limitation program initiated by the State of Florida in 1993 has reduced the number of lobster traps available annually from approximately one million to 485,891 trap tag certificates for the 2010 season (A. Podey, Florida Fish and Wildlife Conservation Commission (FFWCC) to A. Herndon, NMFS, pers. comm., 2010).

Commercial landings of spiny lobster in the contiguous United States have been reported in Florida, Alabama, Georgia, Mississippi, South Carolina and Texas since 1962. However, in 35 of the 45 years from 1962 through 2006, Florida landings, mostly from the Florida Keys, accounted for all of the annual commercial landings; and in each of the other 10 years, annual landings in Florida represented at least 94% of the total pounds commercially landed that year. In 2006, 100% of all 4,773,995 pounds of spiny lobster landings were within the State of Florida. Also 80% of fishing effort for this fishery is within state of Florida waters.

Trap fishing is the most common gear type used in the Florida Keys. Vessels operating in the lower Florida Keys typically fish up to 2,000 traps, but a few fishers may use as many as 5,000 traps (D. Gregory, Florida Sea Grant, to A. Herndon, NMFS, pers. comm., 2006). Vessels fishing off the upper Florida Keys are generally smaller day crafts that carry no more than 500-800 traps. Unlike the larger vessels fishing in the Lower Keys, these fishers tend to pull 100-300 traps per day.

Recreational fishing for spiny lobsters is primarily conducted by divers using scuba equipment, hookah rigs or free-diving to collect lobsters by hand (GMFMC and SAFMC 1987). Recreational fishers without a SRCL are not allowed to use traps to capture lobster.

Temporal and Spatial Distribution: The distribution of the commercial and recreational spiny lobster harvest off Florida is almost exclusively limited to the waters of the Florida Keys (GMFMC and SAFMC 1982). Effort occurs on both the Atlantic and Gulf side of the Florida Keys; however, diving for lobster is most common on the Gulf side (NMFS 2009). Fishing occurs from very nearshore areas out to water depths of 200 ft, although most fishing occurs in waters less than 100 ft.

The commercial and regular recreational spiny lobster seasons (in both state and federal waters of Florida and other Gulf states) start on August 6 and end on March 31 (F.A.C. Chapter 68B-24.005(1) Florida Statutes; 50 CFR 640.20(b)) with the exception of the two-day sport season in which trap gear is prohibited.
Gear Characteristics: Spiny lobster trap/pot gear most commonly used in the commercial fishery is a cube made of wooden slats. Wire traps are occasionally used, but more frequently in deeper water. Concrete is typically poured in the bottom of traps to weight them. A buoy is attached to the trap via a float line and floated at the surface. Buoys attached to spiny lobster traps must be marked with the letter “C.” Tags displaying the crawfish endorsement number are also required on all traps.

The type of bait used in traps depends on fisher preference. Some traps are set unbaited, some are baited with fish scraps, sardines, cat food or cowhide, while others are baited with legal sized or undersized lobsters used to attract larger lobsters. Soak times average from 8 to 28 days, with soak times increasing as the season progresses and catch rates decline (Matthews 2001).

Larger vessels in the Lower Florida Keys may set traps several miles apart and usually allow traps to soak for up to two weeks (Powers and Bannerot 1984). Vessels of this size are also capable of fishing 500 traps a day (GMFMC and SAFMC 1982). The smaller vessels of the Upper Florida Keys also stay closer to shore and the duration of their trips is shorter than the larger vessels operating out of the Lower Keys (GMFMC and SAFMC 1987).

Management and Regulations: The spiny lobster trap/pot fishery is currently a Category III fishery under the MMPA’s 2012 List of Fishery (76 FR 73912;November 29, 2011) due to a remote likelihood of serious injuries or mortalities to marine mammals (50 CFR 229). Bottlenose dolphin stocks with documented and confirmed interactions with the spiny lobster fishery include the Biscayne Bay and Florida Bay Stocks. However, based on the overlap between this fishery and stranding data, other bottlenose stocks such as the Northern Florida Coastal Stock, Central Florida Coastal Stock and the Indian River Lagoon Estuarine System Stock are also potentially impacted by this fishery.

There is not fishery management plan for Spiny Lobster, but rather, the federal and state fishery is managed by the

Florida Fish and Wildlife Commission in order to streamline state and federal management.

The fishery is currently managed via bag limits, minimum size limits, regulated fishing seasons for the commercial and recreational sectors, gear restrictions, trap construction requirements and a trap limitation and permitting program.

Observer Coverage: There is no observer coverage in this fishery.

Comments: Based on the similar gear type used in a number of different trap/pot fisheries (e.g., blue crab, stone crab, etc.) especially in coastal Florida waters, bottlenose dolphin strandings associated with this fishery are likely underestimated. Derelict trap/pot gear is also a substantial concern for marine life entanglements. It is estimated that between 10-20% of all traps (i.e., 50,000-100,000) are lost annually.

Protected Species Interactions: Based on bottlenose dolphin stranding data from the United States' Atlantic coast between 2002-April 2009, there have been two bottlenose dolphin strandings likely to have resulted from the lobster pot fishery. Gear determination was based on local knowledge and gear analyses techniques. These animals were most likely associated with the Biscayne Bay or Central Florida Coastal Stocks. An additional eight bottlenose dolphin strandings in Florida had trap/pot gear on the carcass, but the gear could not be definitively identified to a target species or specific fishery. Therefore, based on known interactions with trap/pot gear and bottlenose dolphin stocks in times and areas where the spiny lobster trap/pot fishery is known to occur, the following bottlenose dolphin stocks may also be affected by this fishery: Northern Florida Coastal Stock, Indian River Lagoon Estuarine System Stock, Florida Bay Stock and Biscayne Bay Stock.

Southeastern U.S. Atlantic, Gulf of Mexico Stone Crab Trap/Pot Fishery

Target Species: Florida stone crab (*Menippe mercenaria*)

Number of Permit Holders: In 2010, the State of Florida issued 1,282 stone crab licenses and 1,190,285 stone crab trap tags. Currently, there are no federal reporting requirements for the federal stone crab fishery. All data regarding the fishery have been collected via partnership with the State of Florida, through its trip ticket program.

Total Effort: Due to the Stone Crab Trap Reduction Schedule [F.A.C Chapter 68B-13.010(3)(f) Florida Statutes], the number of commercial trap certificates issued by the State of Florida has decreased from approximately 1,475,000 in the 2002-2003 fishing season to 1,190,285 in the 2010 fishing season. The Stone Crab Trap Reduction Schedule [F.A.C Chapter 68B-13.010(3)(f) Florida Statutes] will eventually reduce the number of trap tags to 600,000 trap/pots statewide. Pots will be reduced by a pre-specified percentage each year until the number of trap tags reaches 600,000 (Muller *et al.* 2006).

Florida state regulations limit recreational stone crab trap/pot numbers to five per person [F.A.C. Chapter 68B-13] Florida Statutes]. Because no documentation or registration is required for recreational stone crab fishing, no accurate estimate of the magnitude of this fishery is possible (Bert *et al.* 1978).

Temporal and Spatial Distribution: The season for commercial and recreational stone crab harvest is from October 15 to May 15.

This commercial fishery operates primarily nearshore in the State of Florida (stone crab fishing outside of this area is likely very minimal). The stone crab trap/pot fishery occurs on both sides of Florida Keys (Gulf of Mexico and Atlantic), but is much more extensive along the Gulf of Mexico side. Crabbers place their traps in waters of 65 foot depth or less and intense trapping extends from the boundary of Everglades National Park through the Gulf of Mexico side of the Marquesa Keys (T. Bert, Florida Fish and Wildlife Conservation Commission (FFWCC), to A. Herndon, NMFS, pers. comm. 2006). Crabbers off Marathon, Florida, typically set traps deeper than the smaller operations of the Upper and Lower Keys, and often work thousands of traps per season (Bert *et al.* 1978).

Distribution of the stone crab trap/pot fishery varies throughout the Gulf of Mexico side of Florida. The stone crab fishery off Collier County is centered in Chokoloskee. It generally extends from the Shark River Basin to Cape Romano and seaward to approximately a 65 foot depth. Crabbers generally work from 1,000 to 3,000 traps per season; a few crabbers fish as many as 8,000 traps per season (Bert *et al.* 1978; T. Bert, FFWCC, to A. Herndon, NMFS, pers.

comm. 2008). In Lee and Charlotte counties of Florida, the crabbers often fish fewer than 200 trap/pots per season in waters less than 20 feet deep. Within Tampa and Sarasota Bay, crabbers fish between a few hundred to a few thousand traps per season. Crabbers in Tarpon Springs and Homasassa fish thousands of traps seasonally and the fishery offshore from this area appears to be the most heavily fished of any area in the state (T. Bert, FFWCC, unpublished data). Within the Taylor, Dixie, Levy, and Citrus counties of Florida, crabbers may use up to 1,000 traps per season. There are few commercial stone crabbers in the Florida panhandle region.

Gear Characteristics: Traps are the exclusive gear type used for the commercial stone crab fishery. Stone crab traps are constructed of pressure-treated pine or cypress slats or of plastic (Bert *et al.* 1978). The tops of the traps have a hinged lid that is opened to gain access to the catch. A 4-inch by 6-inch plastic opening in the center of the lid serves as the mouth of the trap, which allows crabs to enter. Fishers pour concrete into the bottom of these traps to weight them.

All traps must be designed to conform to the specifications established under 50 CFR 654.22, as well as State of Florida statutes. A marking buoy and line are attached to each commercial trap (GMFMC 1979) which is denoted with the letter "X." No trap is allowed to be larger than 24 by 24 by 24 inches and several requirements also exist for escape vents, throat, sizes and configuration (50 CFR 654.22).

Traps are baited with bait fish or fish remnants. Mullet, grouper or snapper heads and skeletons, jacks, sharks and skates or rays are commonly used baits (GMFMC 1979). Pigs' feet and cowhide have also become common baits in recent years. One-to-three pounds of bait is generally used per trap. Bait configuration within the trap depends on fisher preference. Some fishers simply place the bait on the bottom of the trap; some place it in a bait container, and others suspend the bait from the top of the trap. Baits may last anywhere from two days to several weeks, depending upon their type, amount and placement inside the trap (Bert *et al.* 1978).

Baited traps are frequently set in a double line formation, generally 100-300 ft apart, running parallel to a bottom contour. Some fishers prefer to lay traps in a grid, crisscross or circular pattern. Traps are usually set on sandy or grassy bottom with scattered sponges, rocks, soft corals or small coral heads (Bert *et al.* 1978). The margins of seagrass flats and bottoms with low rocky relief are also favored areas for trap placement (T. Bert, FFWCC, to A. Herndon, NMFS, pers. comm., 2006).
Fishers who operate large vessels usually allow their traps to soak for 10 to 21 days. After the trap has been retrieved, the catch is removed, the trap is re-baited, minor repairs are made to the trap if necessary, and then the trap is reset. Stone crab fishing is conducted almost entirely during one-day trips (GMFMC 1979).

Depending on the experience of the crew, a three-man crew may haul and reset anywhere from 25 to 100 traps per hour. This rate is also highly dependent on tide, weather conditions, smoothness of operation and the condition of equipment. Sixty traps an hour is considered an average rate for larger vessels (Bert *et al.* 1978). Per season, stone crab fishers operating large vessels may set from 1,500 to 8,000 traps or more; a few leaders in the fishery may own several vessels ranging 60-85 ft in length and fish up to 10,000 traps per season (T. Bert, FFWCC, to A. Herndon, pers. comm., 2006).

Small vessels (30 ft or less) generally fish shallower waters and pull their traps every few days. They use the same techniques described above to set and retrieve their traps, but powered haulback devices are rarely employed. The number of traps worked per day by these single man crews, ranges from less than 25 to 300. Over a season, the number of traps set by these smaller operators varies but may be as high as 1,500 (Bert *et al.* 1978).

The recreational stone crab trap/pot fishery is composed of crabbers that use much of the same equipment and techniques as the commercial crabbers described above. Most recreational trap fishers fish only a few traps (Florida state regulations limit recreational stone crab trap number to 5 per person [F.A.C. Chapter 68B-13, Florida Statutes]) and set them in shallow water (20 ft or less). The State of Florida has no specific marking requirement for recreational crab trap/pots.

Management and Regulations: The stone crab trap/pot fishery is currently a Category II fishery under the MMPA's 2012 List of Fishery (76 FR 73912;November 29, 2011) due to occasional interactions with marine mammals (50 CFR 229). Based on stranding data and confirmation of gear to the stone crab fishery, the bottlenose dolphin stocks with known interactions with this fishery include the Biscayne Bay Stock and Eastern Coastal Stock (Gulf of Mexico). Other bottlenose dolphin stocks with stranding data documenting interactions with trap pot gear for which the gear

may be stone crab include the Caloosahatchee River Stock, Central Florida Coastal Stock (Atlantic Ocean), and Jacksonville Estuarine System Stock. Based on the stone crab fishery effort, all bay, sound, and estuary stocks in Florida are potentially impacted by this fishery.

The State of Florida and the Gulf of Mexico Fishery Management Council (GMFMC) manage this fishery jointly (GMFMC 2001). The GMFMC and NMFS both acknowledge the fishery is primarily a state fishery, and requires cooperative state/federal management. Federal management of the stone crab fishery consists primarily of the concurrent regulations established to support existing State of Florida regulations.

Under the FMP, the federal management area for the stone crab trap/pot fishery is defined as the EEZ off the coast of Florida from a line extending directly south from the Alabama/Florida boundary (87°31'06" W. long.) to a line extending directly east from the Dade/Monroe County, Florida, boundary (25º20.4' N. lat.) (as a federal management area, this does not include state waters within three miles of shore although the regulations are concurrent with state waters). The stone crab management area overlaps jurisdictions of the GMFMC and the South Atlantic Fishery Management Council (SAFMC). Due to this overlap, the GMFMC acts as the lead federal agency for developing, amending, and managing the stone crab fishery and its FMP while working concurrently with the State of Florida, though any federal management decisions are submitted to the SAFMC for review as well.

The fishery is currently managed through seasonal closures, effort limitations, harvest limitations, permit requirements, trap construction requirements, and a passive trap limitation program managed by the State of Florida. Recreational fishers must follow the same guidelines as commercial fishers unless otherwise noted.

Observer Coverage: There is no observer coverage in this fishery.

Comments: Based on the similar gear type used in a number of different pot fisheries (e.g., blue crab, spiny lobster, etc.) especially in coastal Florida waters, bottlenose dolphin strandings associated with this fishery are likely underestimated. Derelict trap/pot gear is also a substantial concern for marine life entanglements.

Protected Species Interactions: Based on Florida Atlantic stranding data from 2002-April 2009 and Florida Gulf of Mexico Stranding Data from 2002-2010, there have been 5 bottlenose dolphin strandings that have resulted from the stone crab trap/pot fishery and 8 bottlenose dolphin strandings that are a result of pot fisheries that could not be definitively identified to a specific fishery. Based on stranding data and confirmation of gear to the stone crab fishery, the bottlenose dolphin stocks with known interactions with this fishery include the Biscayne Bay Stock and Eastern Coastal Stock (Gulf of Mexico). Other stocks with stranding data documenting interactions with trap pot gear for which the gear may be stone crab include the Caloosahatchee River Stock, Central Florida Coastal Stock (Atlantic Ocean), and Jacksonville Estuarine System Stock.

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 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. However, based on Gulf of Mexico Stranding Data from 2002-2010, there has been 1 mortality from the blue crab trap/pot fishery, and 1 mortality and 4 bottlenose dolphin disentanglements with live releases that were a result of pot fisheries that may have been blue crab but could not be definitively identified to a specific fishery. The fishery has been defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011).

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 bay, sound and estuary and

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. Takes reported through the MMAP likely affected the following stocks: Western Coastal Stock; Northern Coastal Stock; Mississippi Sound, Lake Borgne, Bay Boudreau Stock; Mississippi River Delta Stock; and Barataria Bay Estuarine System Stock. The fishery has been defined as a Category II fishery in the 2012 List of Fisheries (76 FR 73912;November 29, 2011).

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 is allowed (CMPR FMP). In state waters, state and Gulf States Marine Fisheries Commission (GSMFC) Interstate FMPs apply. No marine mammal mortalities associated with commercial 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. Four research-related gillnet mortalities occurred between 2003 and 2007 in Texas and Louisiana and an additional research gillnet entanglement (released alive) occurred during 2008 in Texas. All of the research-related interactions were likely with animals belonging to the following bay, sound and estuary stocks: Copano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay Stock (2 mortalities); Mississippi River Delta Stock (1 mortality); and Matagorda Bay, Tres Palacios Bay, Lavaca Bay Stock (1 mortality, 1 released alive). The Gulf of Mexico Gillnet Fisheries are listed as Category II fisheries in the 2011 List of Fisheries (76 FR 73912;November 29, 2011).

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Appendix III: Fishery Descriptions - List of Figures

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Figure 45. 2010 Observed sets and marine mammal interactions in the pelagic longline fishery - Gulf of Mexico.

Figure 1. 2006 Northeast sink gillnet observed hauls (A) and observed takes (B).

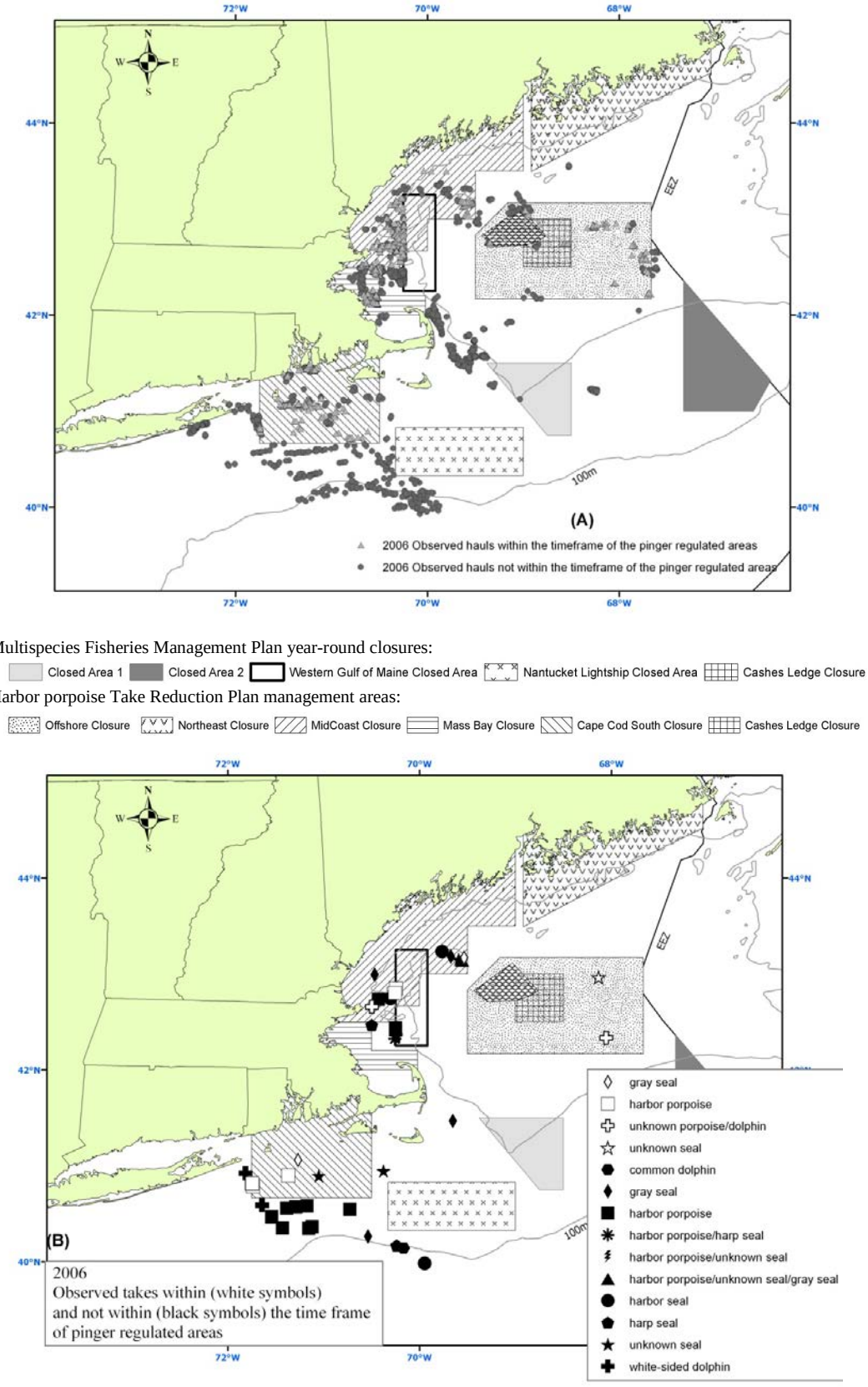
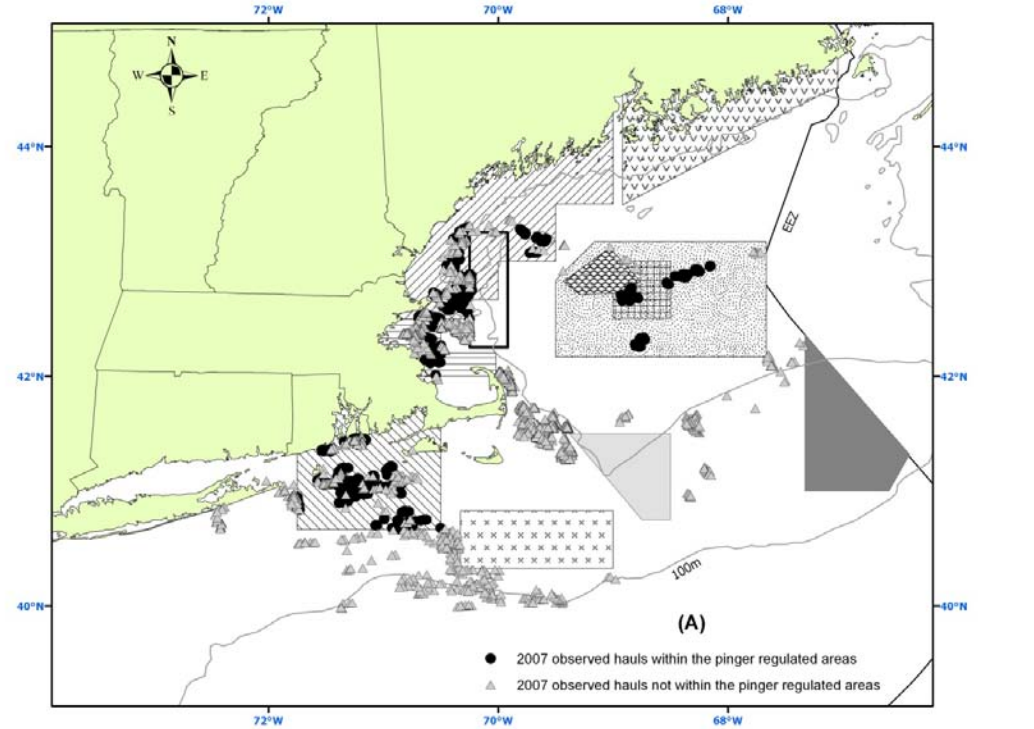


Figure 2. 2007 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closure

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

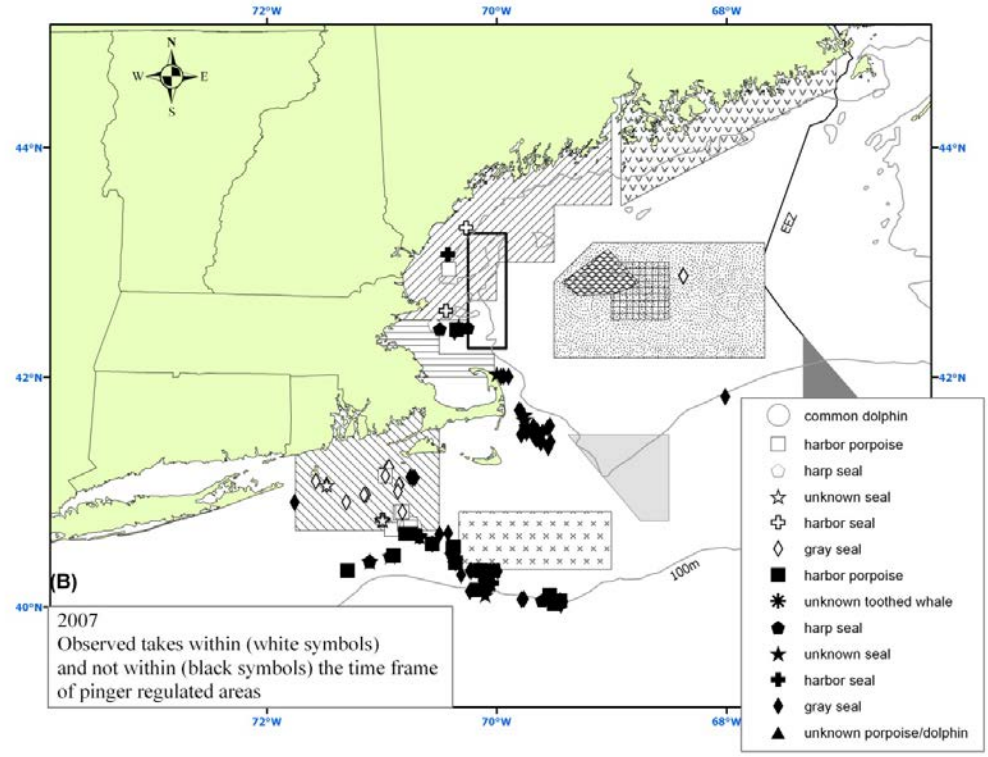
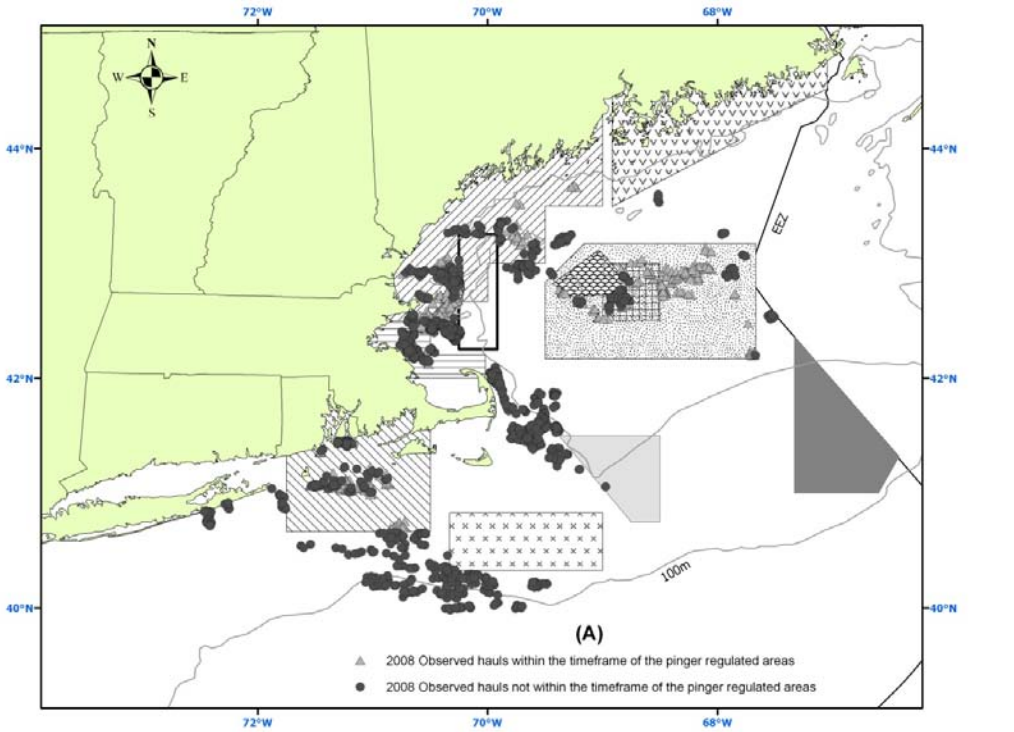


Figure 3. 2008 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Closed Area 1 | Closed Area 2 | Western Gulf of Maine Closed Area | Nantucket Lightship Closed Area | Cashes Ledge Closure

Harbor porpoise Take Reduction Plan management areas:

Offshore Closure | Northeast Closure | MidCoast Closure | Mass Bay Closure | Cape Cod South Closure | Cashes Ledge Closure

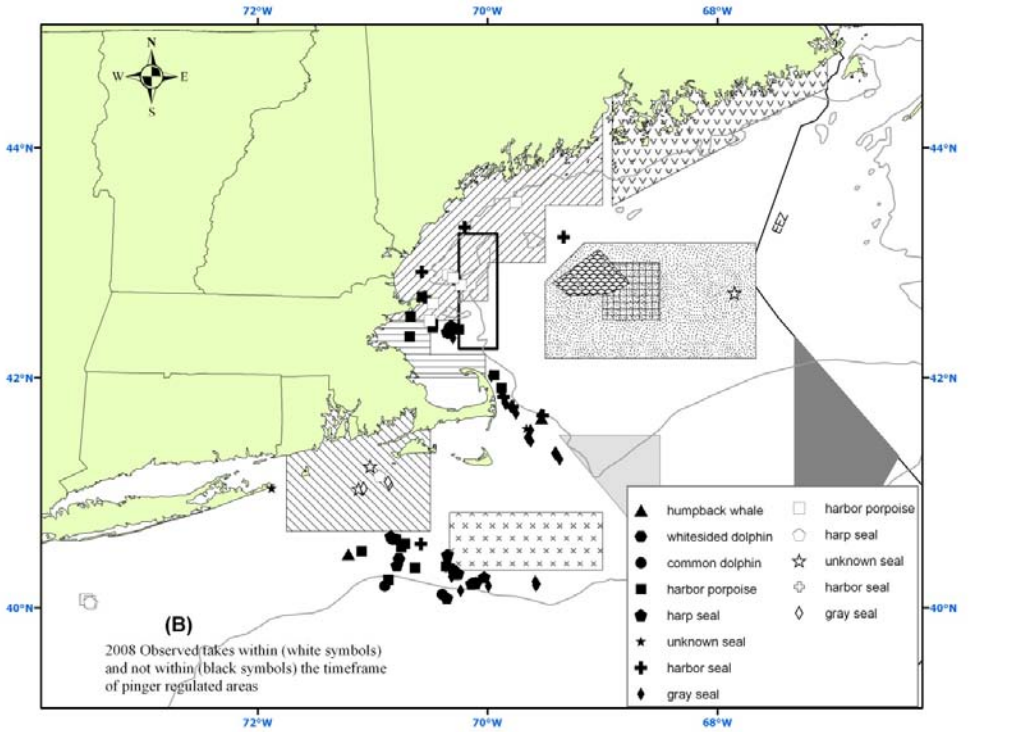


Figure 4. 2009 Northeast sink gillnet observed hauls (A) and observed takes (B).

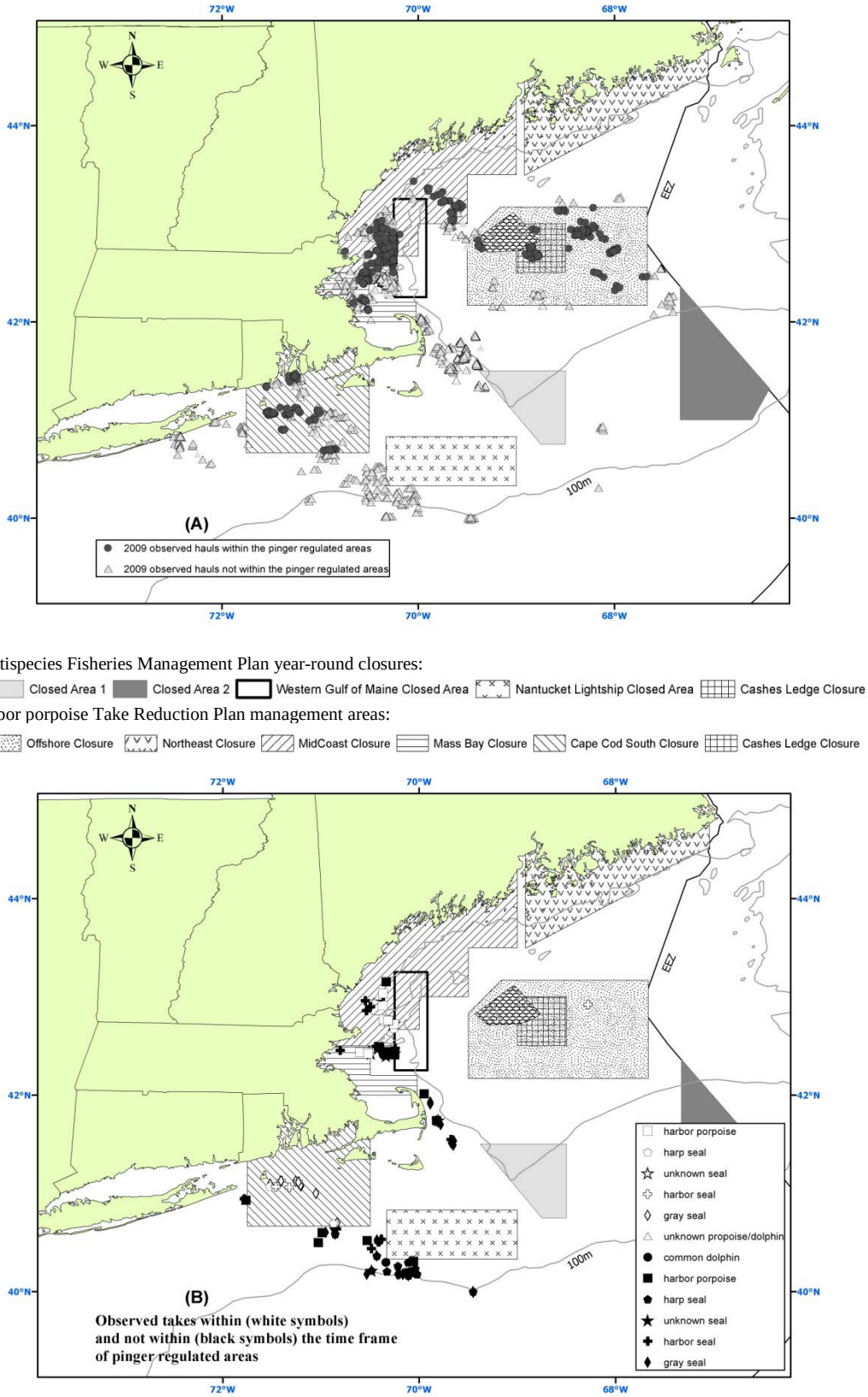
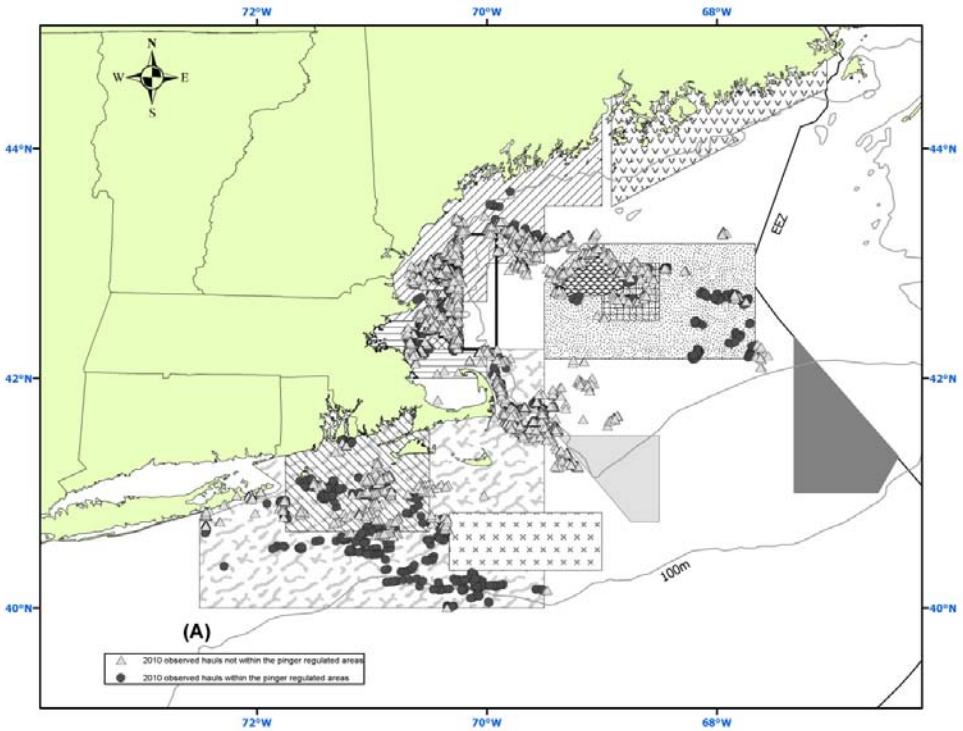


Figure 5. 2010 Northeast sink gillnet observed hauls (A) and observed takes (B).



Multispecies Fisheries Management Plan year-round closures:

Harbor porpoise Take Reduction Plan management areas:

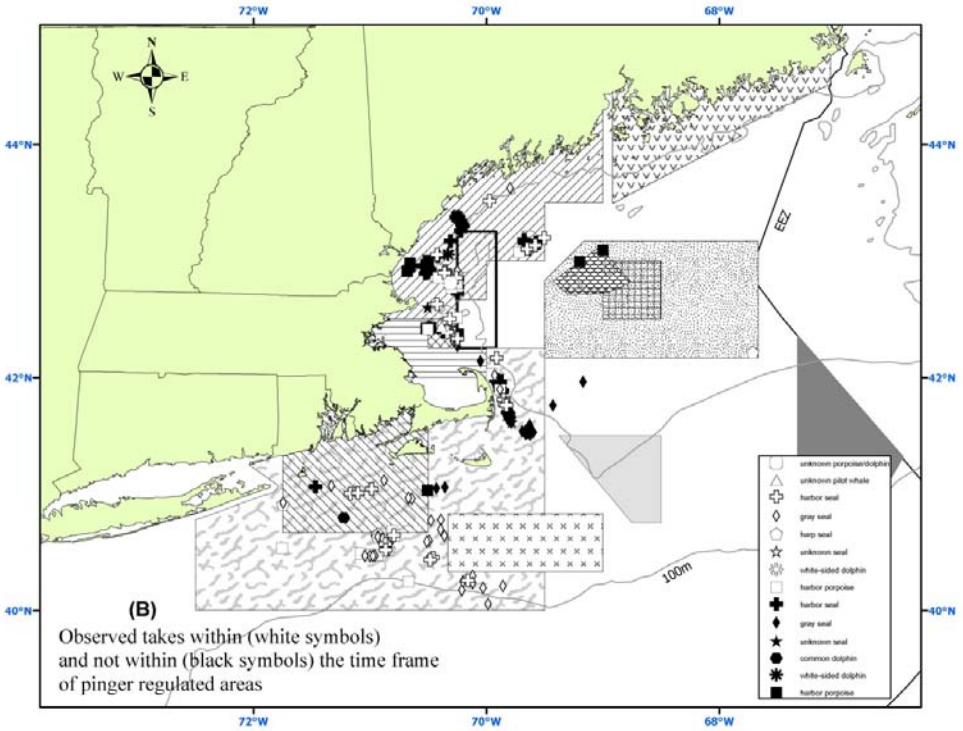


Figure 6. 2006 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).

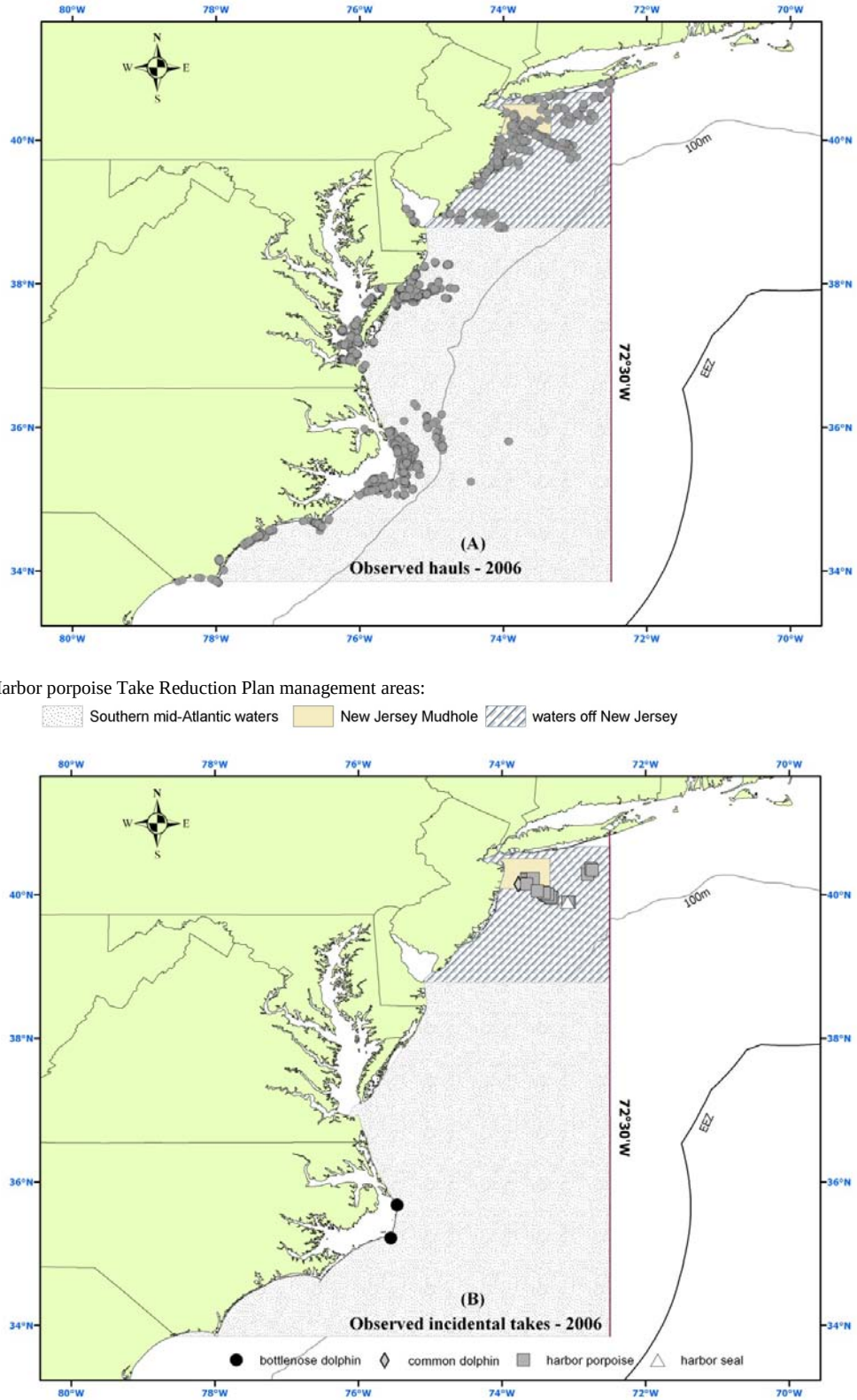


Figure 7. 2007 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).

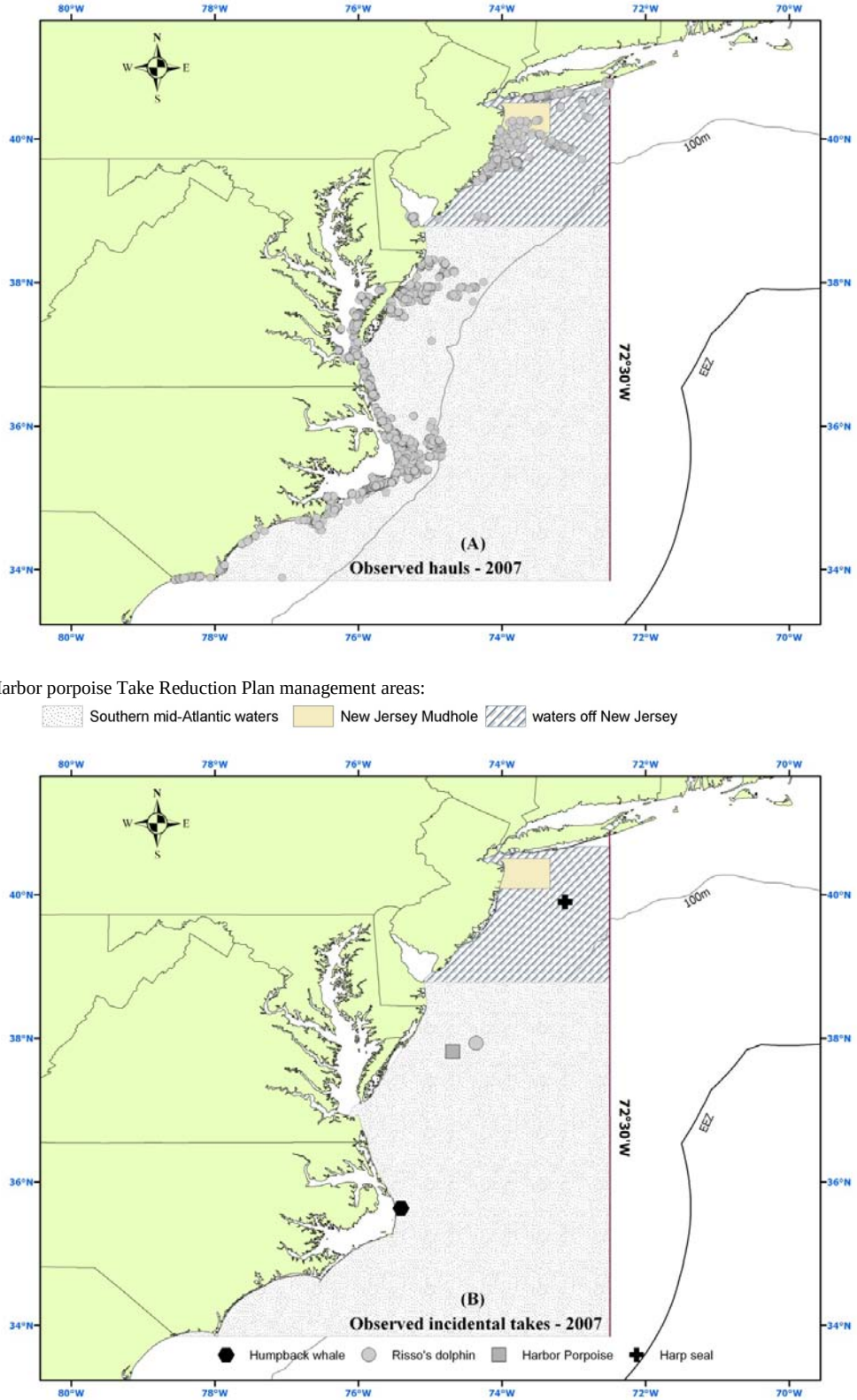
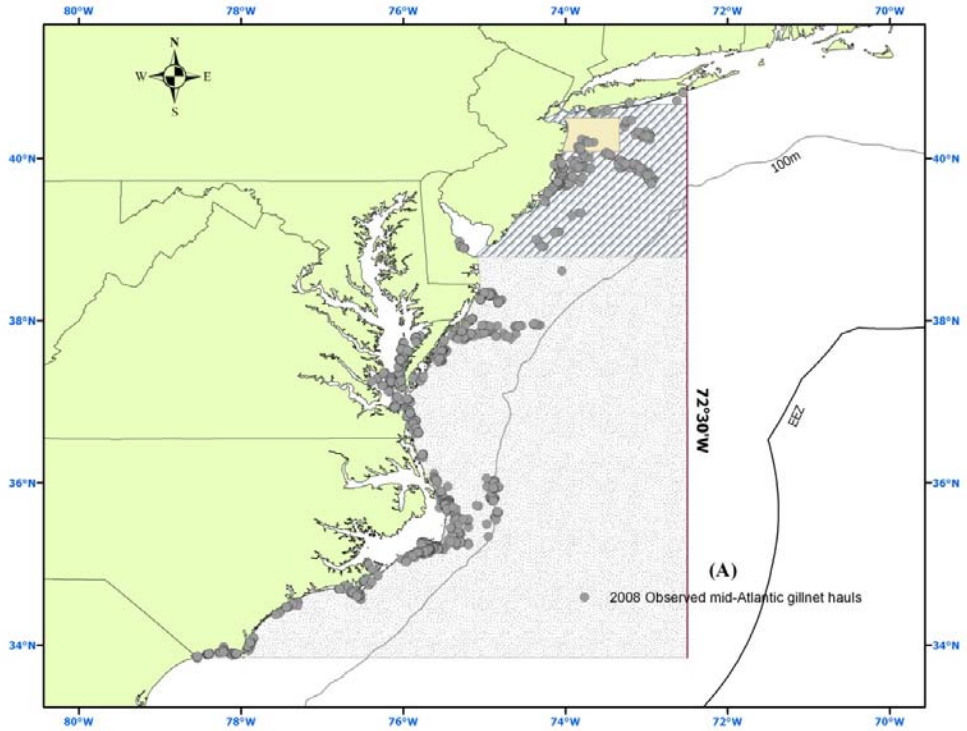


Figure 8. 2008 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

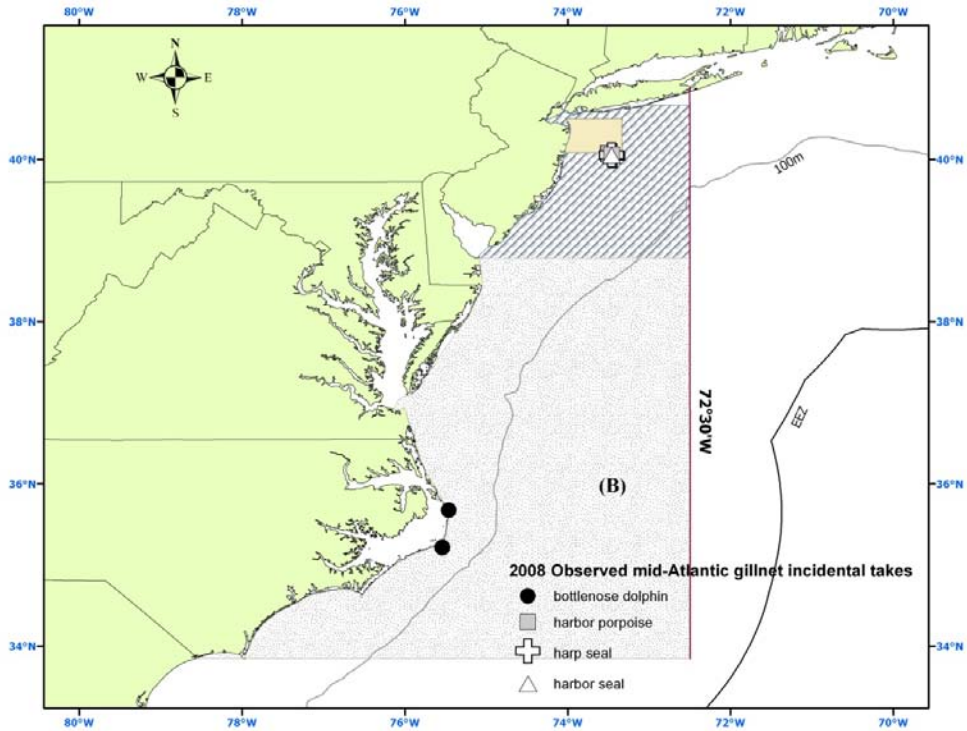
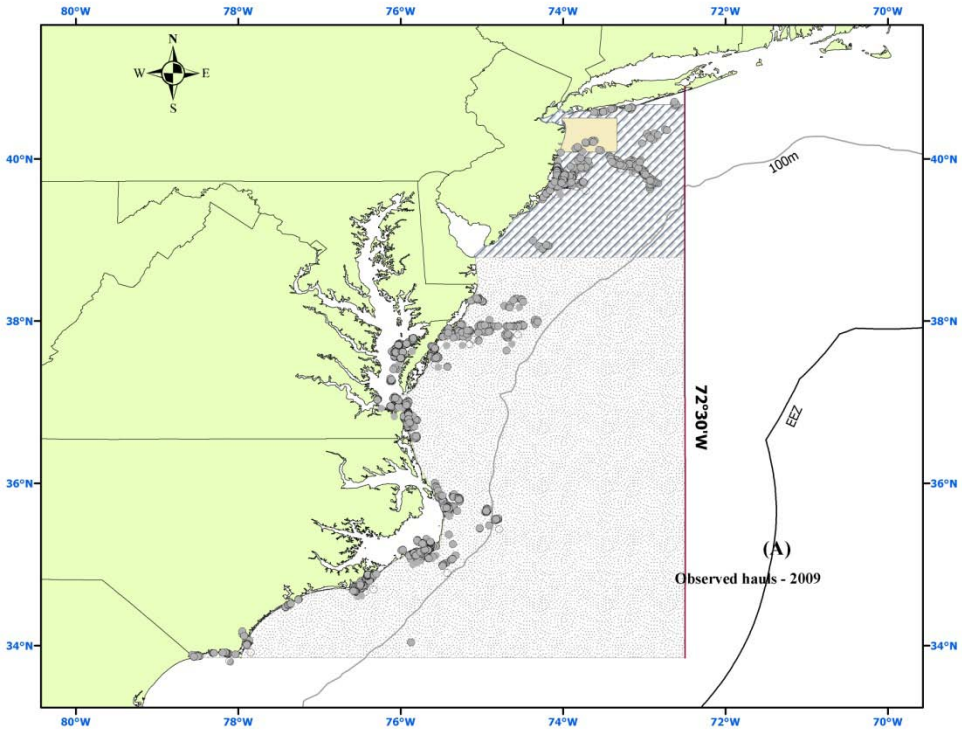


Figure 9. 2009 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

Southern mid-Atlantic waters | New Jersey Mudhole | waters off New Jersey

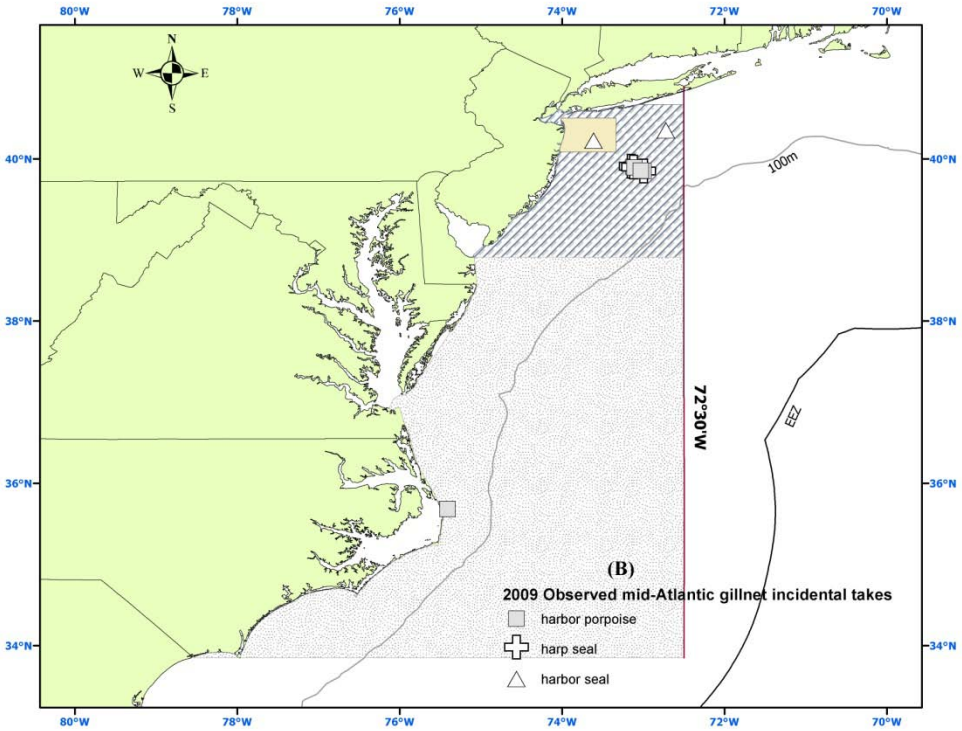
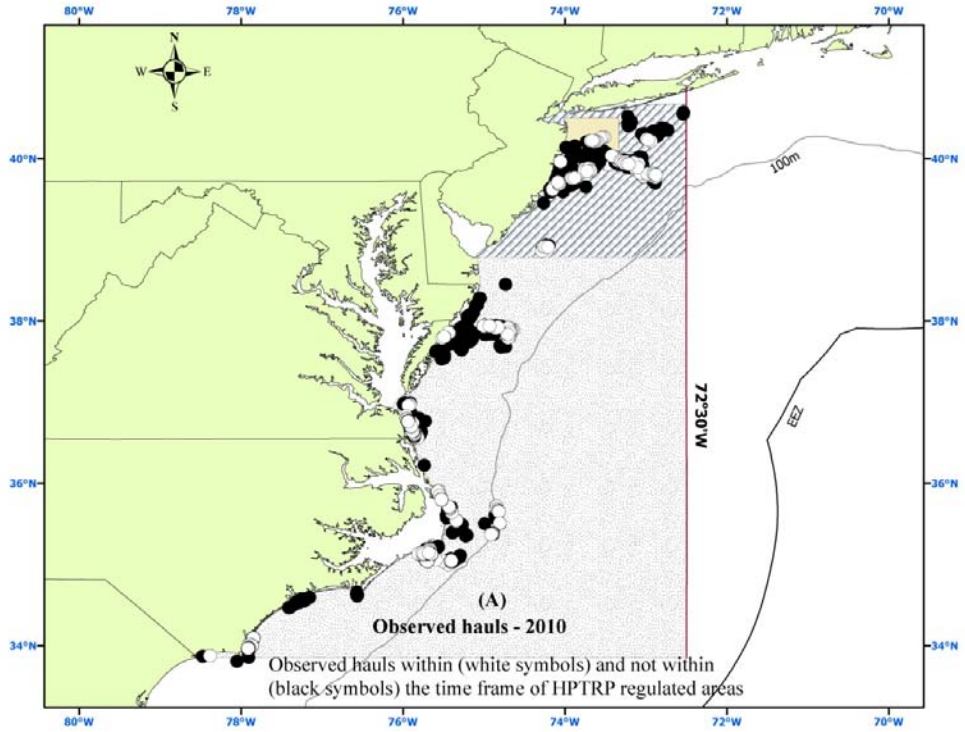


Figure 10. 2010 Mid-Atlantic gillnet observed hauls (A) and observed takes (B).



Harbor porpoise Take Reduction Plan management areas:

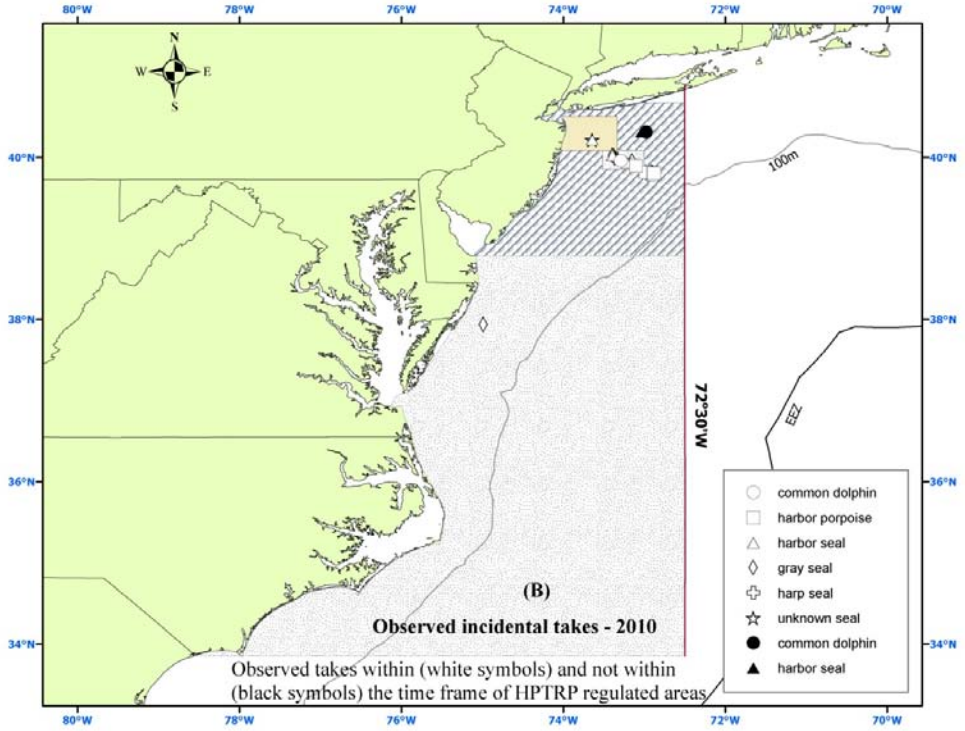


Figure 11. 2006 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

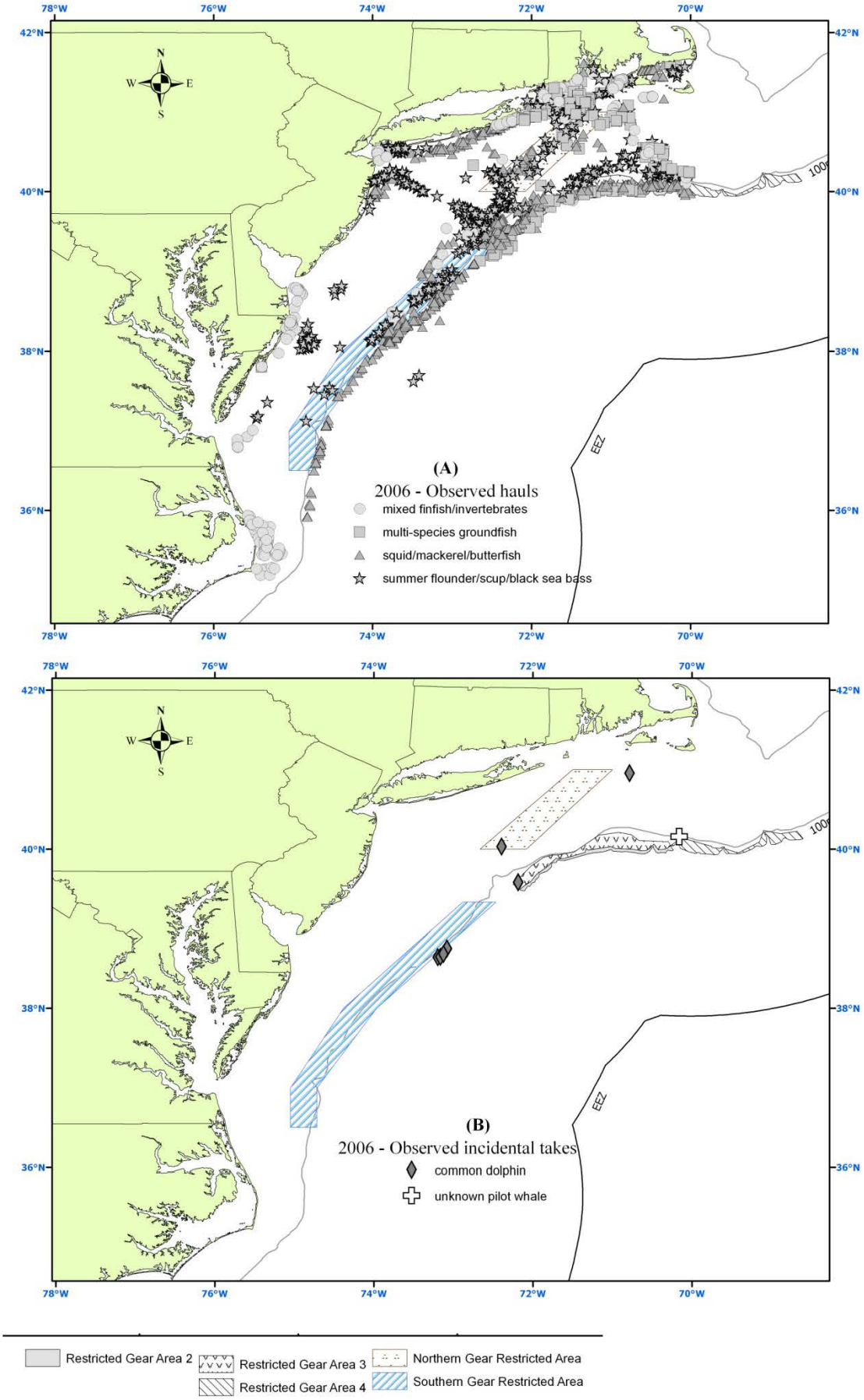


Figure 12. 2007 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

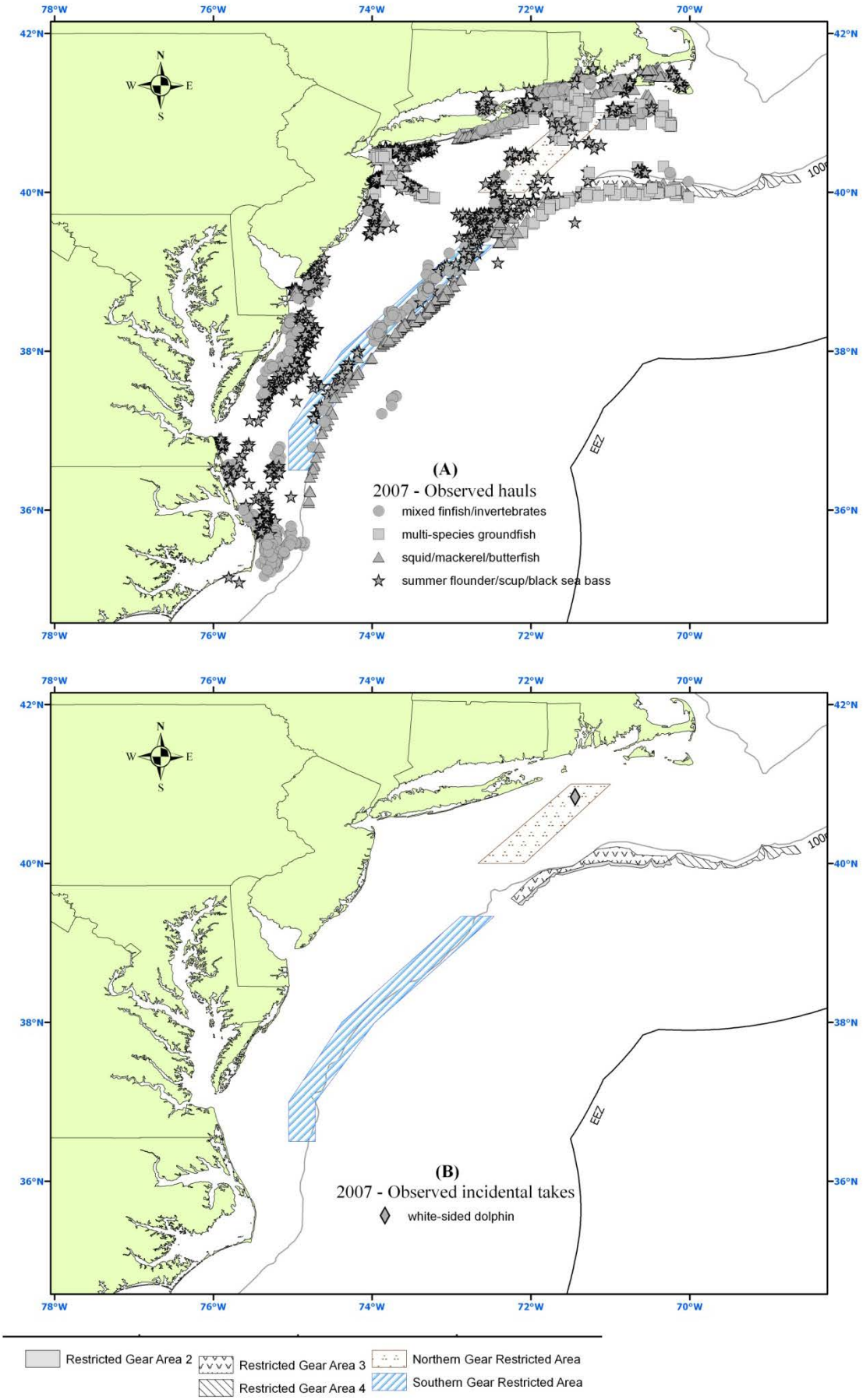


Figure 13. 2008 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

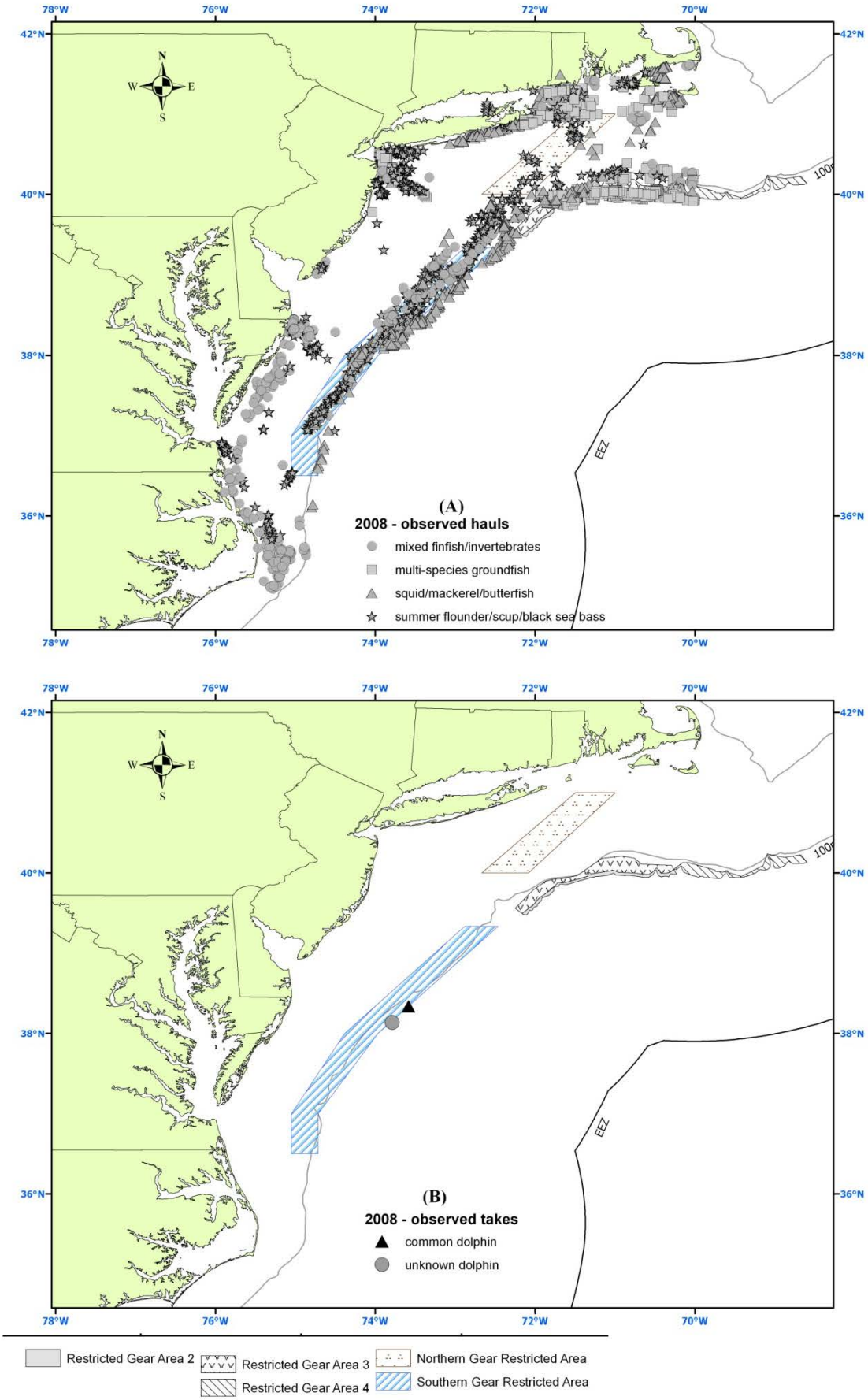


Figure 14. 2009 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

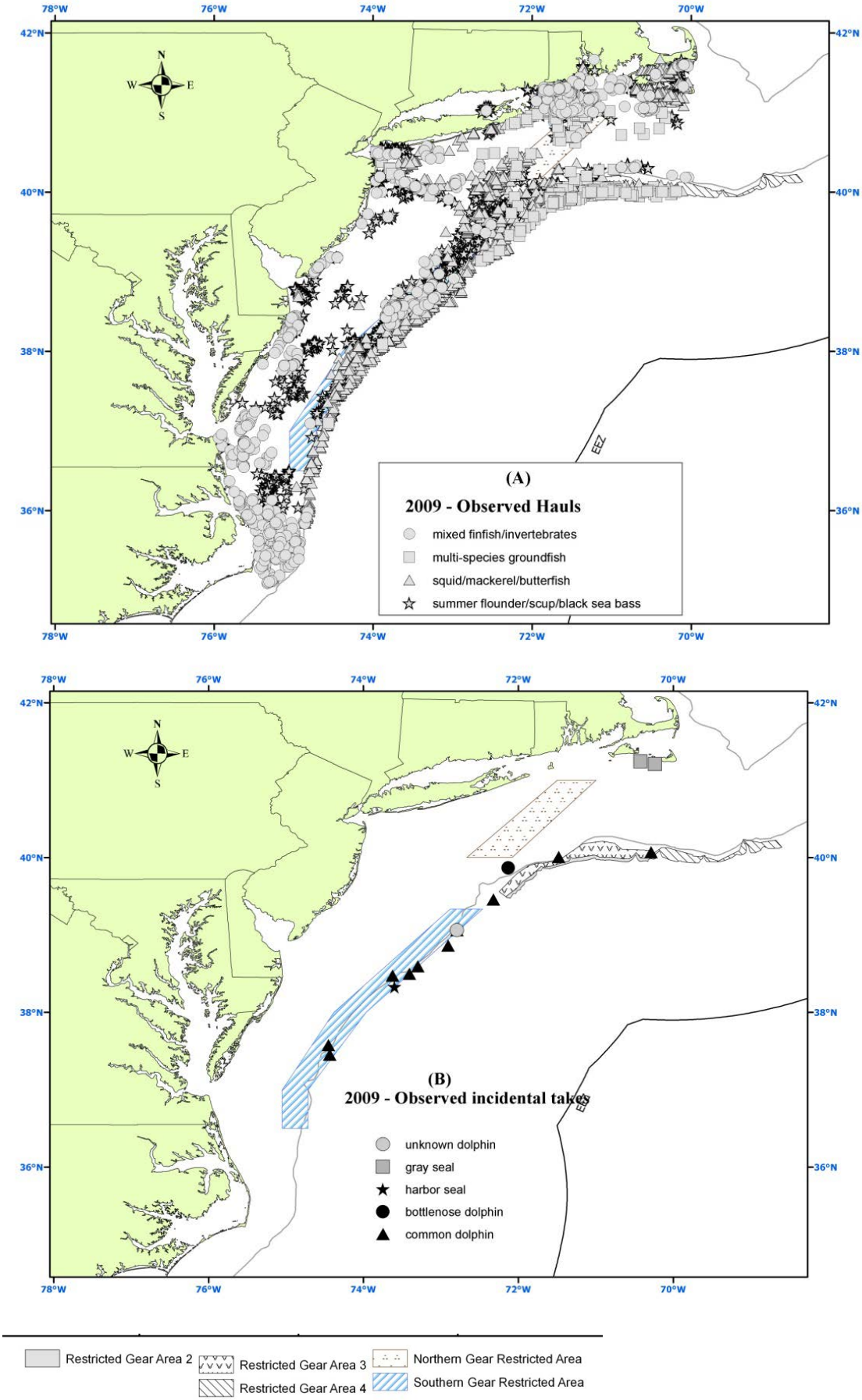


Figure 15. 2010 Mid-Atlantic bottom trawl observed tows (A) and observed takes (B).

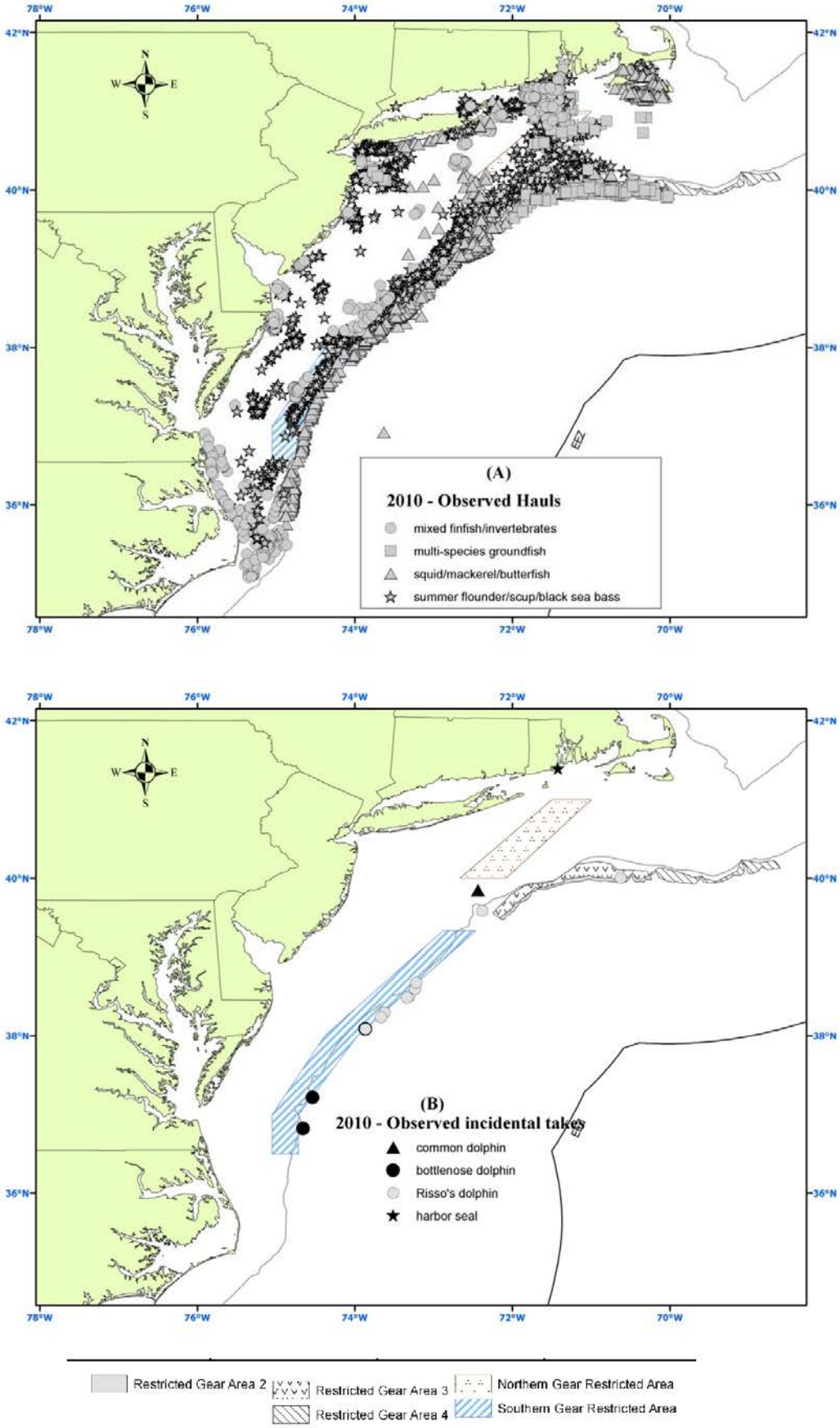


Figure 16. 2006 Northeast bottom trawl observed tows (A) and observed takes (B).

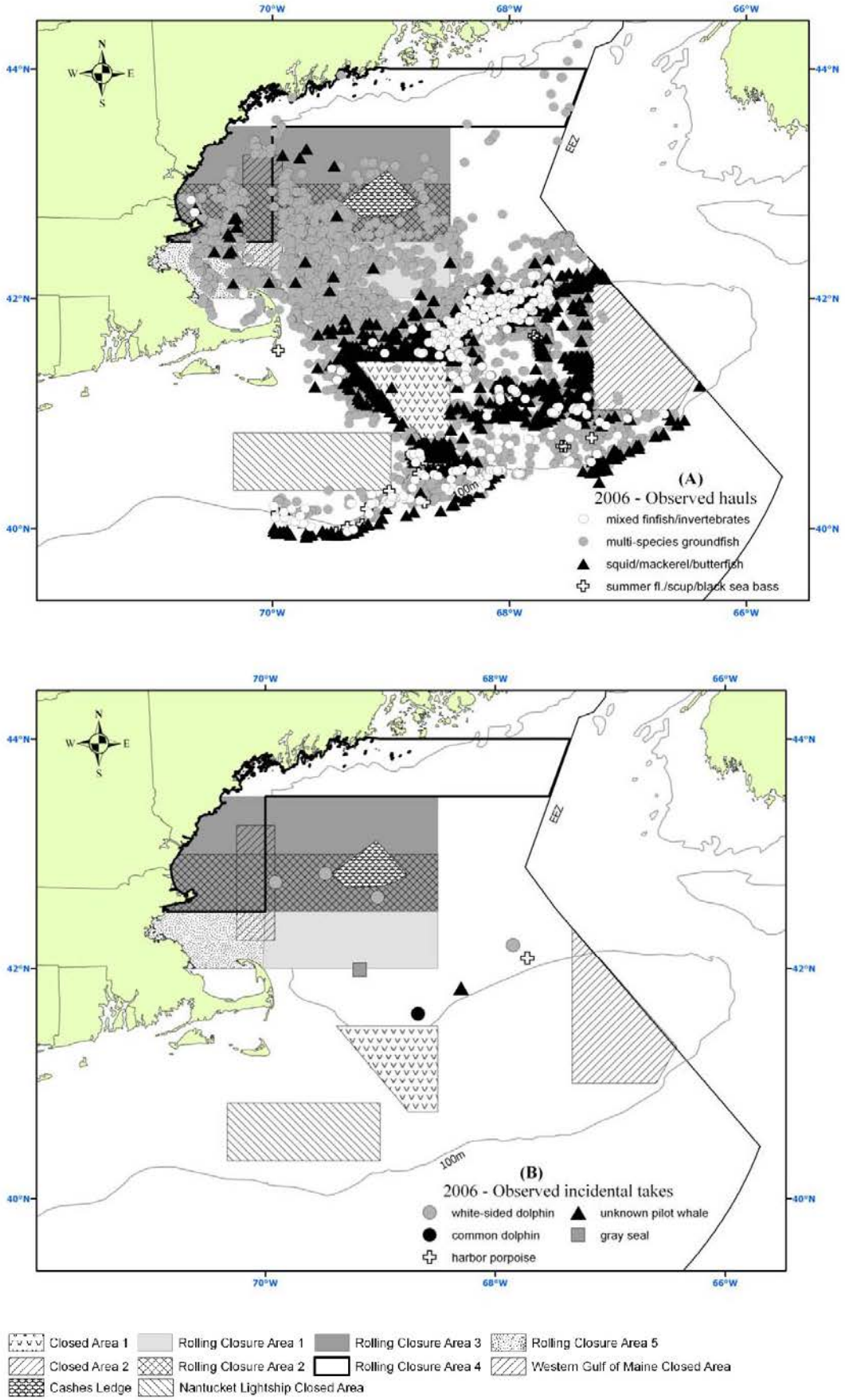


Figure 17. 2007 Northeast bottom trawl observed tows (A) and observed takes (B).

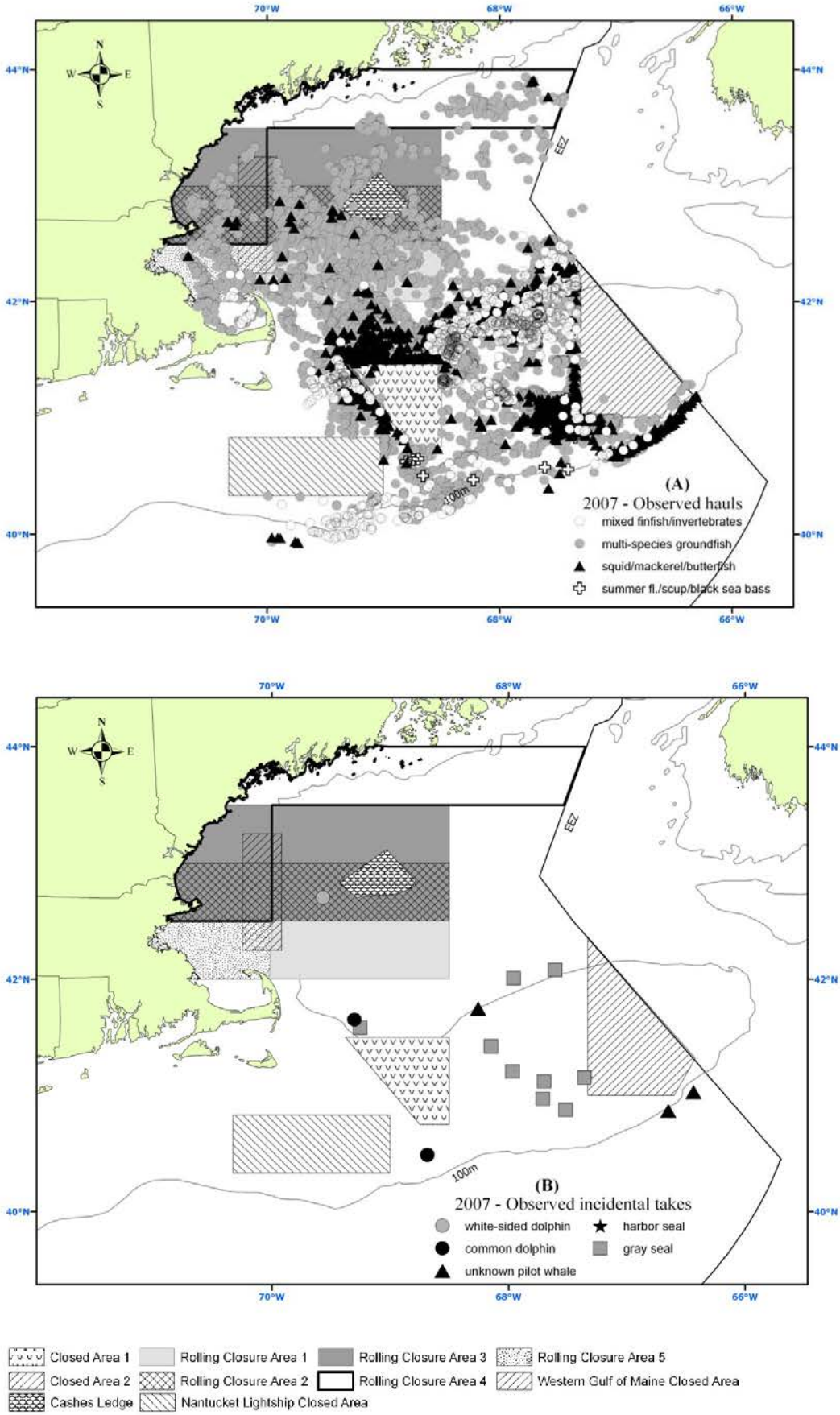


Figure 18. 2008 Northeast bottom trawl observed tows (A) and observed takes (B).

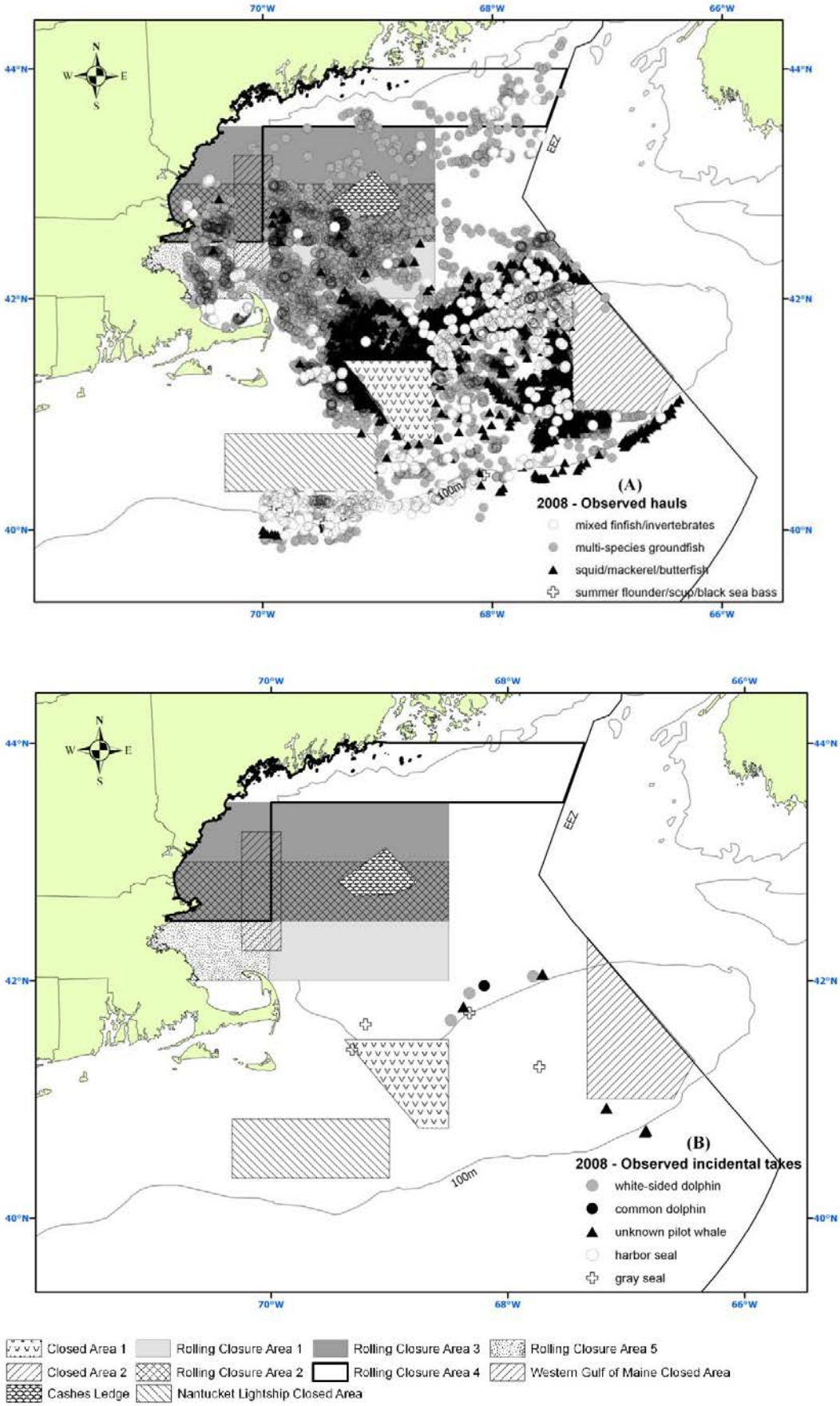


Figure 19. 2009 Northeast bottom trawl observed tows (A) and observed takes (B).

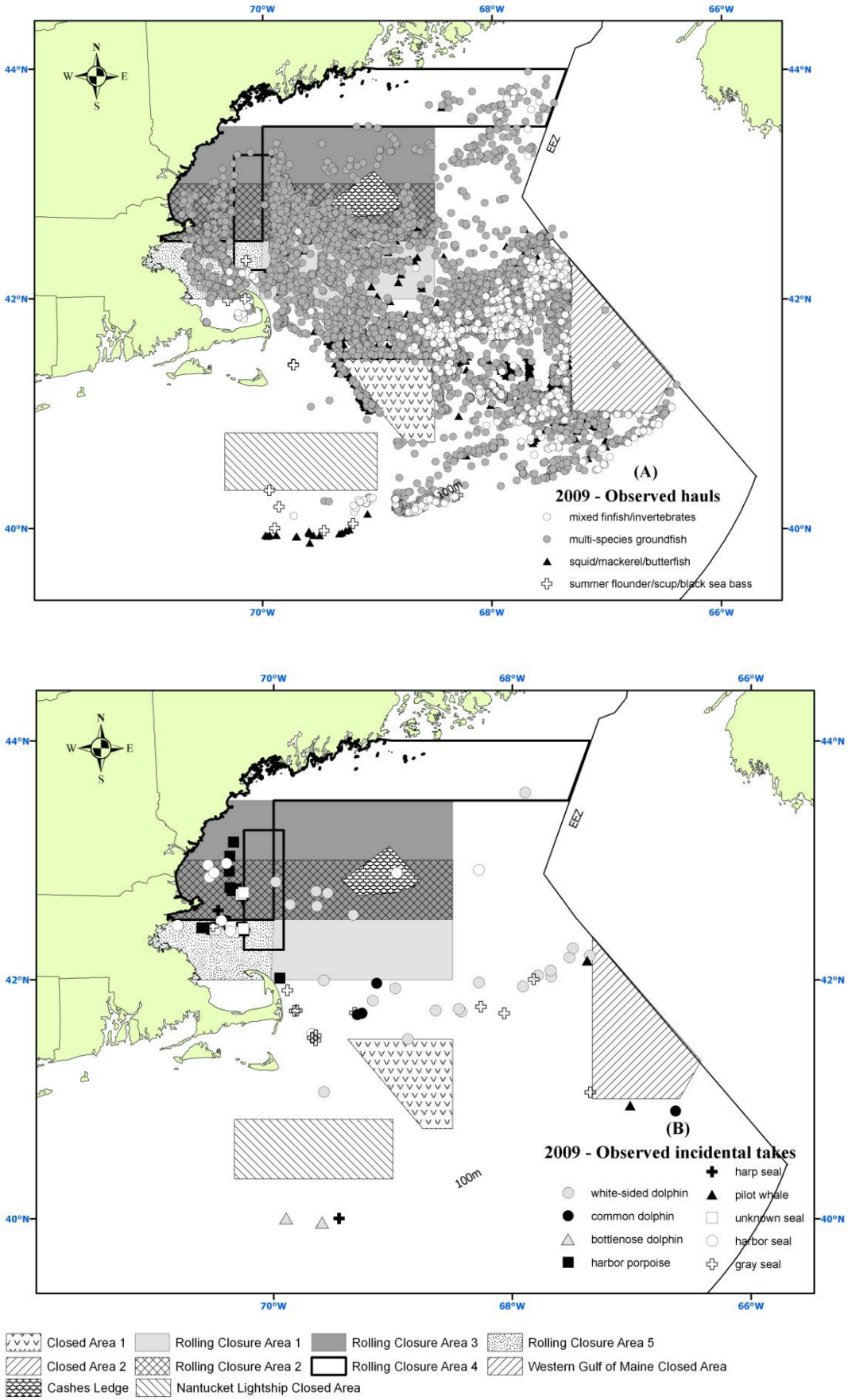


Figure 20. 2010 Northeast bottom trawl observed tows (A) and observed takes (B).

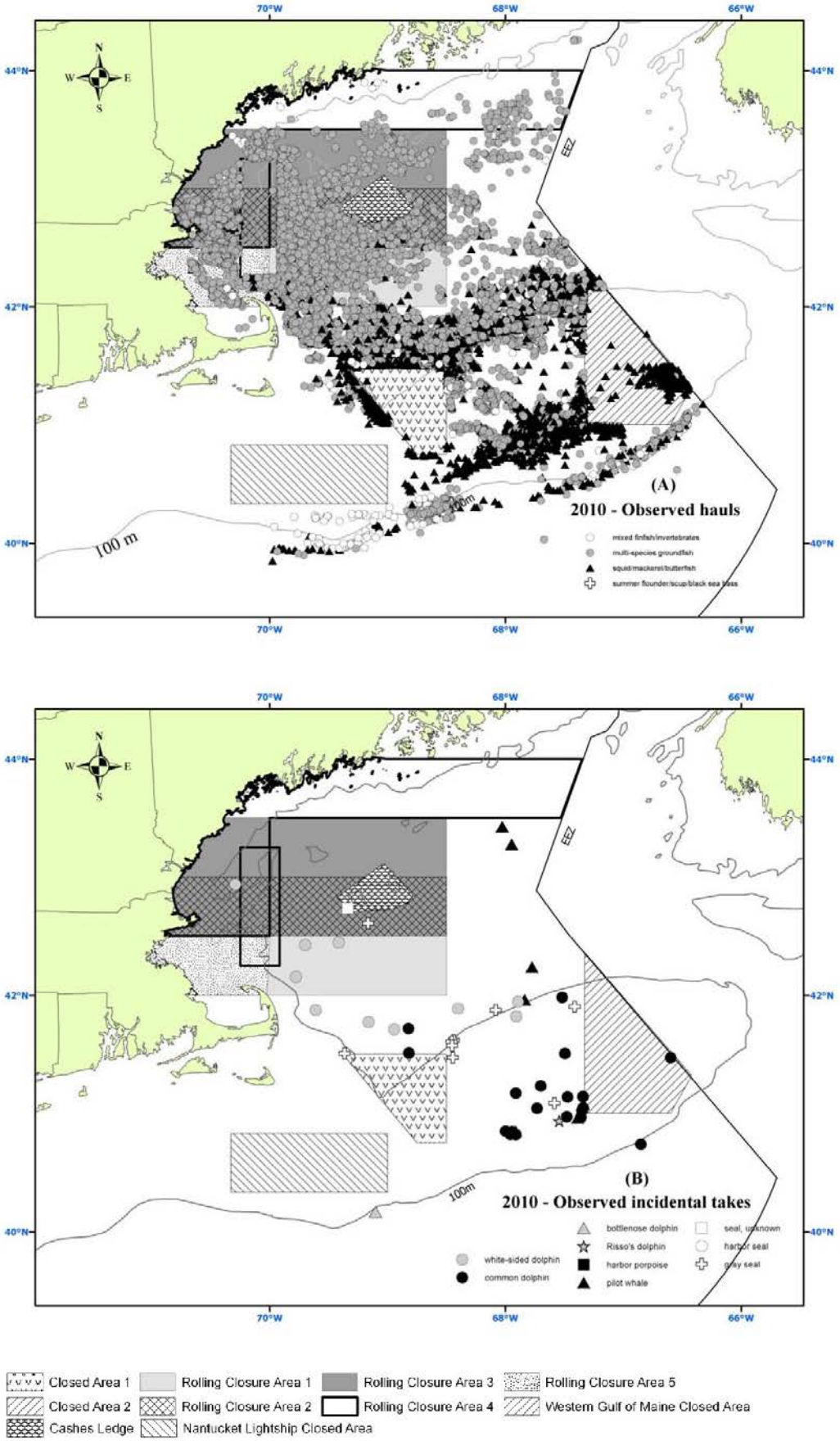


Figure 21. 2006 Northeast mid-water trawl observed tows (A) and observed takes (B).

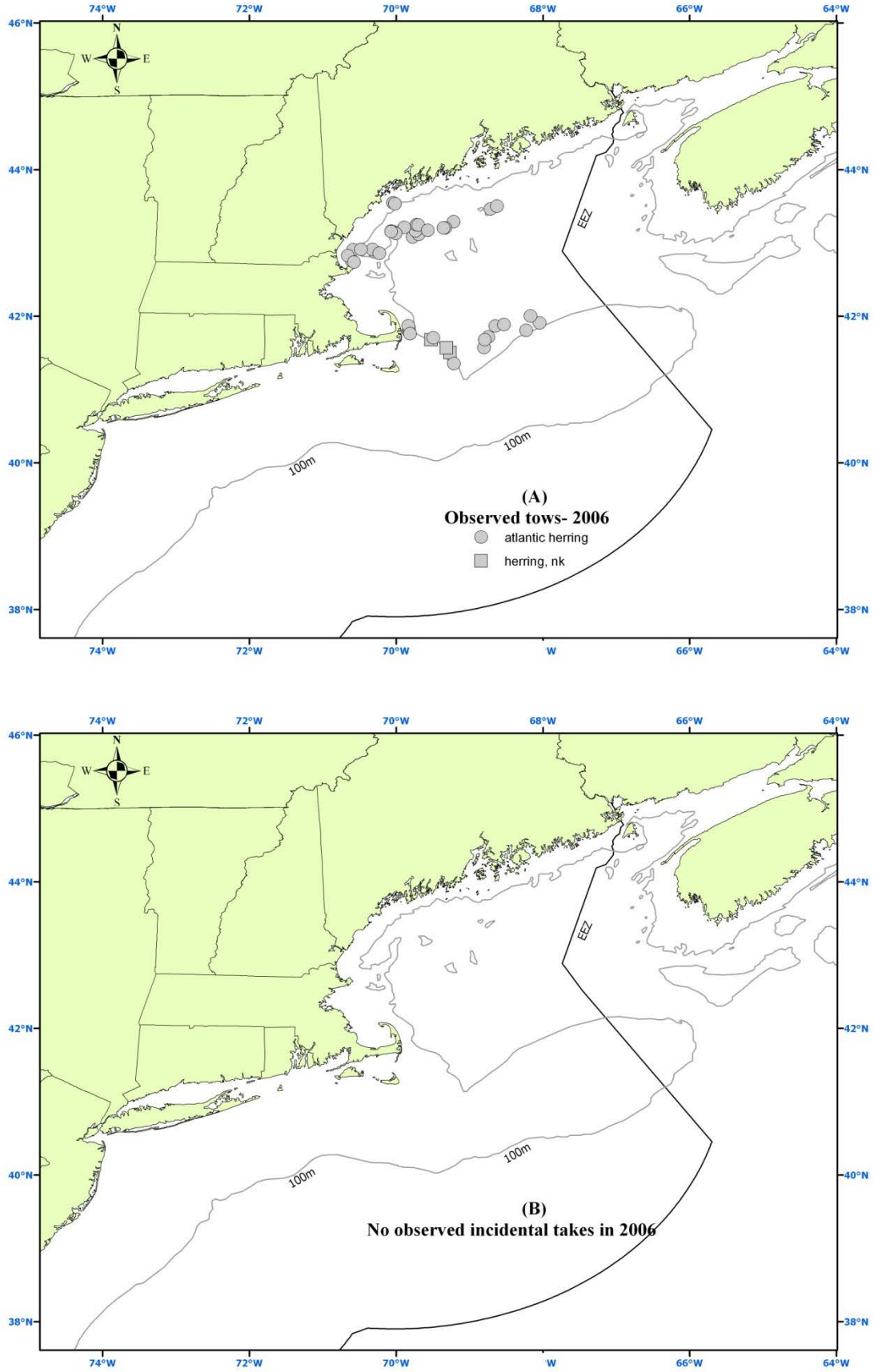


Figure 22. 2007 Northeast mid-water trawl observed tows (A) and observed takes (B).

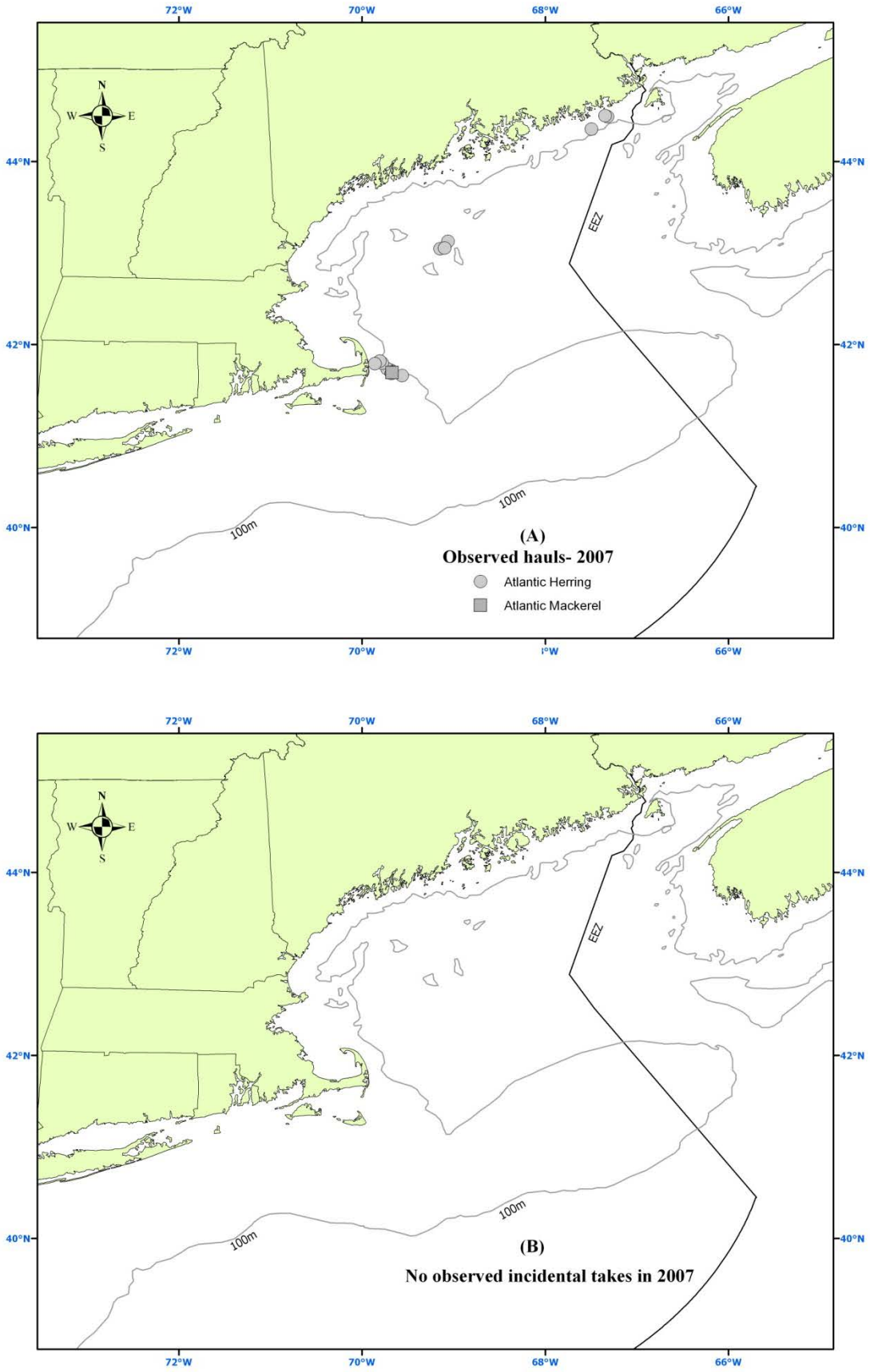
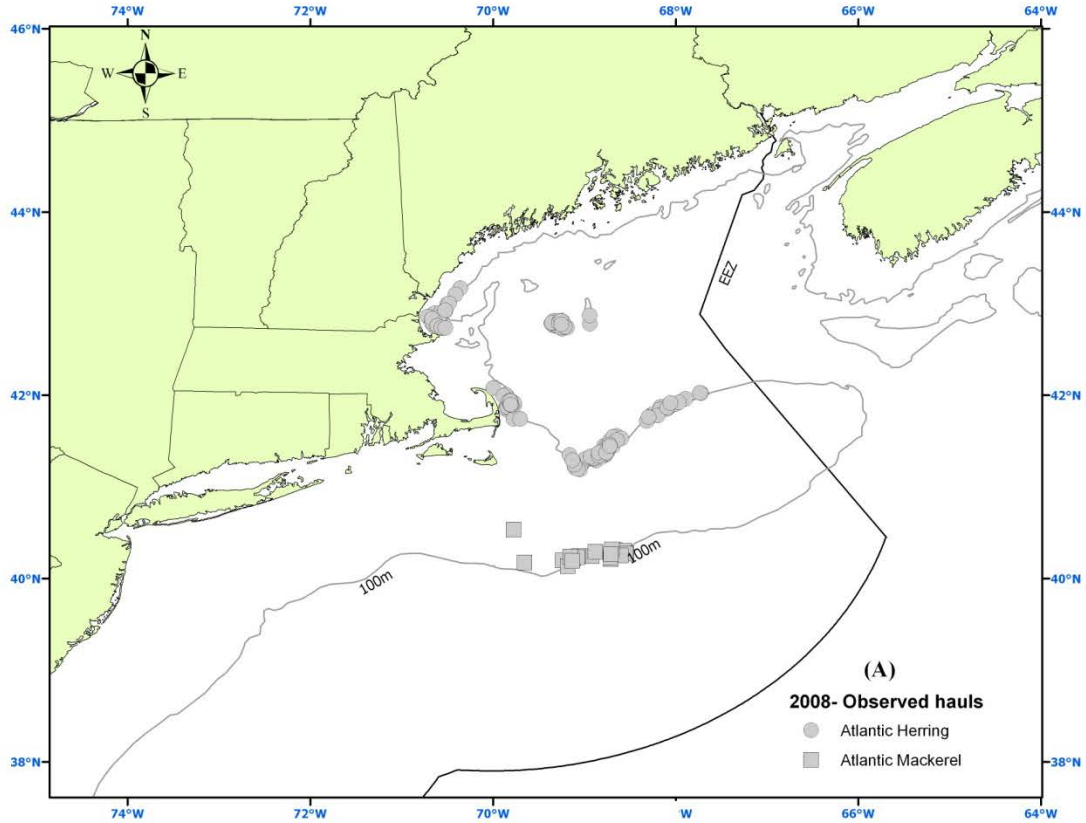


Figure 23. 2008 Northeast mid-water trawl observed tows (A) and observed takes (B).



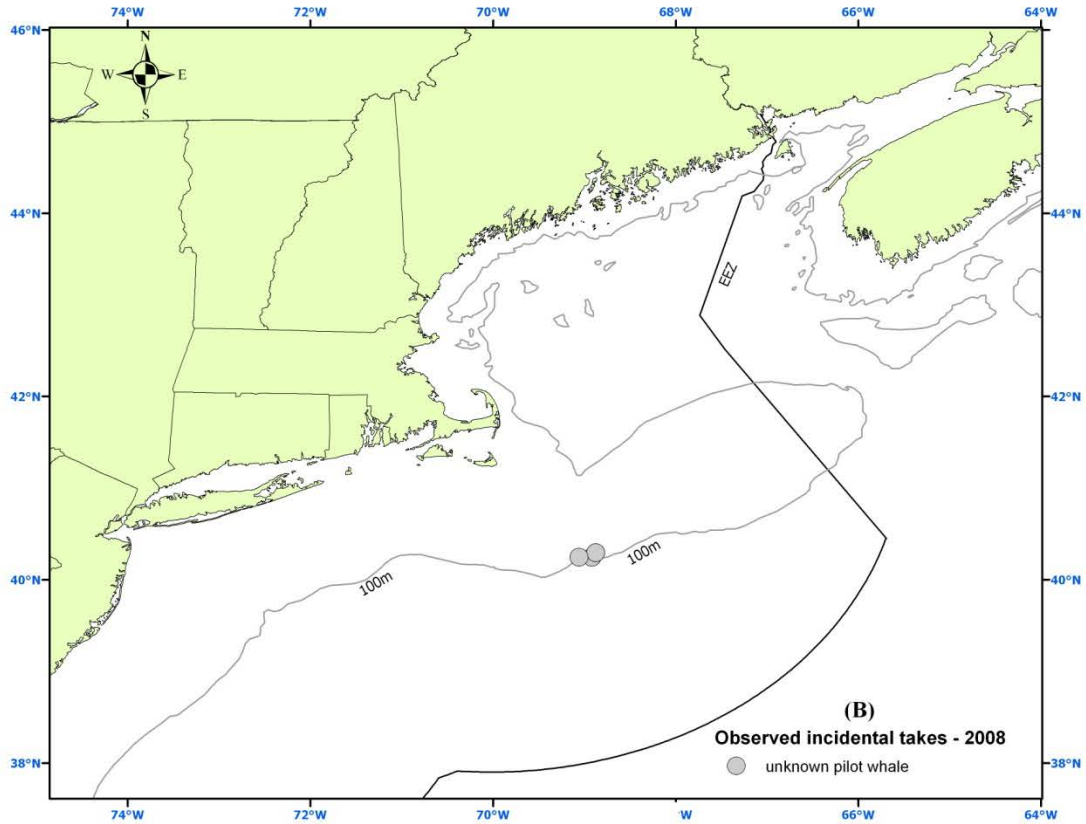
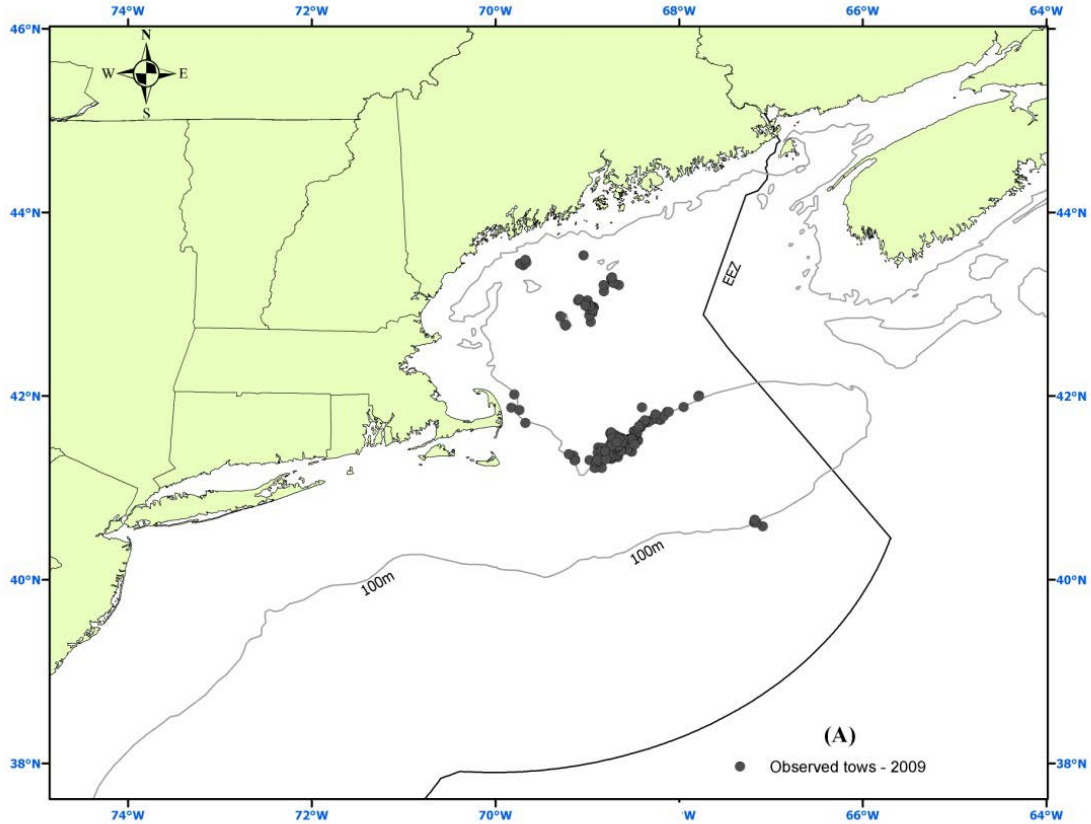


Figure 24. 2009 Northeast mid-water trawl observed tows (A) and observed takes (B).



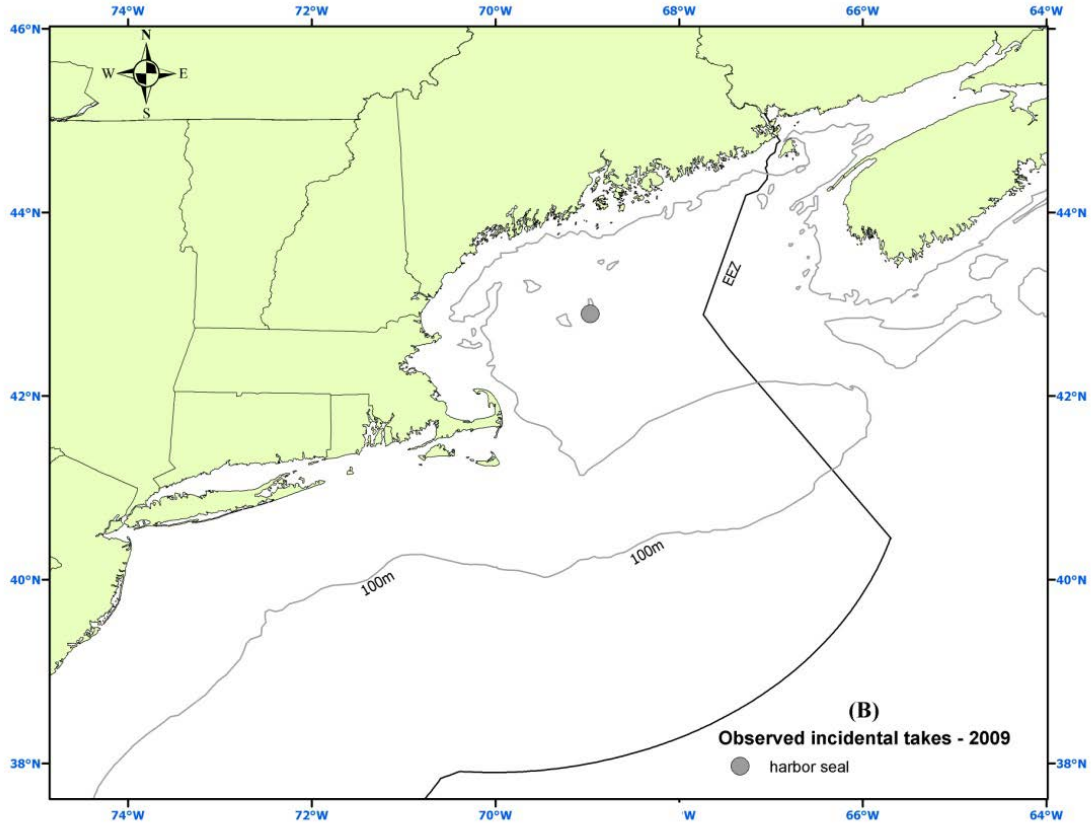


Figure 25. 2010 Northeast mid-water trawl observed tows (A) and observed takes (B).

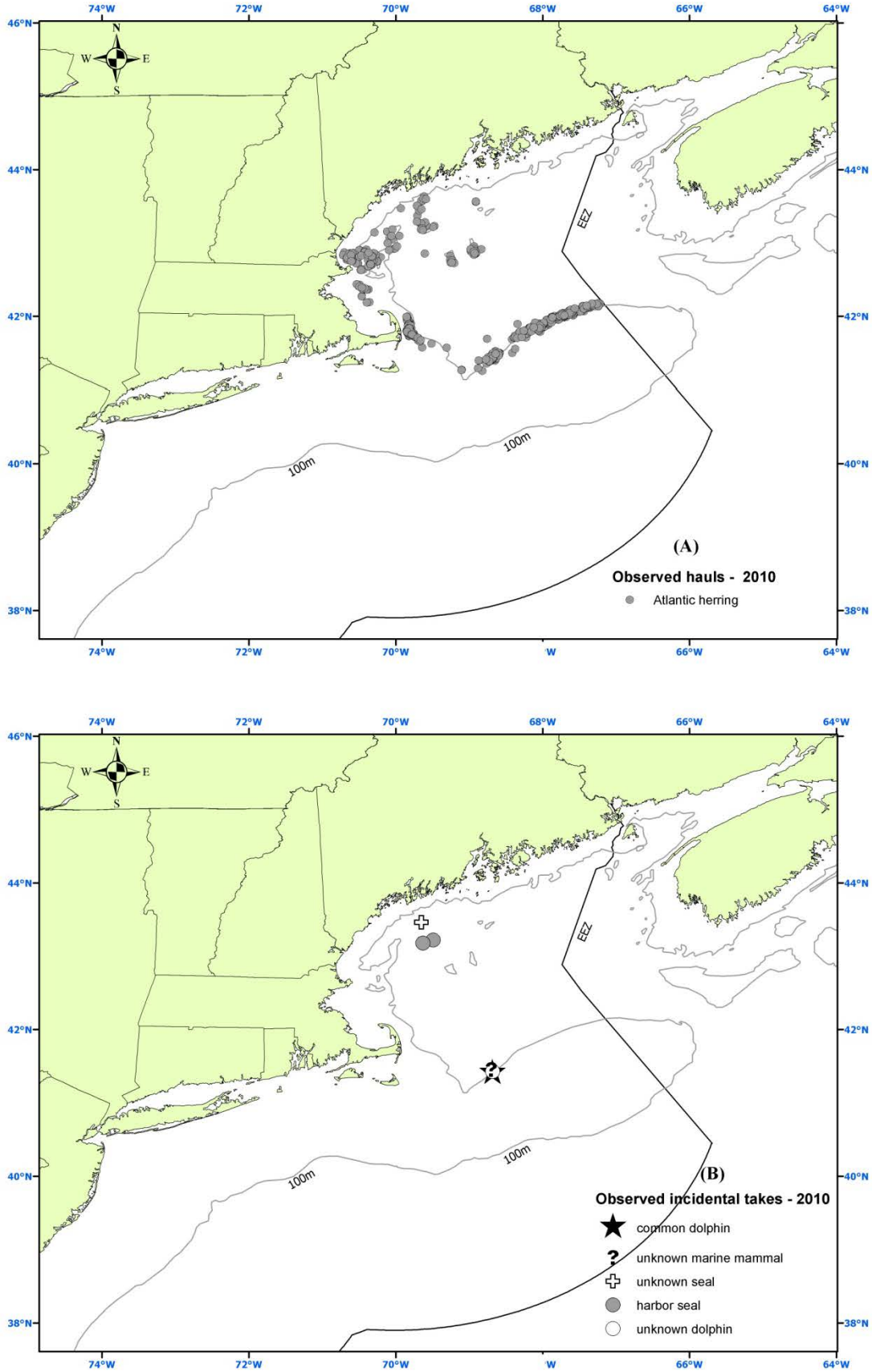


Figure 26. 2006 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

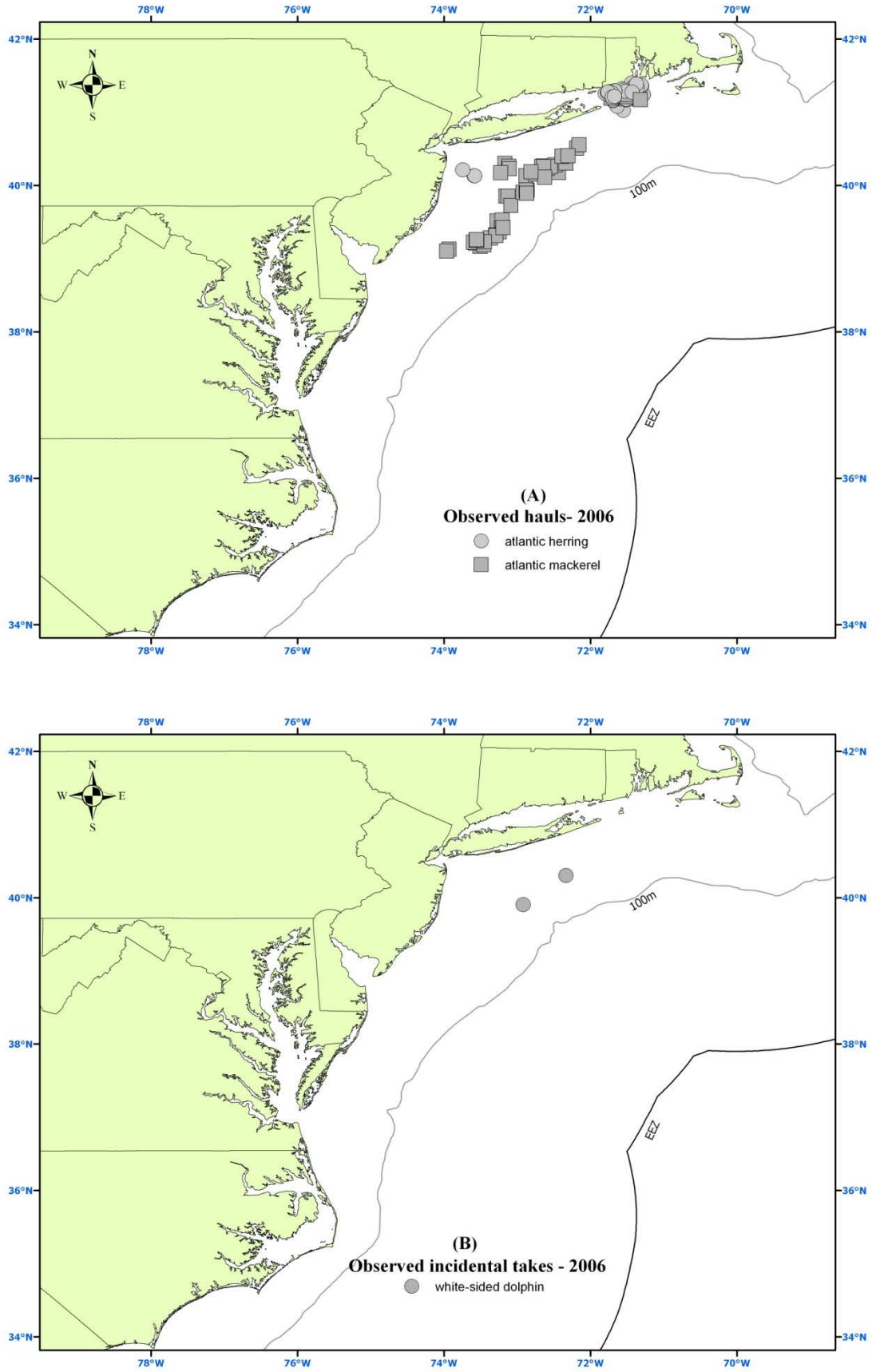


Figure 278. 2007 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

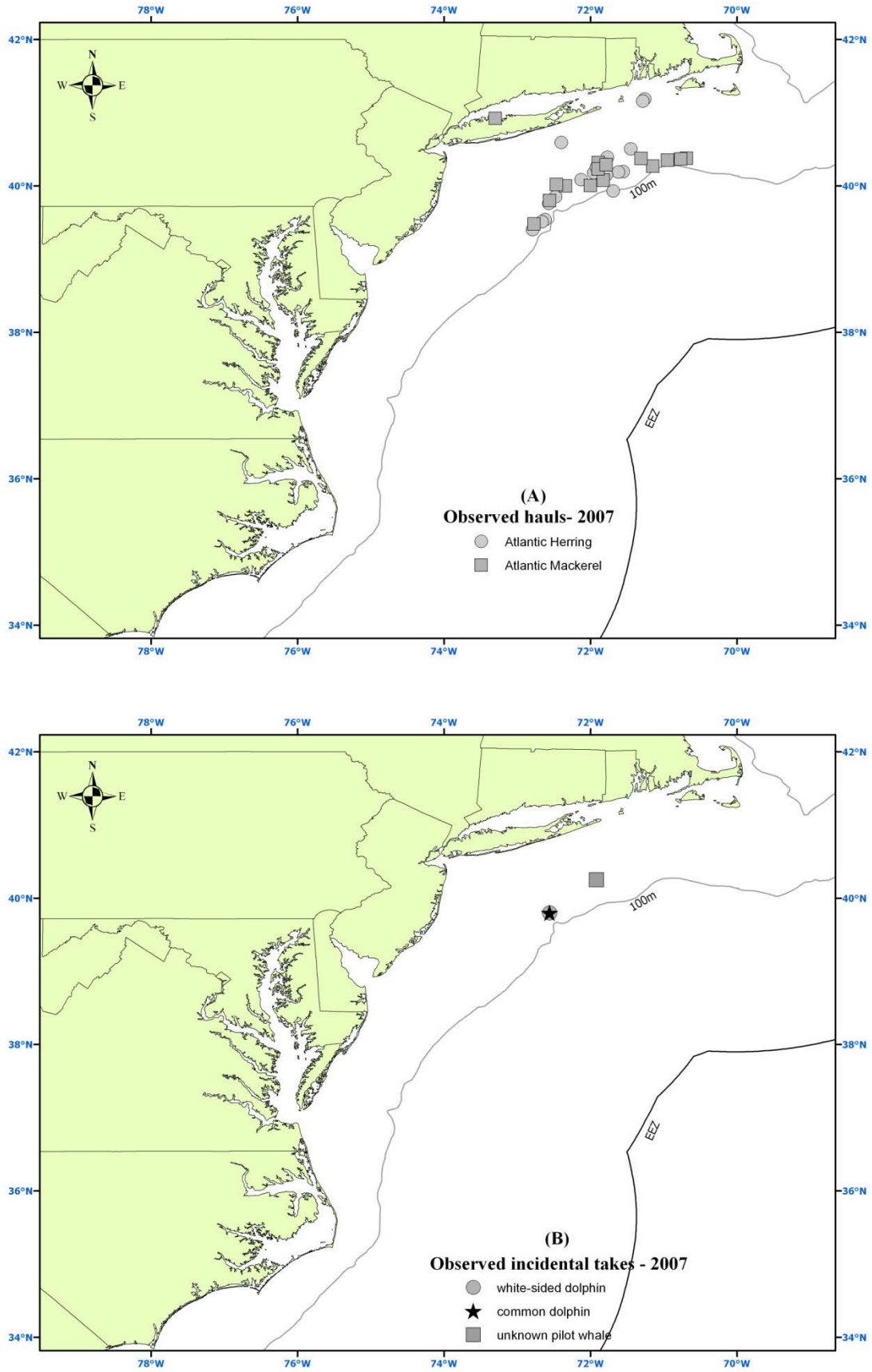


Figure 28. 2008 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

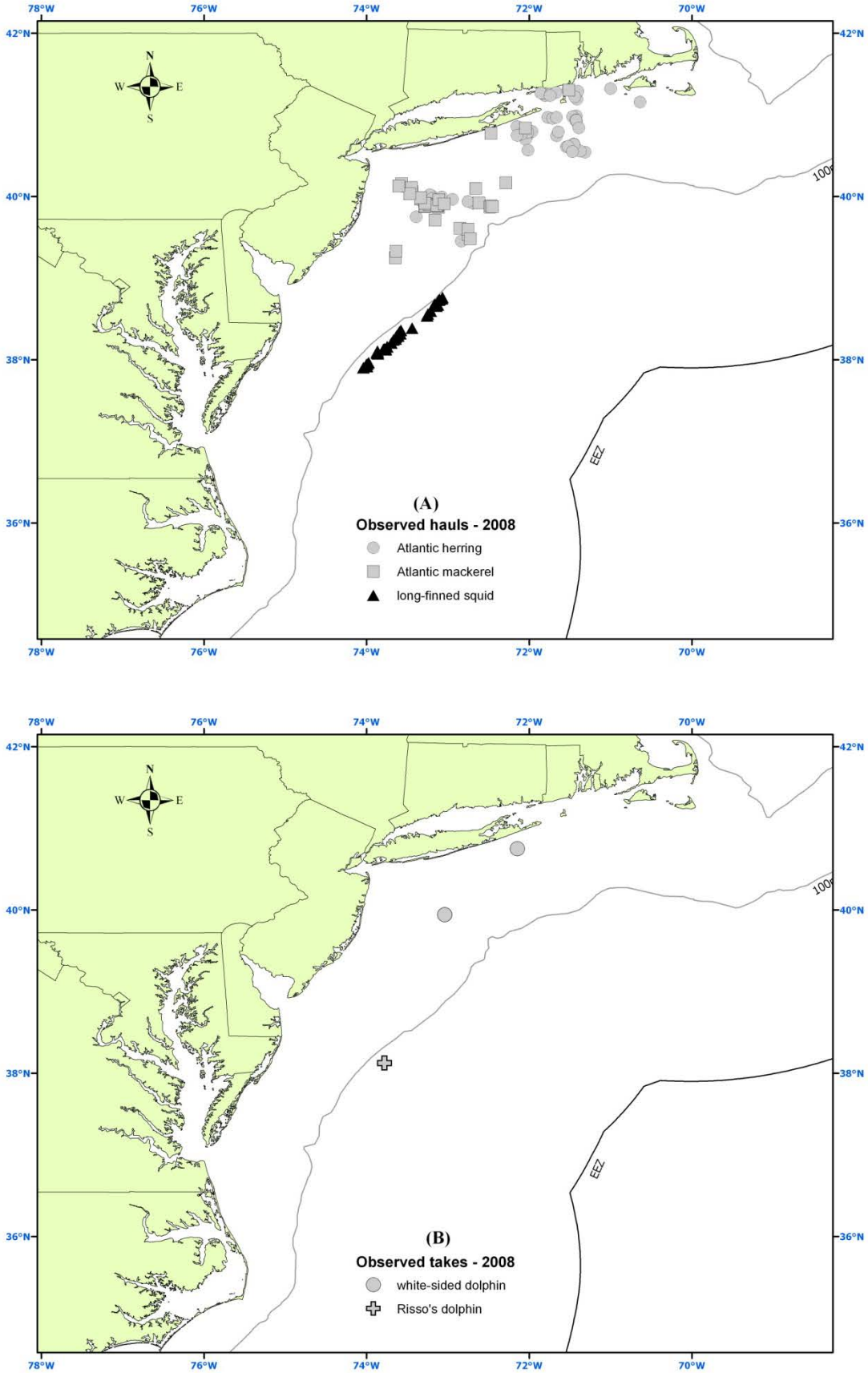


Figure 29. 2009 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

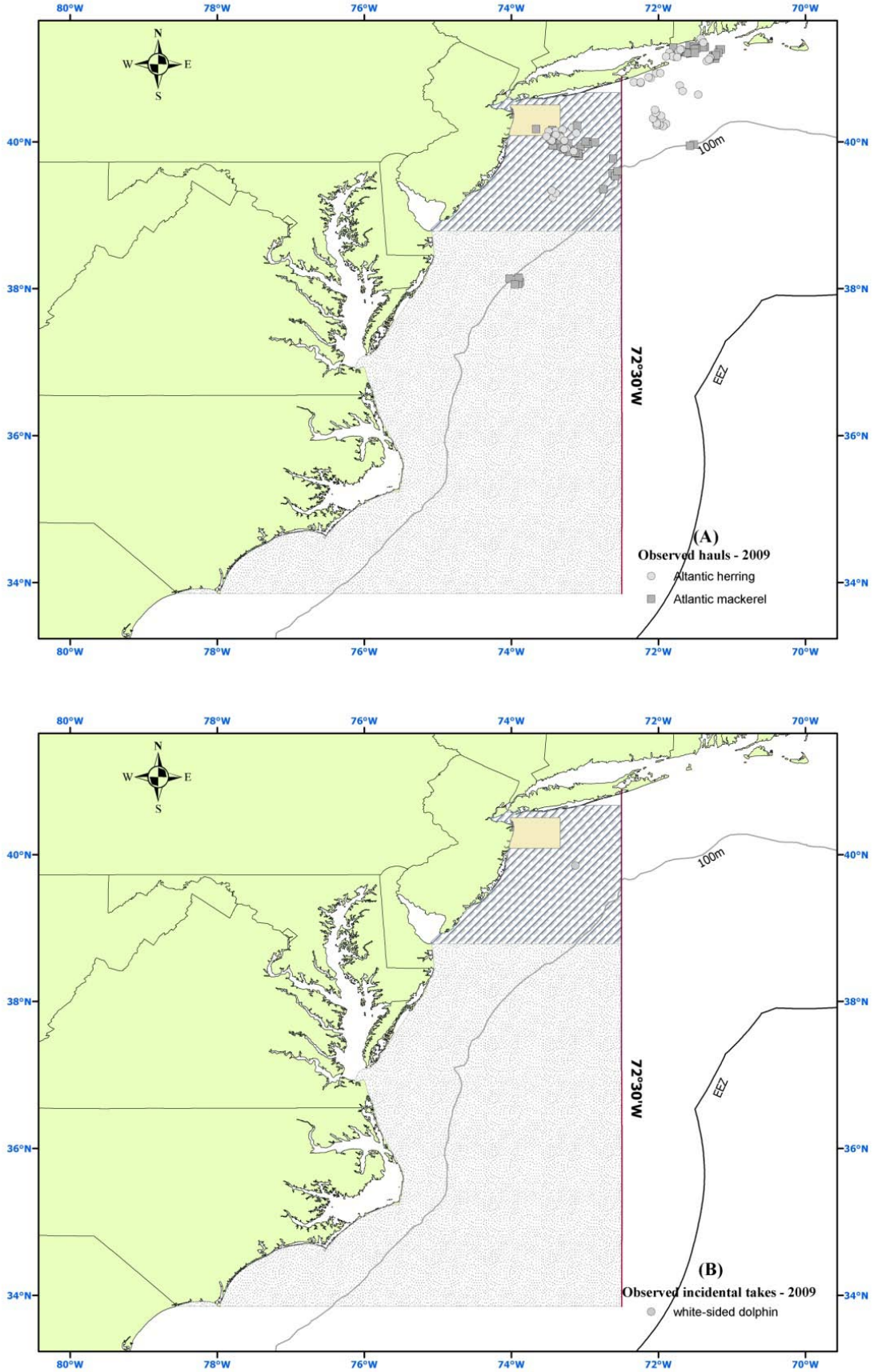


Figure 30. 210 Mid-Atlantic mid-water trawl observed tows (A) and observed takes (B).

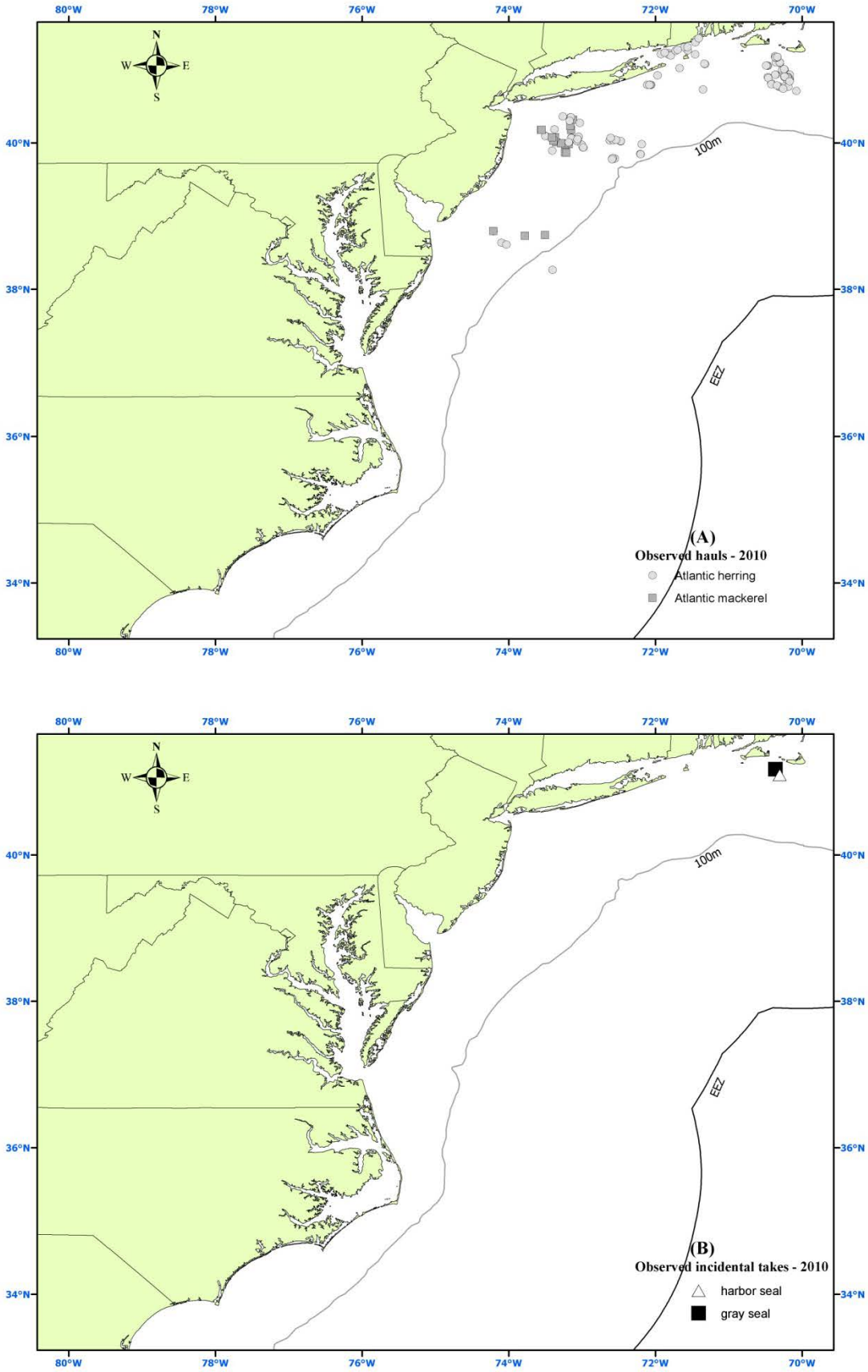
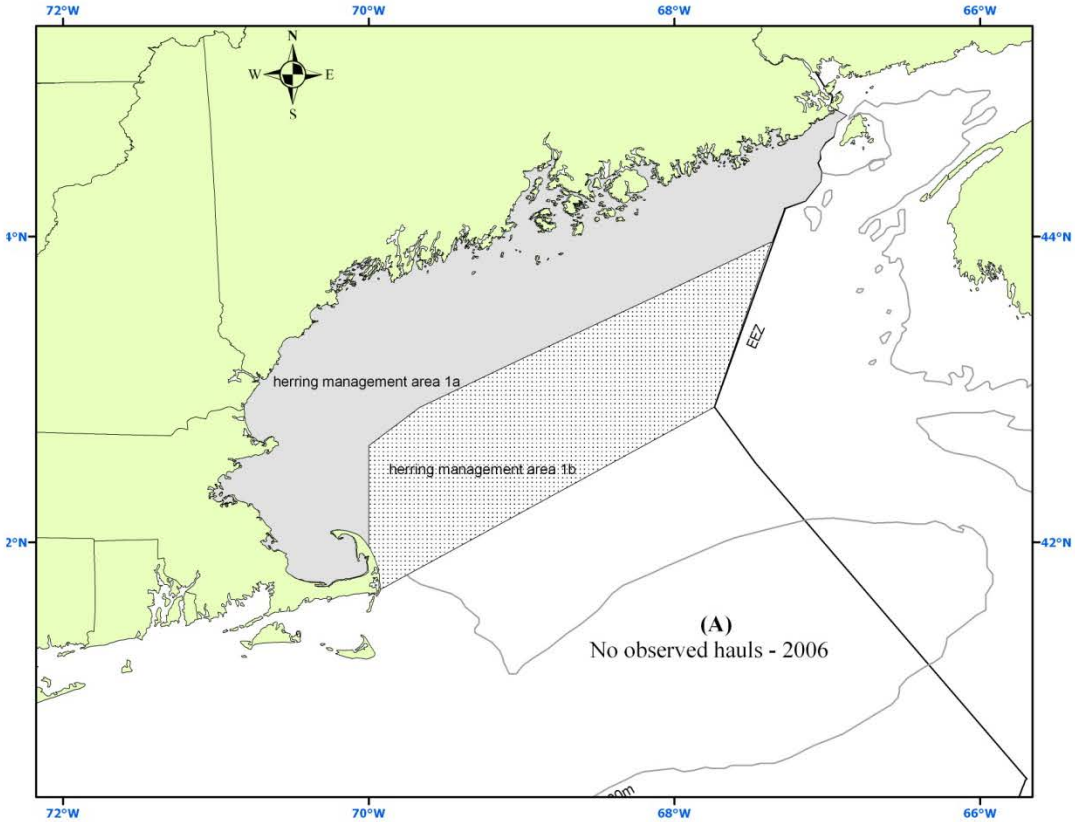


Figure 31. 2006 Herring Purse Seine observed hauls (A) and observed takes (B).



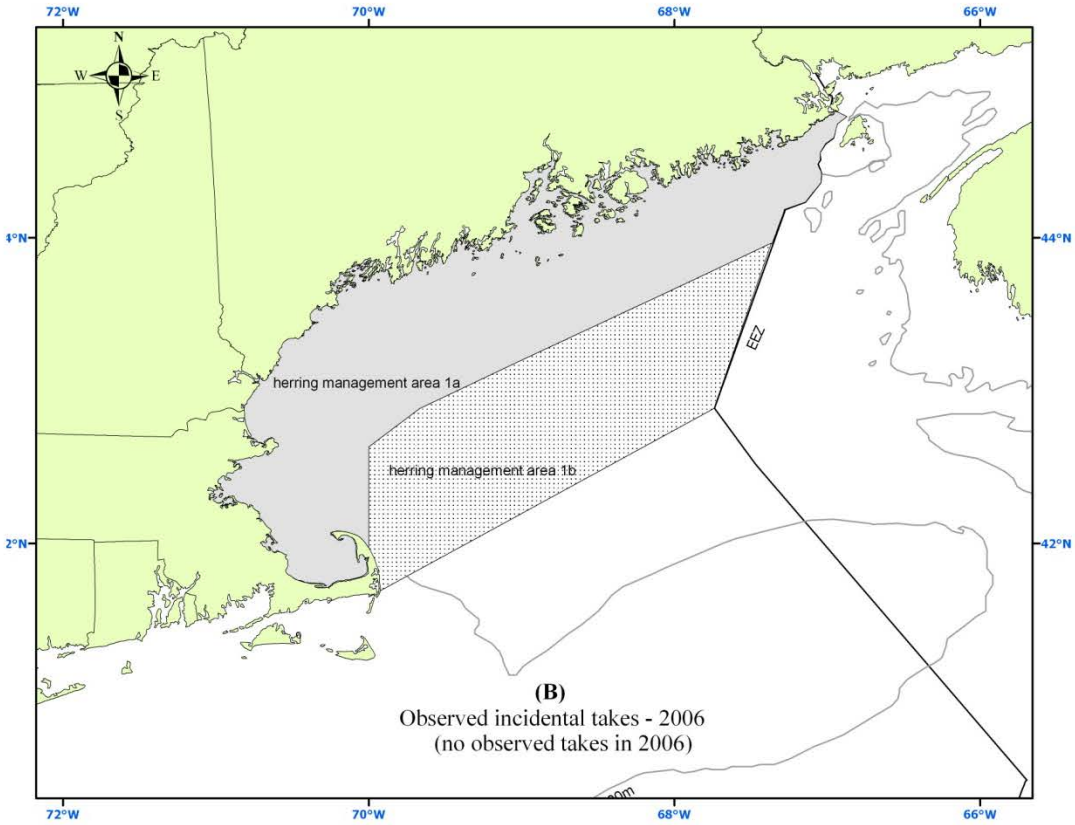
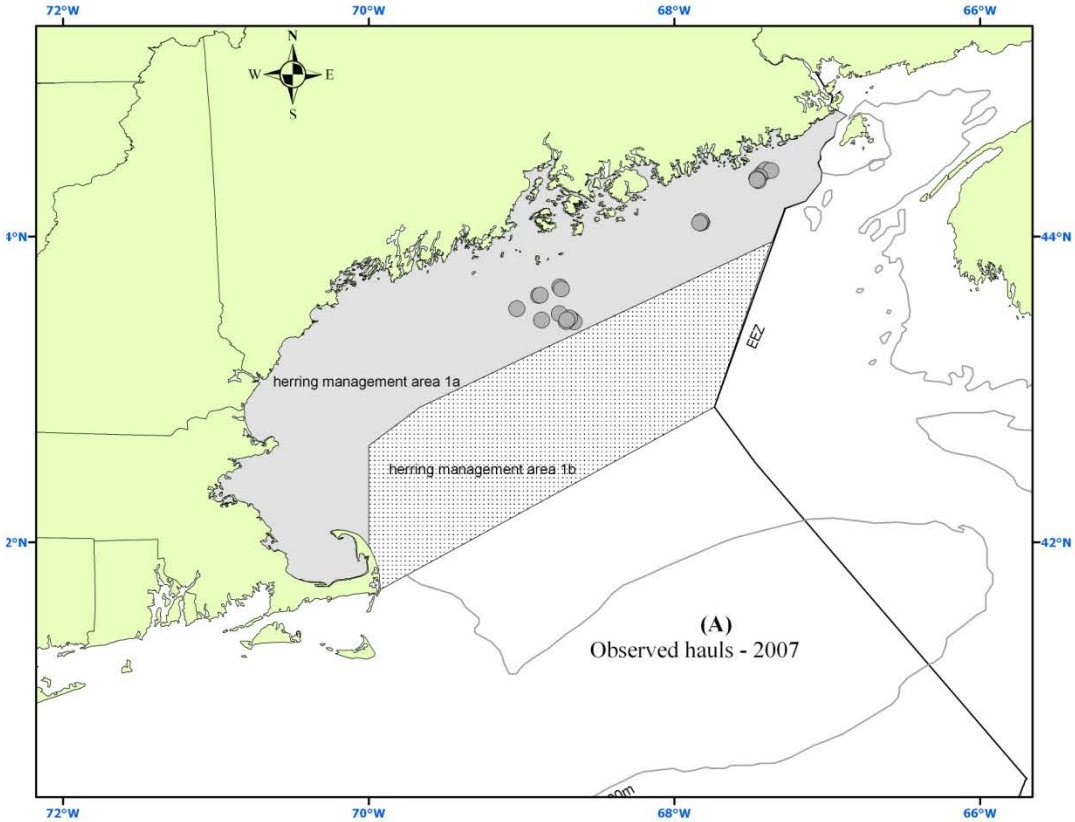


Figure 32. 2007 Herring Purse Seine observed hauls (A) and observed takes (B).



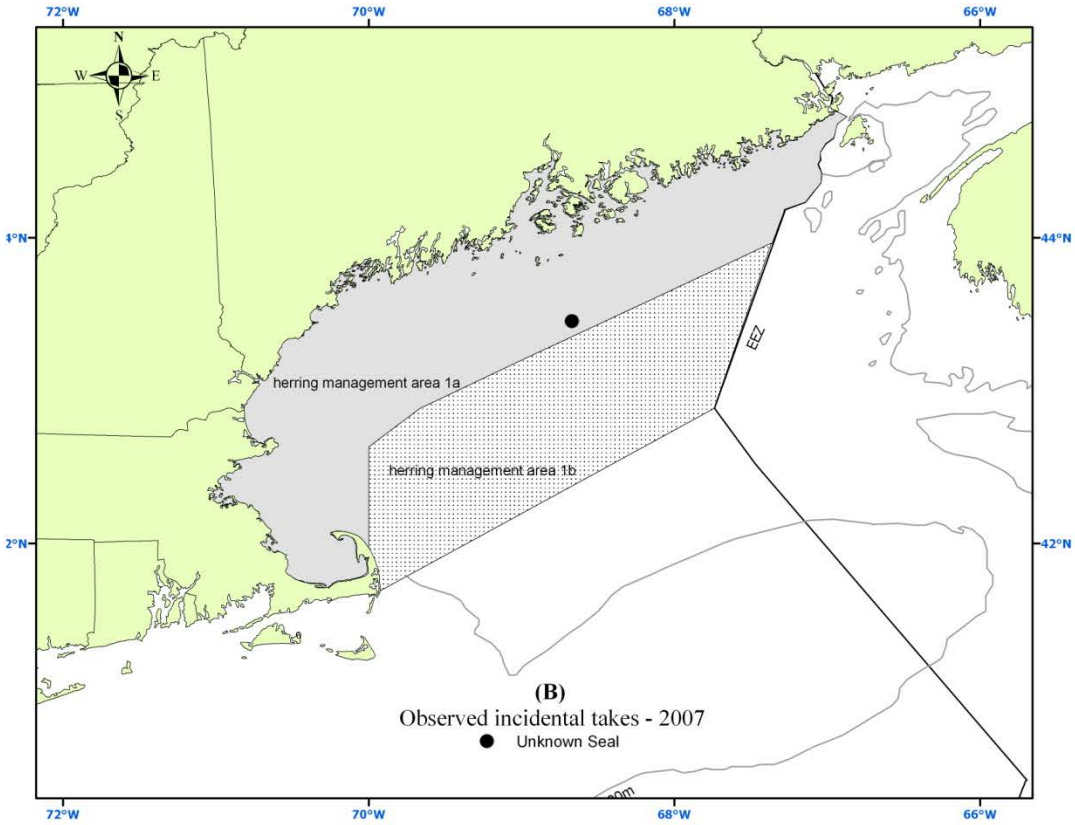


Figure 33. 2008 Herring Purse Seine observed hauls (A) and observed takes (B).

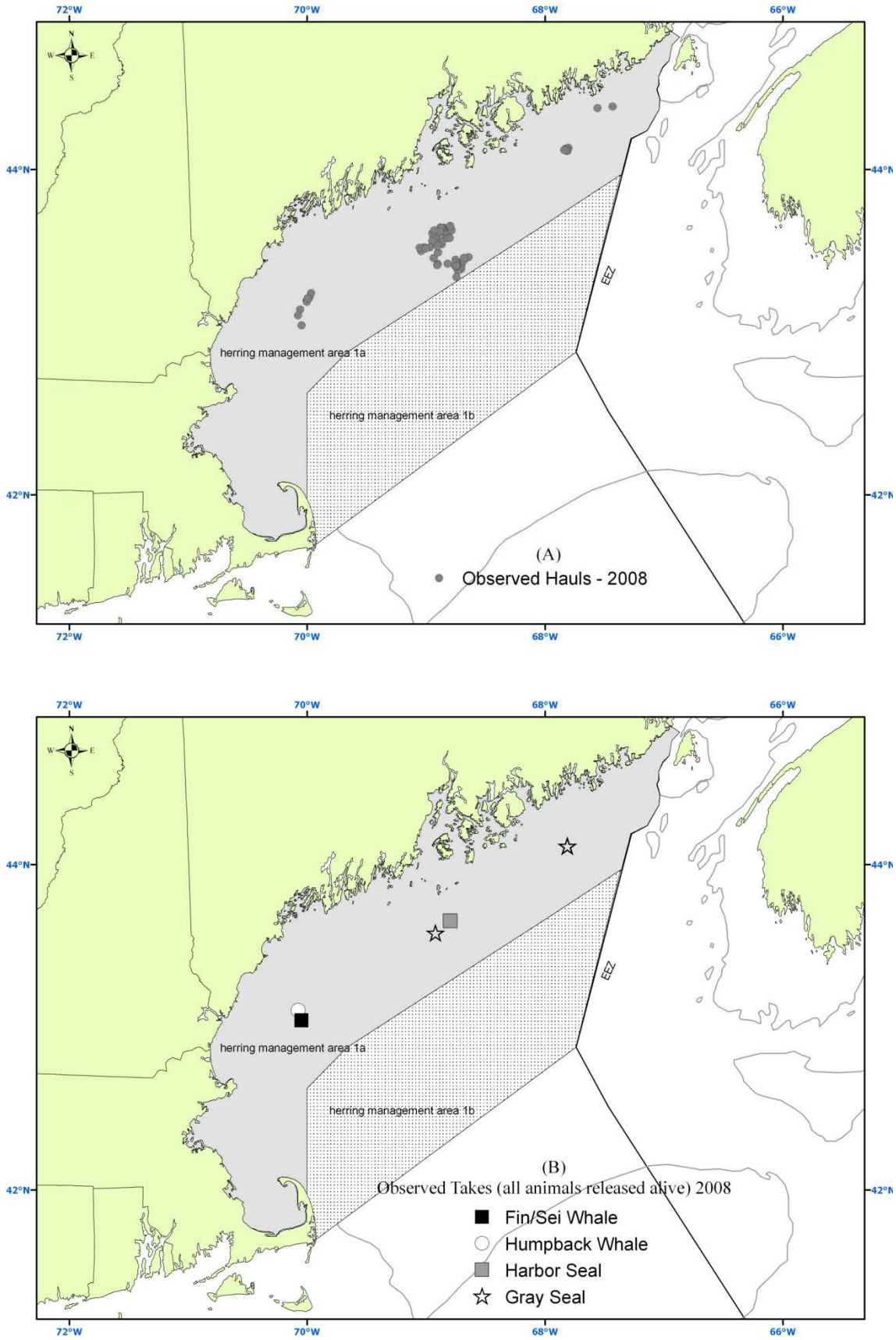


Figure 34. 2009 Herring Purse Seine observed hauls (A) and observed takes (B).

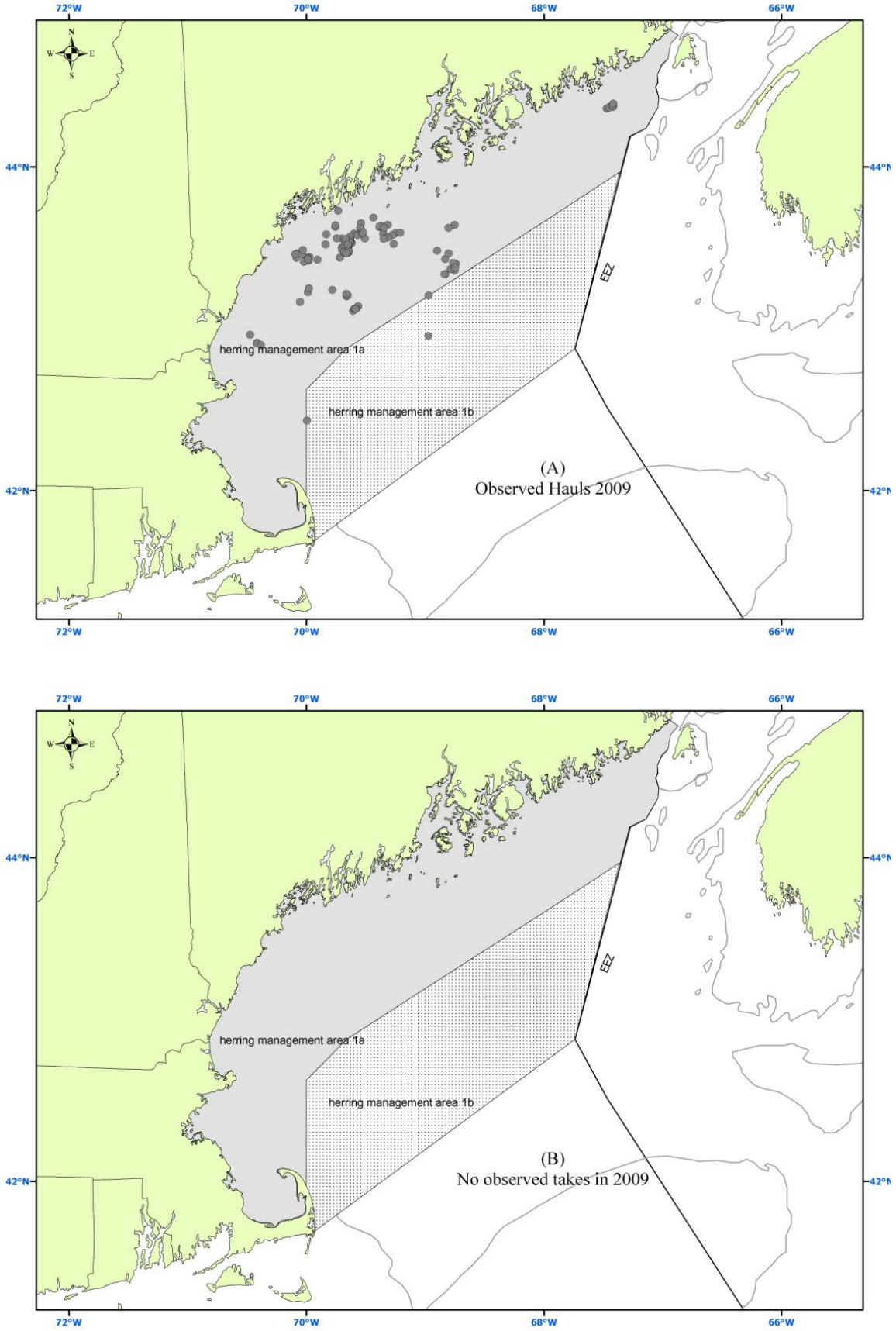
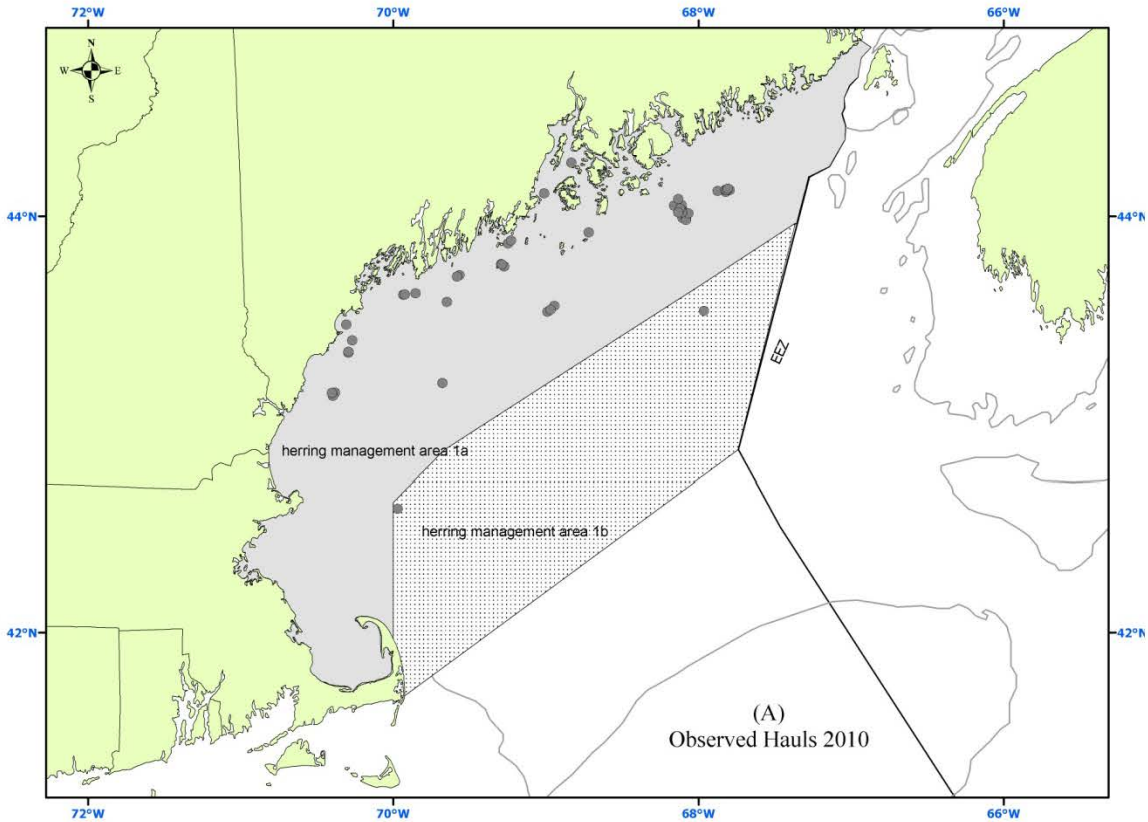


Figure 35. 2010 Herring Purse Seine observed hauls (A) and observed takes (B).



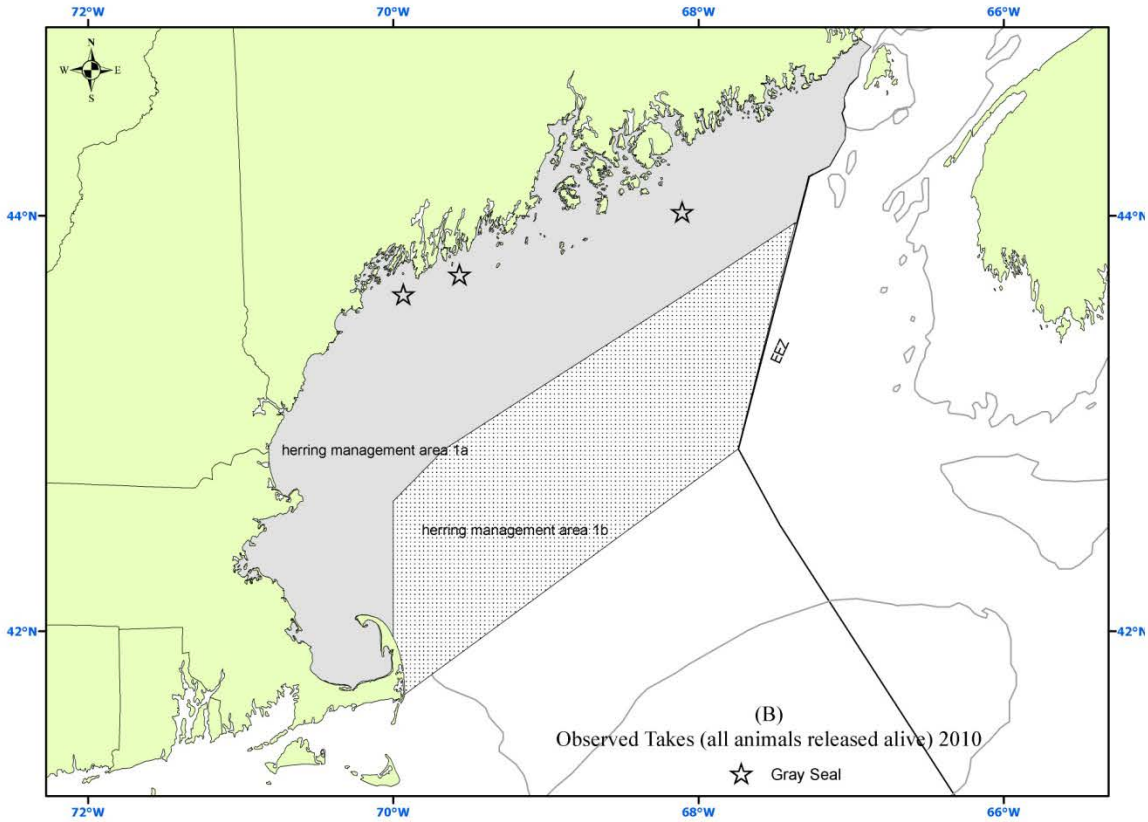


Figure 36. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2006. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

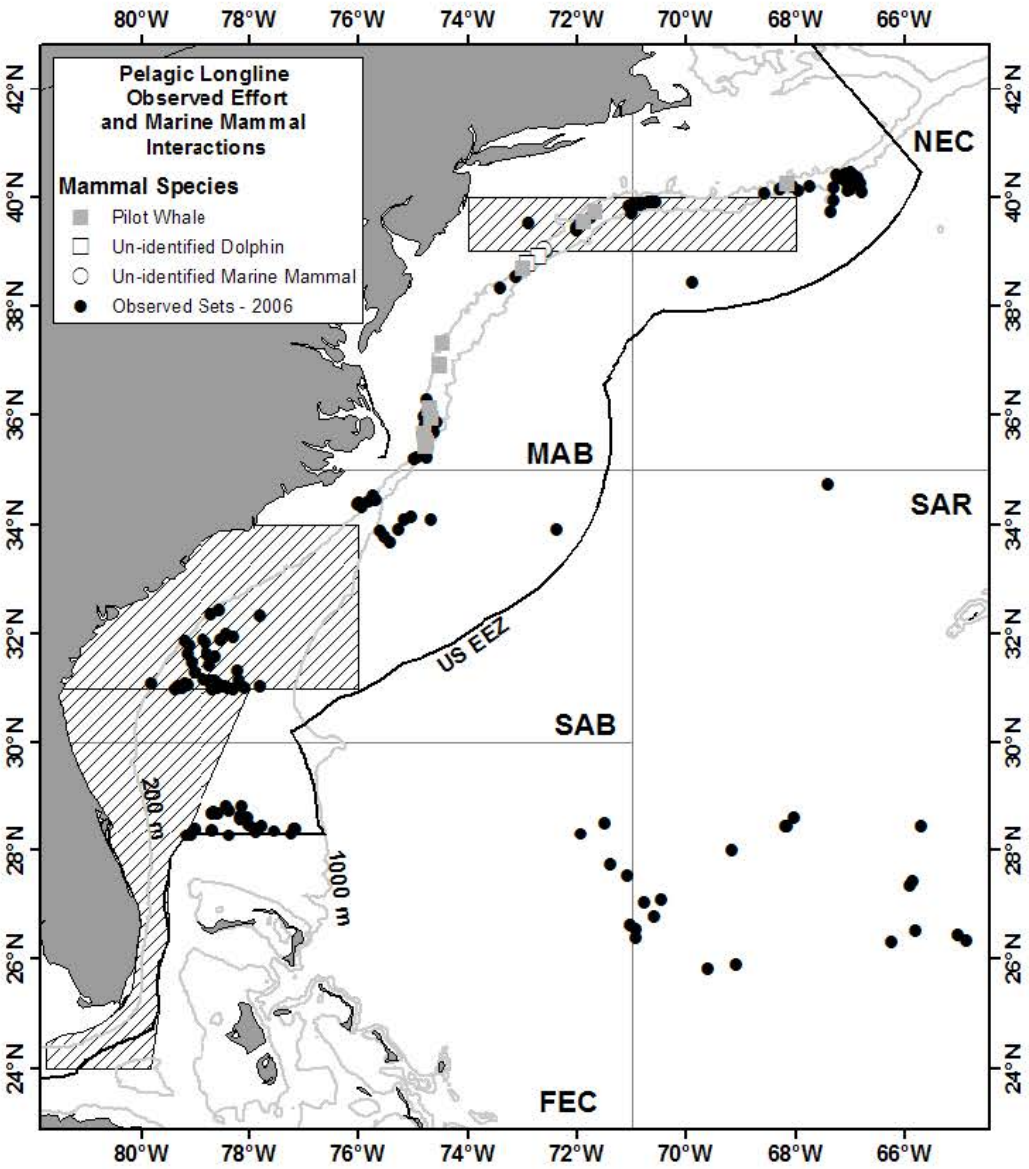


Figure 37. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2007. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

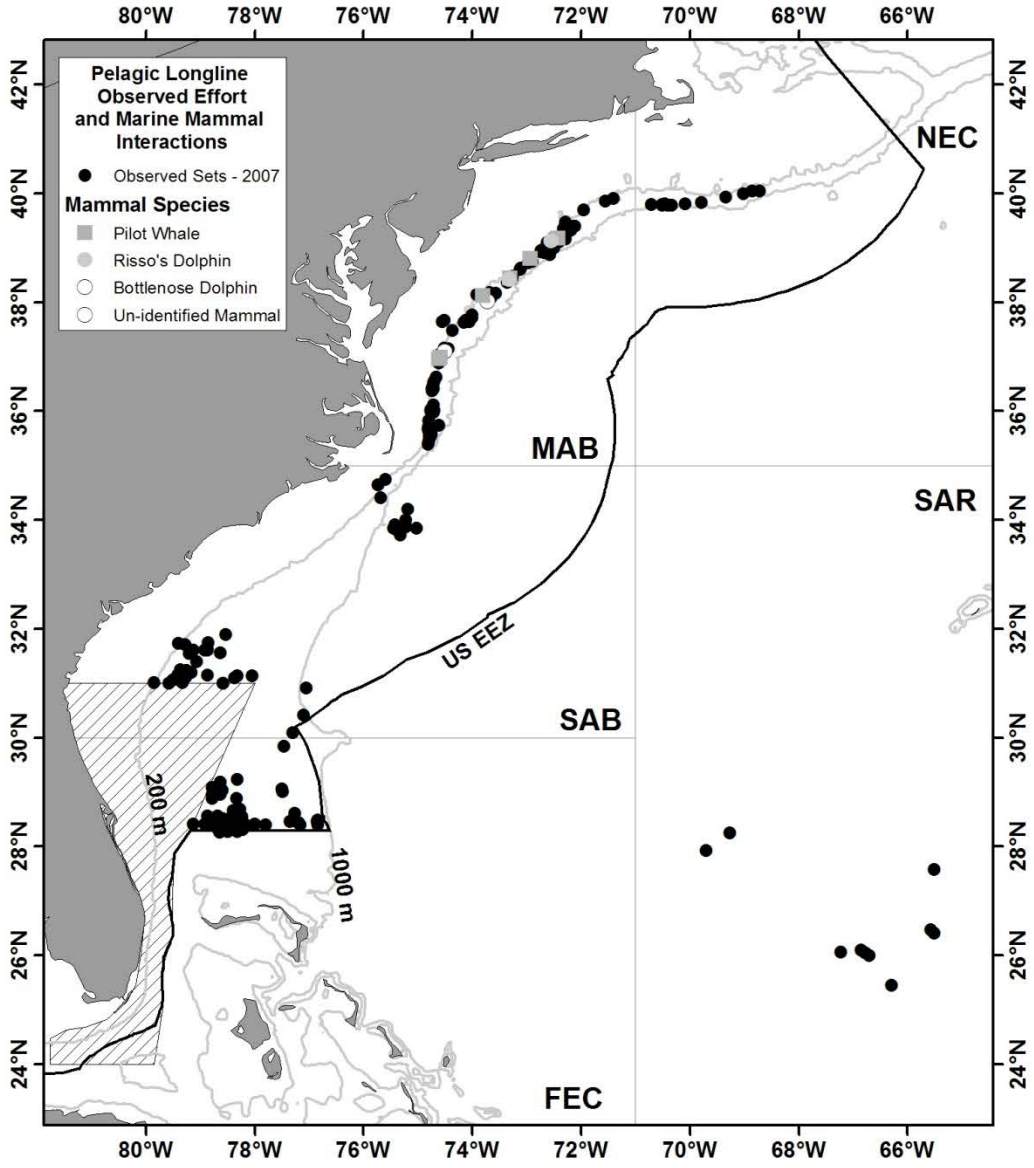


Figure 38. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2008. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

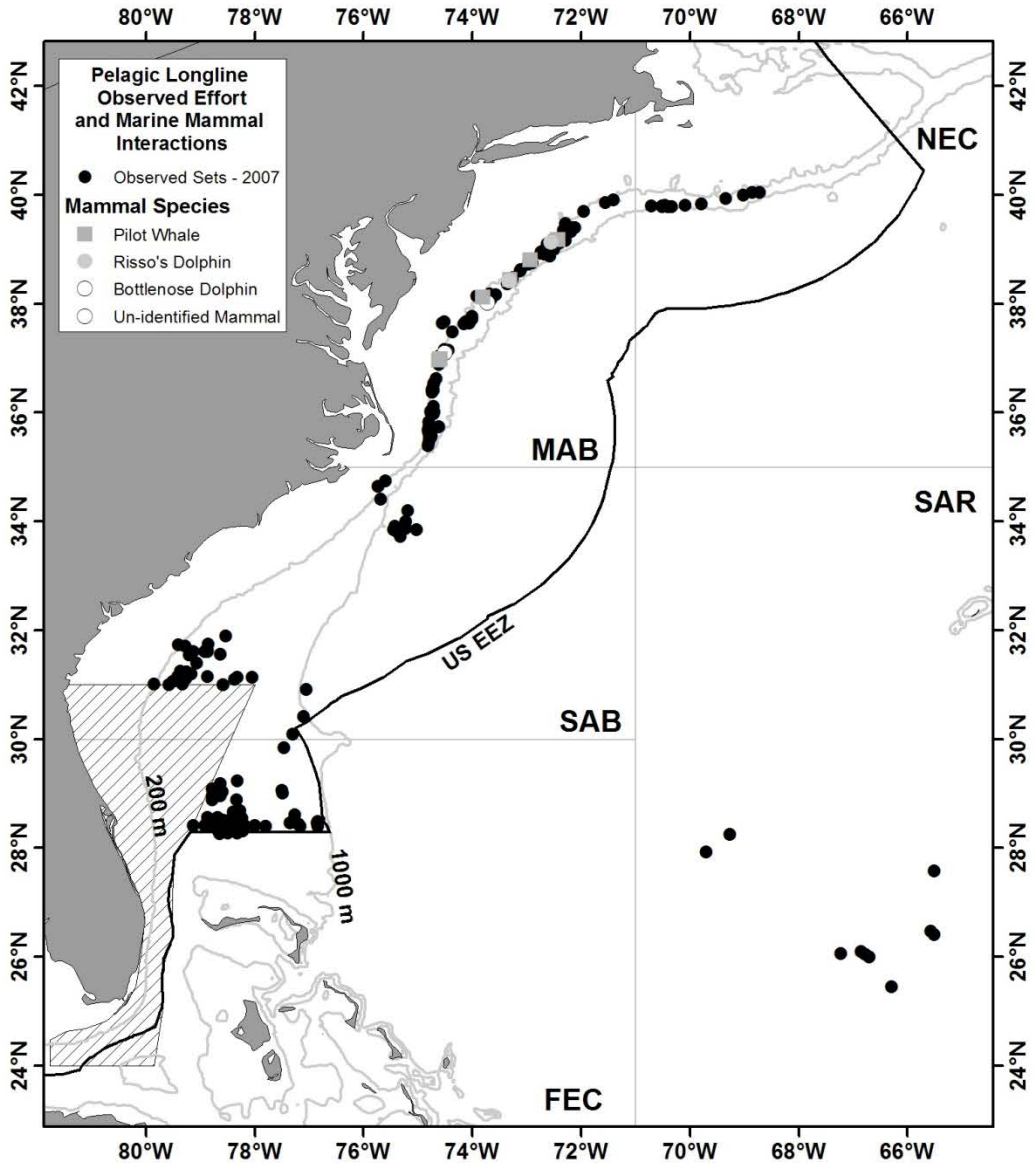


Figure 39. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2009. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

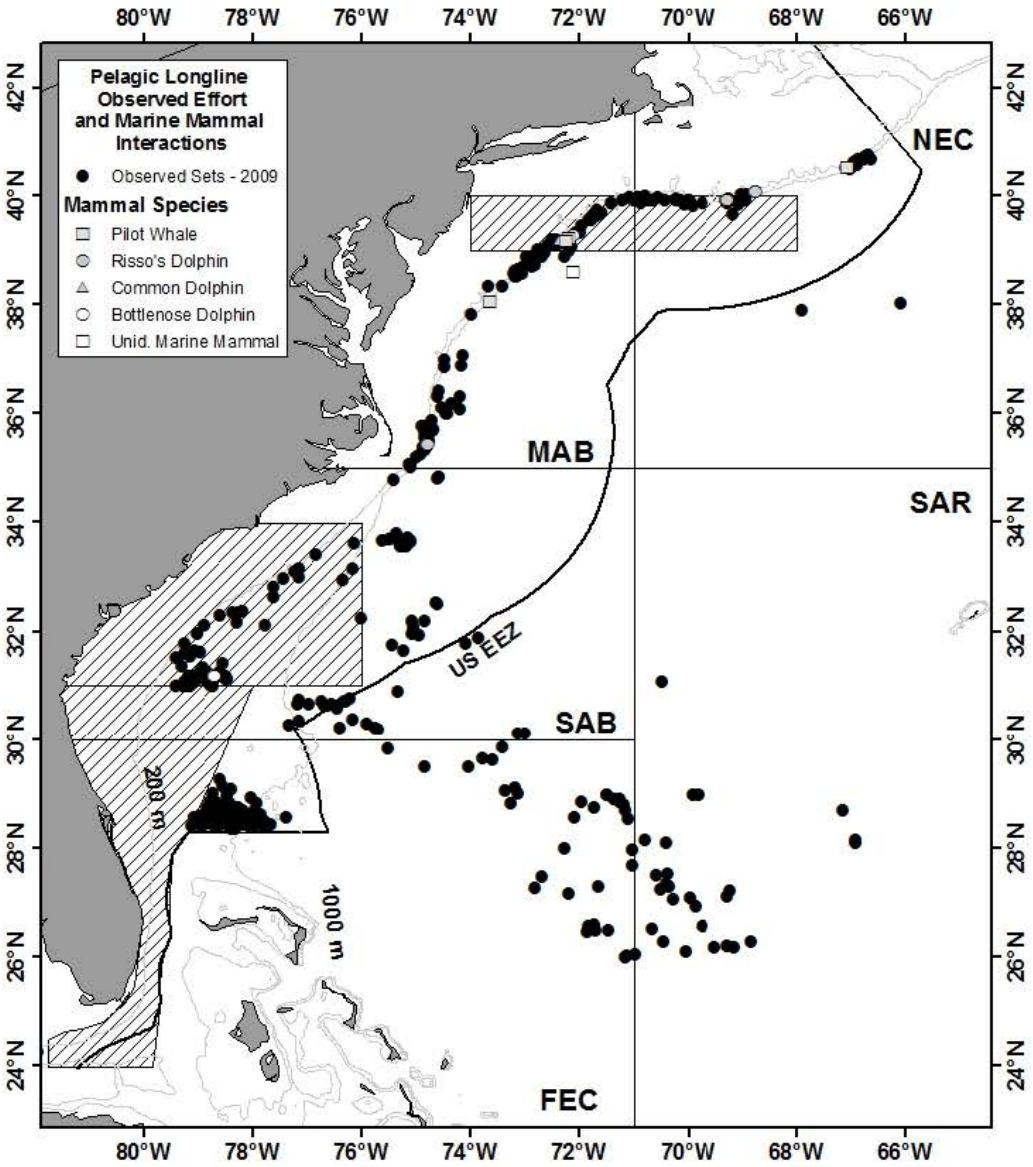


Figure 40. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2010. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

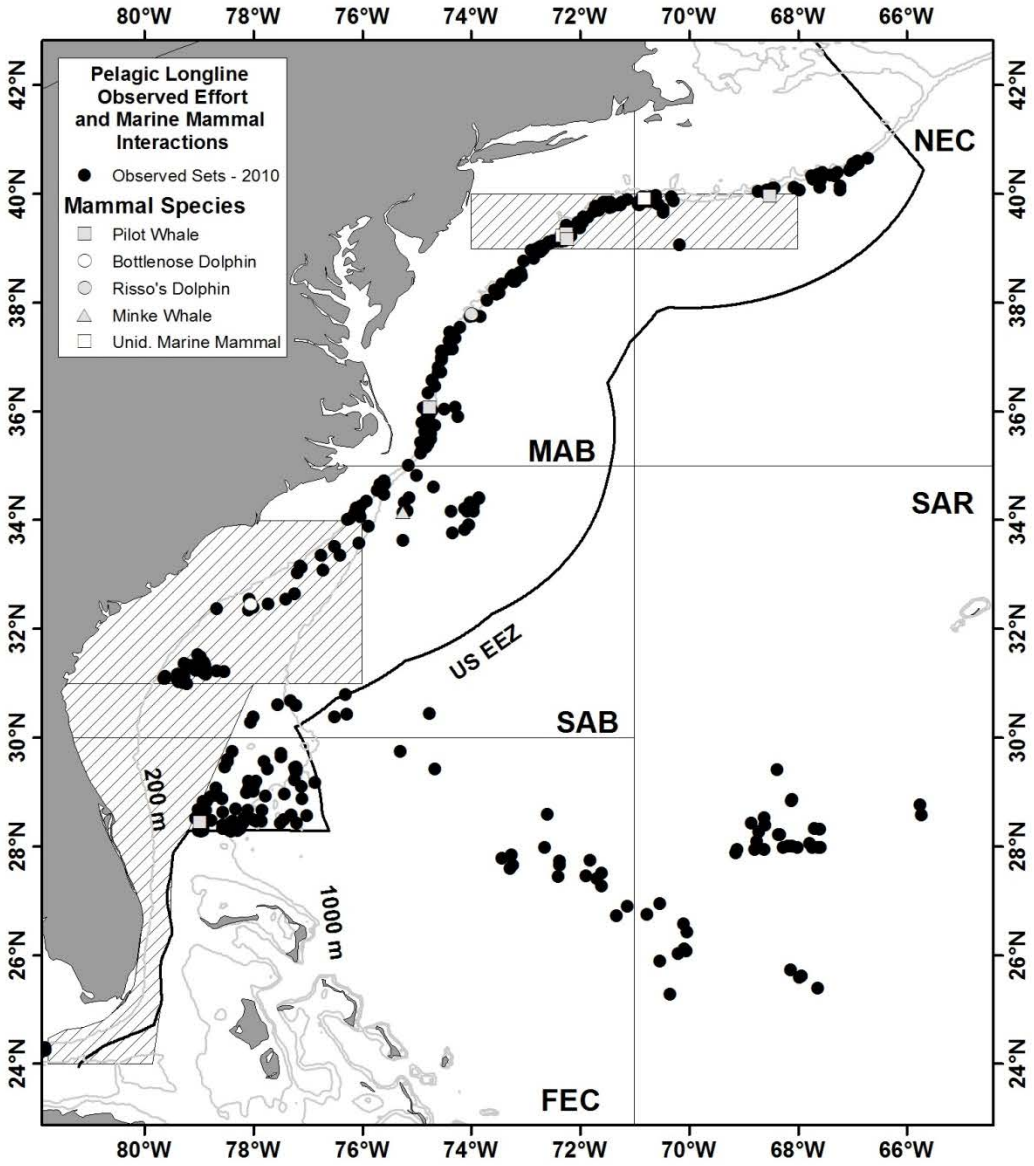


Figure 41. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2006. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

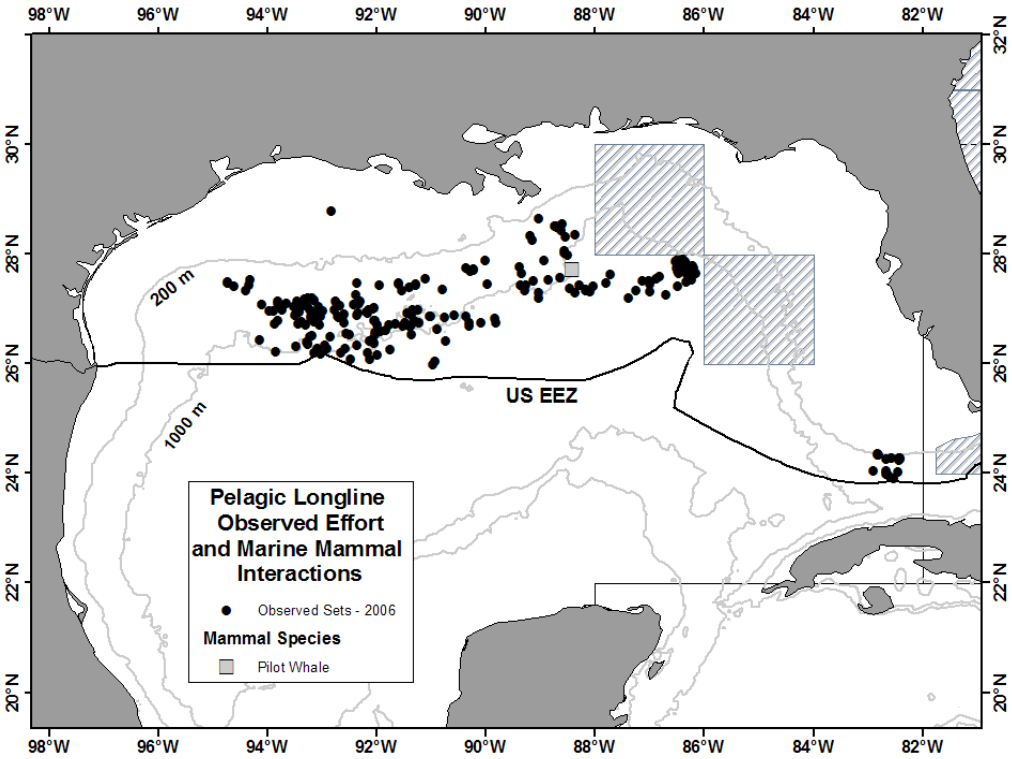


Figure 42. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2007. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

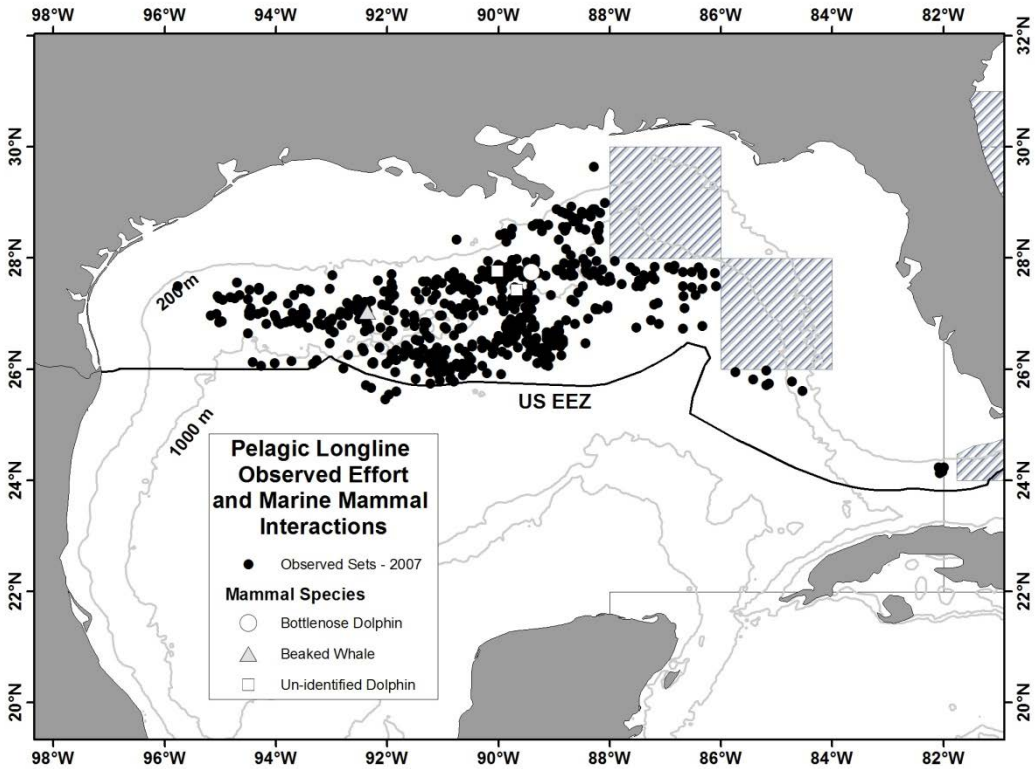


Figure 43. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2008. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

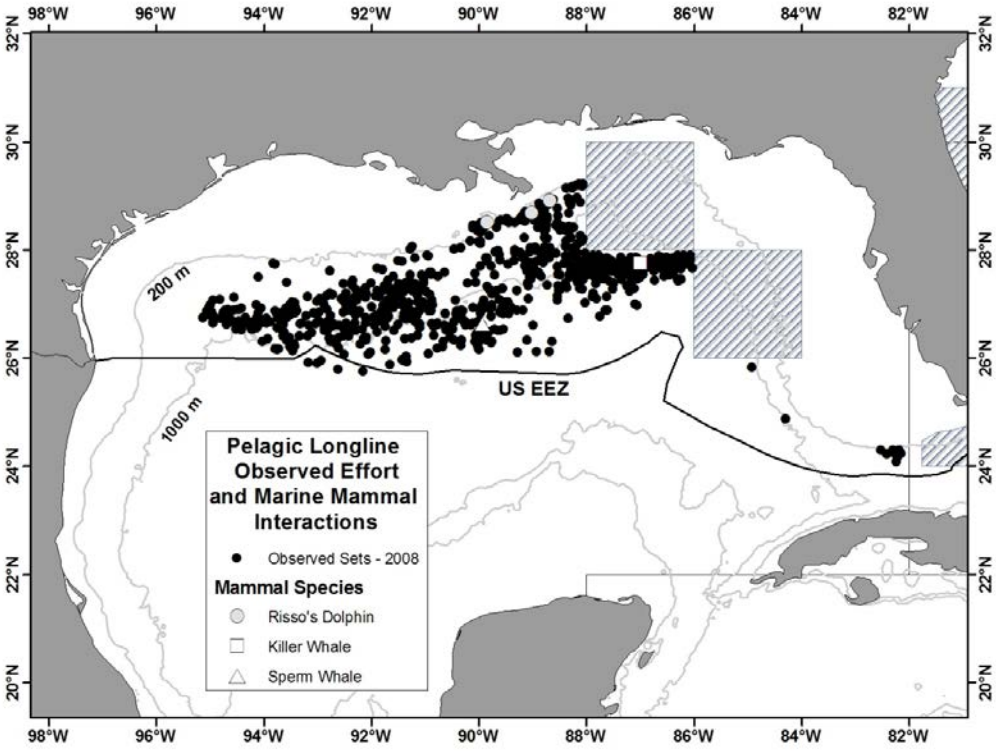


Figure 44. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2009. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

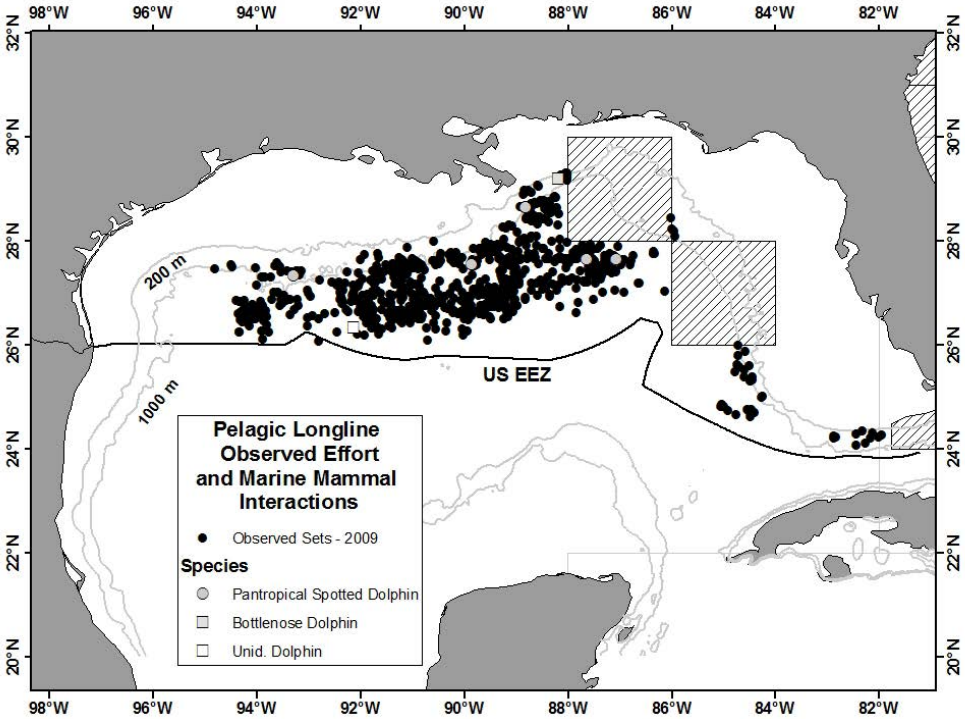
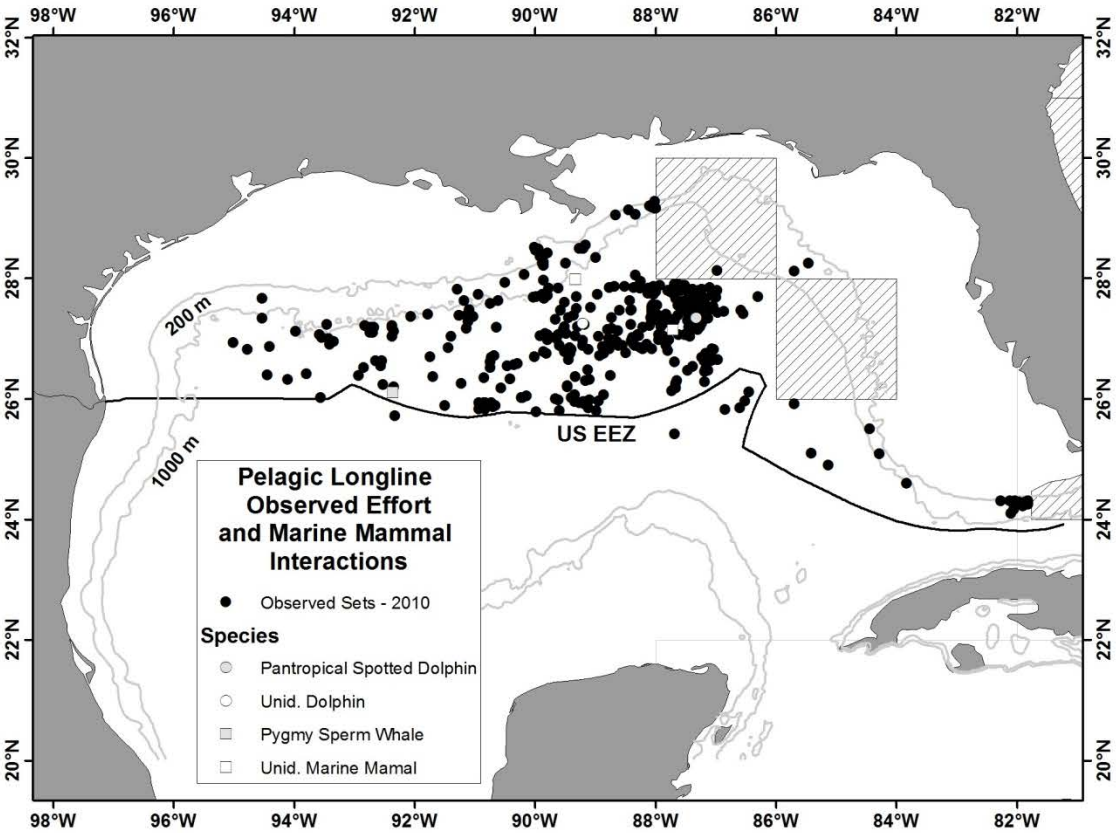


Figure 45. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2010. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.



APPENDIX IV: Table A. Surveys

Survey Number	Year	Season	Platform	Track line length (km)	Area	Agency/ Program	Analysis	Corrected for g(0)	Reference
1	1982	year-round	plane (AT-11; 1978-1982)	211,585	Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	CETAP	Line transect analyses of distance data	N	(CETAP 1982)
2	1990	Aug	ship (Chapman)	2,067	Cape Hatteras, NC to Southern New England, North wall of the Gulf Stream	NEC	One team data analyzed by DISTANCE.	N	(NMFS 1990)
3	1991	Jul–Aug	ship (Abel-J)	1,962	Gulf of Maine, lower Bay of Fundy, southern Scotian Shelf	NEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Palka 1995)
4	1991	Aug	boat (Sneak Attack)	640	inshore bays of Maine	NEC	One team data analyzed by DISTANCE.	Y	(Palka 1995)
5	1991	Aug–Sep	plane 1(AT-11)	9,663	Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	NEC/SEC	One team data analyzed by DISTANCE.	N	(NMFS 1991)
6	1991	Aug–Sep	plane 2 (Twin Otter)		Cape Hatteras, NC to Nova Scotia, continental shelf and shelf edge waters	NEC/SEC	One team data analyzed by DISTANCE.	N	(NMFS 1991)
7	1991	Jun–Jul	ship (Chapman)	4,032	Cape Hatteras to Georges Bank, between 200 and 2,000m isobaths	NEC	One team data analyzed by DISTANCE.	N	(Waring *et al.* 1992; Waring 1998)
8	1992	Jul–Sep	ship (Abel-J)	3,710	N. Gulf of Maine and lower Bay of Fundy	NEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Smith *et al.* 1993)
9	1993	Jun–Jul	ship (Delaware II)	1,874	S. edge of Georges Bank, across the Northeast Channel, to the SE. edge of the Scotian Shelf	NEC	One team data analyzed by DISTANCE.		(NMFS 1993)

10	1994	Aug–Sep	ship (Relentless)	534	shelf edge and slope waters of Georges Bank	NEC	One team data analyzed by DISTANCE.	N	(NMFS 1994)
11	1995	Aug–Sep	plane (Skymaster)	8,427	Gulf of St. Lawrence	DFO	One team data analyzed using quenouille's jackknife bias reduction procedure that modeled the left truncated sighting curve	N	(Kingsley and Reeves 1998)
12	1995	Jul–Sep	2 ships (Abel-J and Pelican) and plane (Twin Otter)	32,600	Virginia to the mouth of the Gulf of St. Lawrence	NEC	Ship: two independent team data analyzed with modified direct duplicate method. Plane: one team data analyzed by DISTANCE.	Ship: Y. Plane: Y (only harbor porpoise) N (rest of species)	(Palka 1996)
13	1996	Jul–Aug	plane	3,993	Northern Gulf of St. Lawrence	DFO	Quenouille's jackknife bias reduction procedure on line transect methods that modeled the left truncated sighting curve	N	(Kingsley and Reeves 1998)
14	1998	Jul–Aug	ship	4,163	south of Maryland	SEC	One team data analyzed by DISTANCE.	N	(Mullin and Fulling 2003)
15	1998	Aug–Sep	plane (1995 and 1998)		Gulf of St. Lawrence	DFO			(Kingsley and Reeves 1998)
16	1998	Jul–Sep	ship (Abel-J) and plane (Twin Otter)	15,900	north of Maryland	NEC	Ship: two independent team data analyzed with the modifed direct duplicate or Palka & Hammond analysis methods, depending on the presence of responsive movement. Plane: one team data analyzed by DISTANCE.	Y	
17	1999	Jul–Aug	ship (Abel-J) and plane (Twin Otter)	6,123	south of Cape Cod to mouth of Gulf of St. Lawrence	NEC	Ship: two independent team data analyzed with modified direct duplicate or Palka & Hammond analysis methods, depending on the presence of responsive movement. Plane: circle-back data pooled with aerial data collected in 1999, 2002, 2004, 2006, 2007, and 2008 to calculate pooled g(0)'s and year-species specific abundance estimates for all years except	Y	

							2008.		
18	2002	Jul–Aug	plane (Twin Otter)	7,465	Georges Bank to Maine	NEC	Same as for plane in survey 17.	Y	(Palka 2006)
19	2002	Feb–Apr	ship (Gunter)	4,592	SE US continental shelf Delaware - Florida	SEC	One team data analyzed by DISTANCE.	N	(Garrison *et al.* 2003)
20	2002	Jun–Jul	plane	6,734	Florida to New Jersey	SEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Garrison 2003)
21	2004	Jun–Aug	ship (Gunter)	5,659	Florida to Maryland	SEC	Two independent team data analyzed with modified direct duplicate method.	Y	(Garrison et al. in prep)
22	2004	Jun-Aug	ship (Endeavor) and plane (Twin Otter)	10,761	Maryland to Bay of Fundy	NEC	Same methods used in survey 17.	Y	(Palka 2006)
23	2006	Aug	plane (Twin Otter)	10,676	Georges Bank to Bay of Fundy	NEC	Same as for plane in survey 17.	Y	Palka (in prep)
24	2007	Aug	ship (Bigelow) and plane (Twin Otter)	8,195	Georges Bank to Bay of Fundy	NEC	Ship: Tracker data analyzed by DISTANCE. Plane: same as for plane in survey 17.	Y	Palka (in prep)
25	2007	July–Aug	plane	46,804	Canadian waters from Nova Scotia to Newfoundland	DFO	uncorrected counts	N	(Lawson and Gosselin 2009)
26	2008	Aug	plane (Twin Otter)	6,267	NY to Maine in US waters	NEC	Same as for plane in survey 17.	Y	Palka (in prep)
27	2001	May–June	plane	na	Maine coast	NEC/UM	corrected counts	N	(Gilbert *et al.* 2005)
28	1999	March	plane	na	Cape Cod	NEC	uncorrected counts	N	(Barlas 1999)
29	1983 -1986	1983 (Fall) 1984 (Winter, Spring, Summer) 1985 (Summer, Fall) 1986 (Winter)	plane (Beechcraft D-18S modified with a bubblenose)	103,490 total 25,627 (bays and sounds) 36,685 (coastal) 41,178 (outer	northern Gulf of Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m	SEC	One team data analyzed with Line-transect theory	N	(Scott *et al.* 1989)

				continental shelf, OCS)	isobath to 9.3 km past the 18-m isobath				
30	1991-1994	Apr–June	ship (Oregon II)	22,041	northern Gulf of Mexico from 200 m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	(Hansen *et al.* 1995)
31	1992-1993	Sep–Oct	plane (Twin Otter)	5,578 (bays and sounds) 4,806 (coastal) 7,678 (outer continental shelf, OCS)	northern Gulf of Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3 km past the 18-m isobath	GOMEX92 GOMEX93	One team data analyzed by DISTANCE	N	(Blaylock and Hoggard 1994)
32	1994	Sep–Nov	plane (Twin Otter)	1,155 (bays and sounds) 1,953 (coastal) 1,879 (outer continental shelf, OCS)	northern Gulf of Mexico bays and sounds, coastal waters from shoreline to 18-m isobath, and OCS waters from 18-m isobath to 9.3 km past the 18-m isobath	GOMEX94	One team data analyzed by DISTANCE	N	NMFS unpub. data
33	1996-1997, 1999-2001	Apr–June	ship (Oregon II and Gunter)	12,162	northern Gulf of Mexico from 200 m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	(Mullin and Fulling 2004)
34	1998-2001	end Aug–early Oct	ship (Gunter and Oregon II)	2,196	northern Gulf of Mexico outer continental shelf (OCS, 20-200 m)	SEC	One team data analyzed by DISTANCE	N	(Fulling *et al.* 2003)
35	2003-2004	Jun–Aug (2003) Apr–Jun (2004)	ship (Gunter)	10,933	northern Gulf of Mexico from 200 m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	(Mullin 2007)
36	2004	12–13 Jan	helicopter		Sable Island	DFO	Pup count	na	(Bowen *et al.* 2007)
37	2004		plane		Gulf of St Lawrence and Nova Scotia Eastern Shore	DFO	Pup count		(Hammill 2005)
38	2009	10 June–13 August	ship	4,600	northern Gulf of Mexico from 200m to U.S. EEZ	SEC	One team data analyzed by DISTANCE	N	

39	2007	17 July–8 August	plane		northern Gulf of Mexico from shore to 200m (majority of effort 0-20m)	SEC	One team data analyzed by DISTANCE	N	
40	2011	4 June–1 August	ship (Bigelow)	3,107	Virginia to Massachusetts (waters that were deeper than the 100-m depth contour out to beyond the US EEZ)	NEC	Two-independent teams, both using big-eyes. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	(Palka 2012)
41	2011	7–26 August	Plane (Twin Otter)	5,313	Massachusetts to New Brunswick, Canada (waters north of New Jersey and shallower than the 100-m depth contour, through the US and Canadian Gulf of Maine and up to and including the lower Bay of Fundy)	NEC	Two-independent teams, both using naked eye in the same plane. Analyzed using DISTANCE, the independent observer option assuming point independence.	Y	(Palka 2012)
42	2011		Ship (Gunther)			SEC		Y	

APPENDIX IV: Table B. Abundance estimates – "Survey Number" refers to surveys described in Table A. "Best" estimate for each species in bold font.

Species	Stock	Year	Nbest	CV	Survey Number	Notes
Humpback Whale	Gulf of Maine	1992	501			minimum pop'n size estimated from photo-ID data
		1993	652	0.29		YONAH sampling (Clapham *et al.* 2003)
		1997	497			minimum pop'n size estimated from photo-ID data
		1999	902	0.45	17	
		2002	521	0.67	18	
		2004	359	0.75	22	
		2006	847	0.55	23	
		2008	**823**			Mark-recapture estimate Robbins 2010
		2011	335	0.42	40+41	
Fin Whale	Western North	1995	2,200	0.24	12	
		1999	2,814	0.21	18	

	Atlantic	2002	2,933	0.49	18	
		2004	1,925	0.55	22	
		2006	2,269	0.37	23	
		2007	**3,522**	**0.27**	**25**	
		2011	*	*	40+41	
Sei Whale	Nova Scotia	1977	1,393-2,248			based on tag-recapture data (Mitchell and Chapman 1977)
		1977	870			based on census data (Mitchell and Chapman 1977)
		1982	280		1	
		2002	71	1.01	21	
		2004	**386**	**0.85**	**23**	
		2006	207	0.62	24	
		2011	*	*	40+41	
Minke Whale	Canadian East Coast	1982	320	0.23	1	
		1992	2,650	0.31	3+8	
		1993	330	0.66	9	
		1995	2,790	0.32	12	
		1995	1,020	0.27	11	
		1996	620	0.52	13	
		1999	2,998	0.19	17	
		2002	756	0.9	18	
		2004	600	0.61	22	
		2006	**3,312**	**0.74**	**23**	
		2007	20,741	0.30	25	
		2011	*	*	40+41	
Sperm Whale	North Atlantic	1982	219	0.36	1	
		1990	338	0.31	2	
		1991	736	0.33	7	
		1991	705	0.66	6	
		1991	337	0.5	5	
		1993	116	0.4	9	
		1994	623	0.52	10	
		1995	2,698	0.67	12	
		1998	2,848	0.49	16	
		1998	1,181	0.51	14	
		2004	2,607	0.57	22	
		2004	2,197	0.47	21	
		2004	**4,804**	**0.38**	**21+22**	Estimate summed from north and south surveys
		2011	*	*	40+41	
Kogia spp.	Western North Atlantic	1998	115	0.61	16	
		1998	580	0.57	14	
		2004	358	0.44	22	

		2004	37	0.75	21	
		2004	395	0.4	21+22	Estimate summed from north and south surveys
Dwarf Sperm Whale	Western North Atlantic	**2011**	**1,042**	**0.65**	**40+41**	
Pygmy Sperm Whale	Western North Atlantic	**2011**	**741**	**0.40**	**40+41**	
Beaked Whales	Western North Atlantic	1982	120	0.71	1	
		1990	442	0.51	2	
		1991	262	0.99	7	
		1991	370	0.65	6	
		1991	612	0.73	5	
		1993	330	0.66	9	
		1994	99	0.64	10	
		1995	1,519	0.69	12	
		1998	2,600	0.4	16	
		1998	541	0.55	14	
		2004	2,839	0.78	22	
		2004	674	0.36	21	
		2004	3,513	0.63	21+22	**Estimate summed from north and south surveys**
		2006	922	1.47	23	
Cuvier's Beaked Whale	Western North Atlantic	**2011**	*****	*****	**40+41**	
Gervais' Beaked Whale	Western North Atlantic	**2011**	*****	*****	**40+41**	
Sowerby's Beaked Whale	Western North Atlantic	**2011**	*****	*****	**40+41**	
Risso's Dolphin	Western North Atlantic	1982	4,980	0.34	1	
		1991	11,017	0.58	7	
		1991	6,496	0.74	5	
		1991	16,818	0.52	6	
		1993	212	0.62	9	
		1995	5,587	1.16	12	
		1998	18,631	0.35	17	
		1998	9,533	0.5	15	
		1998	28,164	0.29	15+17	Estimate summed from north and south surveys
		2002	69,311	0.76	18	
		2004	15,053	0.78	21	
		2004	5,426	0.54	22	
		2004	**20,479**	**0.59**	**21+22**	Estimate summed from north and south surveys
		2006	14,408	0.38	23	
		2011	*	*	40+41	
Pilot Whale	Western North Atlantic	1951	50,000			Derived from catch data from 1951-1961 drive fishery (Mitchell 1974)
		1975	43,000-96,000			Derived from population models (Mercer 1975)
		1982	11,120	0.29	1	

		1991	3,636	0.36	7	
		1991	3,368	0.28	5	
		1991	5,377	0.53	6	
		1993	668	0.55	9	
		1995	8,176	0.65	12	
		1995	9,776	0.55	12+16	Sum of US (#12) and Canadian (#16) surveys
		1998	1,600	0.65	16	
		1998	9,800	0.34	17	
		1998	5,109	0.41	15	
		2002	5,408	0.56	18	
		2004	15,728	0.34	22	
		2004	15,411	0.43	21	
		2004	**31,139**	**0.27**	**21+22**	**Estimate summed from north and south surveys**
		2006	26,535	0.35	23	
		2007	6,134		25	
Atlantic white-sided Dolphin	Western North Atlantic	1982	28,600	0.21	1	
		1992	20,400	0.63	2+7	
		1993	729	0.47	9	
		1995	27,200	0.43	12	
		1995	11,750	0.47	11	
		1996	560	0.89	13	
		1999	51,640	0.38	17	
		2002	109,141	0.3	18	
		2004	2,330	0.8	22	
		2006	17,594	0.3	23	
		2006	63,368	0.27	(18+23)/2	average of #18 and #23
		2007	5,796	0.43	25	
		2011	*****	*****	**40+41**	
White-beaked Dolphin	Western North Atlantic	1982	573	0.69	1	
			5,500			(Alling and Whitehead 1987)
		1982	3,486	0.22		(Alling and Whitehead 1987)
		2006	**2,003**	**0.94**	**23**	
		2007	1,1842		25	
		2008			26	
Common Dolphin	Western North Atlantic	1982	29,610	0.39	1	
		1991	22,215	0.4	7	
		1993	1,645	0.47	9	
		1995	6,741	0.69	12	
		1998	30,768	0.32	17	
		1998	0		15	
		2002	6,460	0.74	21	
		2004	90,547	0.24	22	
		2004	30,196	0.54	21	
		2004	120,743	0.23	21+22	Estimate summed from north and south surveys
		2006	84,000	0.36	24	
		2007	53,625	0.22	25	

		2011	**67,191**	**0.29**	**40+41**	
Altantic Spotted Dolphin	Western North Atlantic	1982	6,107	0.27	1	
		1995	4,772	1.27	12	
		1998	32,043	1.39	16	
		1998	14,438	0.63	14	
		2004	3,578	0.48	22	
		2004	47,400	0.45	21	
		2004	50,978	0.42	21+22	Estimate summed from north and south surveys
		2011	**26,798**	**0.66**	**40+41**	
Pantropical Spotted Dolphin	Western North Atlantic	1982	6,107	0.27	1	
		1995	4,772	1.27	12	
		1998	343	1.03	16	
		1998	12,747	0.56	14	
		2004	0		22	
		2004	4,439	0.49	21	
		2004	**4,439**	**0.49**	**21+22**	**Estimate summed from north and south surveys**
Striped Dolphin	Western North Atlantic	1982	36,780	0.27	1	
		1995	31,669	0.73	12	
		1998	39,720	0.45	16	
		1998	10,225	0.91	14	
		2004	52,055	0.57	22	
		2004	42,407	0.53	21	
		2004	94,462	0.4	21+22	Estimate summed from north and south surveys
		2011	**46,882**	**0.33**	**40+41**	
Bottlenose Dolphin	Western North Atlantic Offshore	1998	16,689	0.32	16	
		1998	13,085	0.4	14	
		2002	26,849	0.19	20	
		2002	5,100	0.41	18	
		2004	9,786	0.56	22	
		2004	44,953	0.26	21	
		2004	**81,588**	**0.17**	**20+21+22**	**Estimate summed from north and south surveys and 2002 survey**
Harbor Porpoise	Gulf of Maine/Bay of Fundy	1991	37,500	0.29	3	
		1992	67,500	0.23	8	
		1995	74,000	0.2	12	
		1995	12,100	0.26	11	
		1996	21,700	0.38	14	
		1999	89,700	0.22	18	survey discovered portions of the range not previously surveyed
		2002	64,047	0.48	21	
		2004	51,520	0.65	23	
		2006	**89,054**	**0.47**	**24**	
		2007	4,862	0.31	25	
		2011	*	*	40+41	
Harbor Seal	Western North Atlantic	2001	99,340	0.097	27	
Gray Seal	Western	1999	5,611		28	

	North Atlantic	2001	1,731		27	
		2004	52,500	0.15	37	Gulf of St Lawrence and Nova Scotia Eastern Shore
		2004	208,720 216,490 223,220	0.14 0.11 0.08	36	Sable Island
Bryde's Whale	Northern Gulf of Mexico	1991-1994	35	1.10	30	
		1996-2001	40	0.61	33	
		2003-2004	15	1.98	35	
		2009	**33**	**1.07**	**38**	
Sperm Whale	Northern Gulf of Mexico	1991-1994	530	0.31	30	
		1996-2001	1,349	0.23	33	
		2003-2004	1,665	0.20	35	
		2009	**763**	**0.38**	**38**	
Kogia spp.	Northern Gulf of Mexico	1991-1994	547	0.28	30	
		1996-2001	742	0.29	33	
		2003-2004	453	0.35	35	
		2009	**186**	**1.04**	**38**	
Cuvier's Beaked Whale	Northern Gulf of Mexico	1991-1994	30	0.50	30	
		1996-2001	95	0.47	33	
		2003-2004	65	0.67	35	
		2009	**74**	**1.04**	**38**	
Mesoplodon spp.	Northern Gulf of Mexico	1996-2001	106	0.41	33	
		2003-2004	57	1.40	35	
		2009	**149**	**0.91**	**38**	
Killer Whale	Northern Gulf of Mexico	1991-1994	277	0.42	30	
		1996-2001	133	0.49	33	
		2003-2004	49	0.77	35	
		2009	**28**	**1.02**	**38**	
False killer Whale	Northern Gulf of Mexico	1991-1994	381	0.62	30	
		1996-2001	1,038	0.71	33	
		2003-2004	777	0.56	35	
Short-finned Pilot Whale	Northern Gulf of Mexico	1991-1994	353	0.89	30	
		1996-2001	2,388	0.48	33	
		2003-2004	716	0.34	35	
		2009	**2,415**	**0.66**	**38**	
Melon-headed Whale	Northern Gulf of Mexico	1991-1994	3,965	0.39	30	
		1996-2001	3,451	0.55	33	
		2003-2004	2,283	0.76	35	
		2009	**2,235**	**0.75**	**38**	
Pygmy Killer Whale	Northern Gulf of Mexico	1991-1994	518	0.81	30	
		1996-2001	408	0.60	33	
		2003-2004	323	0.60	35	
		2009	**152**	**1.02**	**38**	
Risso's Dolphin	Northern Gulf of Mexico	1991-1994	2,749	0.27	30	
		1996-2001	2,169	0.32	33	
		2003-2004	1,589	0.27	35	

		2009	**2,442**	**0.57**	**38**	
Pantropical Spotted Dolphin	Northern Gulf of Mexico	1991-1994	31,320	0.20	30	
		1996-2001	91,321	0.16	33	
		2003-2004	34,067	0.18	35	
		2009	**50,880**	**0.27**	**38**	
Striped Dolphin	Northern Gulf of Mexico	1991-1994	4,858	0.44	30	
		1996-2001	6,505	0.43	33	
		2003-2004	3,325	0.48	35	
		2009	**1,849**	**0.77**	**38**	
Spinner Dolphin	Northern Gulf of Mexico	1991-1994	6,316	0.43	30	
		1996-2001	11,971	0.71	33	
		2003-2004	1,989	0.48	35	
		2009	**11,441**	**0.83**	**38**	
Clymene Dolphin	Northern Gulf of Mexico	1991-1994	5,571	0.37	30	
		1996-2001	17,355	0.65	33	
		2003-2004	6,575	0.36	35	
		2009	**129**	**1.00**	**38**	
Atlantic Spotted Dolphin	Northern Gulf of Mexico	1991-1994 oceanic	3,213	0.44	30	
		1996-2001 oceanic	175	0.84	33	
		1998-2001 OCS	37,611	0.28	34	This abundance estimate is from 2000-2001 surveys only. Current best population size estimate is unknown because data from the continental shelf portion of this species' range are more than 8 years old.
		2003-2004 oceanic	0	-	35	
		2009	2968	0.67	38	
Fraser's Dolphin	Northern Gulf of Mexico	1991-1994	127	0.90	30	
		1996-2001	726	0.70	33	
		2003-2004	0	-	35	
		2009	**0**	**-**	**38**	Current best population size estimate is unknown.
Rough-toothed Dolphin	Northern Gulf of Mexico	1991-1994 oceanic	852	0.31	30	
		1996-2001 oceanic	985	0.44	33	
		1998-2001 OCS	1,145	0.83	34	This abundance estimate is from 2000-2001 surveys only. Current best population size estimate is unknown because data from the continental shelf portion of this species' range are more than 8 years old.
		2003-2004 oceanic	1,508	0.39	35	
		2009	624	0.99	0.05	
Bottlenose Dolphin	Northern Gulf of Mexico Oceanic	1996-2001	2,239	0.41	33	
		2003-2004	3,708	0.42	35	
		2009	**5,806**	**0.39**	**38**	
Bottlenose Dolphin	Northern Gulf of Mexico Continental Shelf	1998-2001	17,777	0.32	34	This abundance estimate is from 2000-2001 surveys only. Current best population size estimate is unknown because data from the continental shelf are more than 8 years old.
Bottlenose Dolphin	Northern Gulf of	Eastern 1994	9,912	0.12	32	
		Eastern 2007	**7,702**	**0.19**	**39**	

	Mexico Coastal (3 stocks)	Northern 1993	4,191	0.21	31	
		Northern 2007	**2,473**	**0.25**	**39**	
		Western 1992	3,499	0.21	31	Current best population size estimate for this stocks is unknown because data are more than 8 years old.
Bottlenose Dolphin	Northern Gulf of Mexico Bay, Sound and Estuarine (33 stocks)	Choctawhatchee Bay, 2007	179	0.04		(Conn *et al.* 2011)
		St. Joseph Bay, 2005-2007	146	0.18		(Balmer *et al.* 2008)
		St. Vincent Sound, Apalachicola Bay, St. George Sound, 2008	439	0.14		(Tyson *et al.* 2011)
		Sarasota Bay, Little Sarasota Bay, 2007	160	-		Direct count
		Remaining 28 stocks	unknown	undetermined	31	Current best population size estimate for each of these 30 stocks is unknown because data are more than 8 years old.

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APPENDIX V: Reports not updated in 2012

(All reports available online at http://www.nefsc.noaa.gov/publications/tm/tm219/)

	Year Updated
Blue Whale (*Balaenoptera musculus*): Western North Atlantic Stock	2010
Killer Whale (*Orcinus orca*): Western North Atlantic Stock	1995
Pygmy Killer Whale (*Feresa attenutta*): Western North Atlantic Stock	2007
Northern Bottlenose Whale (*Hyperoodon ampullatus*): Western North Atlantic Stock	2008
Melon-Headed Whale (*Peponocephala electra*): Western North Atlantic Stock	2007
Long-finned Pilot Whale (*Globicephala melas*): Western North Atlantic Stock	2011
Short-finned Pilot Whale (*Globicephala machrorhynchus*): Western North Atlantic Stock	2011
White-Beaked Dolphin (*Lagenorhynchus albirostris*): Western North Atlantic Stock	2007
Pantropical Spotted Dolphin (*Stenella attenuata*): Western North Atlantic Stock	2007
Fraser's Dolphin (*Lagenodelphis hosei*): Western North Atlantic Stock	2007
Rough-Toothed Dolphin (*Steno bredanensis*): Western North Atlantic Stock	2008
Clymene Dolphin (*Stenella clymene*): Western North Atlantic Stock	2007
Spinner Dolphin: (*Stenella longirostris*): Western North Atlantic Stock	2007
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Western North Atlantic Offshore Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Western North Atlantic Northern Migratory Coastal Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Western North Atlantic Southern Migratory Coastal Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Western North Atlantic South Carolina/Georgia Coastal Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Western North Atlantic Northern Florida Coastal Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Western North Atlantic Central Florida Coastal Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Southern North Carolina Estuarine System Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Charleston Estuarine System Stock	2009
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Northern Georgia/Southern South Carolina Estuarine System Stock	2009
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Southern Georgia Estuarine System Stock	2009
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Jacksonville Estuarine System Stock	2009
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Indian River Lagoon Estuarine System Stock	2009
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Biscayne Bay Stock	2009
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Florida Bay Stock	2009
Hooded Seal (*Cystophora cristata*): Western North Atlantic Stock	2007
Sperm Whale (*Physeter macrocephalus*): Puerto Rico and U.S. Virgin Islands Stock	2010
Bottlenose Dolphin (*Tursiops truncatus truncatus*): Puerto Rico and U.S. Virgin Islands Stock	2011
Cuvier's Beaked Whale (*Ziphias cavirostris*): Puerto Rico and U.S. Virgin Islands Stock	2011
Short-finned Pilot Whale (*Globicephala machrorhynchus*): Puerto Rico and U.S. Virgin Islands Stock	2011
Spinner Dolphin: (*Stenella longirostris*): Puerto Rico and U.S. Virgin Islands Stock	2011

APPENDIX VI: West Indian Manatee Stock Assessments – Florida and Antilles stocks

Revised: 11/2009

WEST INDIAN MANATEE *(Trichechus manatus)*
FLORIDA STOCK
(Florida subspecies, *Trichechus manatus latirostris*)

U.S. Fish and Wildlife Service, Jacksonville, Florida

STOCK DEFINITION AND GEOGRAPHIC RANGE

Florida manatees are found throughout the southeastern United States. Because manatees are a sub-tropical species with little tolerance for cold, they are generally restricted to the inland and coastal waters of peninsular Florida during the winter, when they shelter in and/or near warm-water springs, industrial effluents, and other warm water sites (Hartman 1979, Lefebvre *et al.* 2001, Stith *et al.* 2007). In warmer months, manatees leave these sites and can disperse great distances. Individuals have been sighted as far north as Massachusetts, as far west as Texas, and in all states in between (Rathbun *et al.* 1982, Schwartz 1995, Fertl *et al.* 2005, USFWS Jacksonville Field Office, unpub. data 2008a). Warm weather sightings are most common in Florida and coastal Georgia.

Previous studies of the manatee in Florida identified four, relatively distinct, regional management units (formerly referred to as subpopulations): an Atlantic Coast unit that occupies the east coast of Florida, including the Florida Keys and the lower St. Johns River north of Palatka; an Upper St. Johns River unit that occurs in the river south of Palatka; a Northwest unit that occupies the Florida Panhandle south to Hernando County; and a Southwest unit that occurs from Pasco County south to Whitewater Bay in Monroe County (USFWS 2001 and 2007). See Figure 1. Each of these management units includes individual manatees that tend to return to the same warm-water site(s) each winter and have similar non-winter distribution patterns. The exchange of individuals between these units is limited during the winter months, based on data from telemetry studies (Rathbun *et al*. 1990, Reid *et al*. 1991, Weigle *et al*. 2001, Deutsch *et al*. 1998 and 2003) and photo-identification studies (Rathbun *et al*. 1990, USGS FISC Sirenia Project, unpubl. data 2007, Higgs, pers. comm. 2007a, b).

While the Florida manatee population has been separated into management units, the Service identifies the Florida manatee population as a single stock. As stated, the management unit construct was originally based on studies of regional manatee wintering sites. The management units are a useful construct for assessing unit-specific population trends and threats; the Service and its collaborators evaluate these parameters for each unit using a core biological model (CBM) developed by Runge *et al.* (2004). Consistent with requirements of the Endangered Species Act of 1973, as amended, threats are then appropriately addressed through methods identified in Service recovery plans (and the State of Florida's Manatee Management Plan). This approach has been successful for efforts to manage Florida manatees and the Service believes that using SARs for each of the management units would provide little added benefit to existing efforts.

Significant genetic differences between the manatees of Florida and Puerto Rico do exist and, as a result, these populations are identified as separate stocks (Vianna *et al.* 2006). Vianna *et al.* (2006) identified a gene flow barrier between Florida and Puerto Rico using mtDNA analyses.

POPULATION SIZE

One to three times each winter, a coordinated series of statewide aerial surveys and ground counts, known as the synoptic surveys, are conducted by the Florida Fish and Wildlife Conservation Commission (FWC) to count wintering manatees (FWC FWRI Manatee Synoptic Aerial Surveys 2009). These counts, conducted since 1991, identify a number of animals observed in wintering sites at the time of the count and suggest that there is at least this number of manatees in the population, if not more. Because the counts do not include the number of manatees located away from the wintering sites on the day of the count, the counts do not accurately represent the total number of manatees in the population. Weather and other environmental factors influence count conditions, adding additional variability.

Furthermore, survey methods preclude any analysis of precision and variability in the counts. In the absence of a comprehensive count, these counts cannot be used to describe population trends. Information based on Florida manatee population demographic data obtained from photo-identification studies is used to accurately describe population trends as they relate to growth rates, adult survival rates, and reproductive rates. Management decisions are based on these more accurate, scientifically supportable numbers and trends.

Minimum Population Estimate

The best available count of Florida manatees is 3,802 animals, based on a single synoptic survey of warm-water refuges in January 2009 (FWC FWRI Manatee Synoptic Aerial Surveys 2009).

Current Population Trends

Recent demographic analyses indicate that, with the exception of the Southwest management unit, manatee populations are increasing or stable throughout much of Florida. See Table 1. The analyses are based on photo-ID based mark-recapture analyses using a manatee-specific core biological model. Population growth rates reported by Runge *et al.* (2004 and 2007a) are as follows: the Northwest Region 4.0% (95% CI 2.0 to 6.0%), the Upper St. Johns River Region 6.2% (95% CI 3.7 to 8.1%), the Atlantic Coast Region 3.7% (95% CI 1.1 to 5.9%), and the Southwest Region -1.1% (95% CI -5.4 to +2.4%). In three of the four management units, reproductive rates and adult survival rates are cited as positive (Runge *et al.* 2007a, Kendall *et al.* 2004, Langtimm *et al.* 2004, and Koelsch 2001). In southwest Florida, estimates of adult survival and reproduction are less precise than for manatees in other regions of Florida because the data time series is comparatively shorter for this unit and no demographic data is available for manatees in the southernmost part of this region. Craig and Reynolds (2004) additionally suggested that populations of wintering manatees in the Atlantic Coast Region have been increasing at rates of between 4 and 6% per year since 1994. Growth rates for each management unit are current through 2000.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Marine Mammal Protection Act defines net productivity rate as "the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to natural mortality." Recently published information on Florida manatee population demographics include studies by Runge *et al.* (2004 and 2007a), Craig and Reynolds (2004), Kendall *et al.* (2004), and Langtimm *et al.* (2004). Per Runge *et al.* (2004), the maximum growth rate for Florida manatees (incorporating reproductive and adult survival rates), is 6.2% (95%, CI 3.7 to 8.1%**).** This rate, reported for the Upper St. Johns River management unit, is identified as R_{max} inasmuch as it describes a maximum rate of increase and reflects both additions and losses to this population, including losses due to both natural and human-causes.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

PBR is the product of three elements: the minimum population estimate (N_{min}), half of the maximum net productivity rate (0.5 R_{max}), and a recovery factor (F_r). Recovery factor values range between 0.1 and 1.0 and population simulation studies demonstrate that a default value of 0.1 should be used for endangered (depleted) stocks and a default value of 0.5 should be used for threatened stocks or stocks of unknown status (NMFS 2005).

N_{min}= 3,802
R_{max}= 6.2%
F_r= 0.1

PBR = (3,802) (0.031) (0.1) = 11.80 (or 12)

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Sources of human caused manatee mortality and injury include watercraft, water control structures, recreational and commercial fishing gear, and others. These sources were identified and are documented through manatee carcass

salvage and rescue programs (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Rommel *et al.* 2007, Lightsey *et al.* 2006, Pitchford *et al.* 2005, Wright *et al.* 1995, Ackerman *et al.* 1995, O'Shea *et al.* 1985, Bonde *et al.* 1983). The Service elected to use data describing the 2003 through 2007 period inasmuch as this data had been verified for completeness and accuracy. (Verifications of the 2008 injury and mortality datasets were incomplete at the time of writing.)

From 1978 through 2007, 6,373 manatee carcasses were salvaged in the southeastern United States. Of these carcasses, 1,877 were of animals that died from human causes. Eighty-two percent of manatees (1,538) that died from human causes were killed by watercraft. Water control structures (including flood gates and navigation locks) killed 182 manatees and the deaths of the remaining 157 manatees were attributed to other human causes (including entanglement in and ingestion of marine debris [including fishing gear], entrapment in pipes and culverts, etc.) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data, 2008c). For the period 2003 – 2007, annual estimated average human-caused mortality was 86.6 or 87 manatees per year (FWC FWRI Manatee Mortality Statistics 2008).

While "serious injury" has been described by the National Marine Fisheries Service "as any injury that will likely result in mortality" (NMFS 2005), the Service has not defined "serious injury." Absent a definition, the Service receives reports of distressed or injured manatees that may or may not meet the NMFS definition of "serious injury" and responds to these reports through a manatee rescue, rehabilitation, and release program. Responses to reports of distressed or injured manatees can include assisting a superficially injured manatee *in situ* or may involve transporting a more than superficially injured animal to a rehabilitation center for further treatment. It is assumed that animals treated *in situ* have not been seriously injured.

Human-caused Mortality

Data on manatee mortality in the southeastern United States have been collected since 1974 by the Manatee Carcass Salvage Program (O'Shea *et al.* 1985, Ackerman *et al.* 1995, Lightsey *et al.* 2006). Based on these data, primary human-related threats include watercraft-related strikes (direct impact and/or propeller) which cause injury and death (Rommel *et al.* 2007, Lightsey *et al.* 2006), entrapment and/or crushing in water control structures (gates, locks, *etc.*), and, as previously described, entanglement in fishing gear, and ingestion of marine debris. Natural threats include exposure to cold and red tide. Mortality associated with these natural threats includes cold stress syndrome and brevetoxicosis, respectively.

Causes of death for many salvaged carcasses cannot be determined. These "undetermined" causes can be the result of a carcass that is too decomposed to diagnose, a carcass that was reported but never retrieved, or when no specific factor or set of factors can be identified as a cause of death. In addition, small manatees (less than or equal to 150 cm in length) that die at or near the time of birth and whose deaths cannot be attributed to one of the known human-related causes are described as "perinatal" deaths, an undetermined cause.

During the most recent five year period for which data have been verified (2003 – 2007), 1,805 manatee carcasses were salvaged in the southeastern United States. See Table 2. Of these carcasses, 433 were of animals that died from human causes. Based on this, the annual estimated average human-caused mortality is 87 (86.6) manatees per year. Eighty-nine percent of manatees (386) that died from human causes were killed by watercraft. Water control structures (including flood gates and navigation locks) killed 18 manatees and the deaths of the remaining 29 manatees were attributed to other human causes (including entanglement in and ingestion of marine debris [including fishing gear], entrapment in pipes and culverts, etc.) (FWC FWRI Manatee Mortality Statistics 2008).

Fisheries-related Mortality and Injury

Manatees are known to entangle in and/or ingest fishing gear used by both commercial and recreational fisheries. As reported in death and rescue reports, fishing gear used by commercial fishers known to entangle or be ingested by manatees includes shrimp trawls, shrimp nets, crab traps (traps and/or associated buoys and lines), seines, shiner nets and hoop nets, and trot lines. Similarly, recreational fishery gear known to either entangle or be ingested by manatees includes monofilament fishing line and/or associated tackle, cast nets, and crab traps. Manatees also become entangled in ropes and lines, possibly related to recreational and commercial fisheries (*e.g.*, float lines detached from traps, etc.) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Smith 1998, Nill 1998). Manatees are struck and killed or injured by a variety of watercraft, including watercraft of a size and type comparable to those used by commercial and recreational fishers (Rommel *et al.* 2007, Lightsey *et al.* 2006, Pitchford *et al.* 2005).

Mortalities

For the most recent five year period (2003 - 2007), at least 10 manatees died due to entanglements in/ingestion of marine debris; six of these deaths were associated with fishing line and/or associated gear, two deaths were attributed to research nets, and two to other sources (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b, Nill 1998, Smith 1998). See Table 3. There were no known sources of commercial fishery gear implicated in these deaths.

Injuries

The Service's manatee rescue, rehabilitation, and release program has rescued injured or distressed manatees since 1973. From 2003 to 2007, there were 80 rescues associated with fishing gear and other sources of marine debris. Thirty-five of these were related to crab trap entanglements, 15 to fishing line and/or associated gear, and 5 were due to net entanglements. Nine of the 35 crab trap-related rescues required treatment at rehabilitation centers and the remaining 26 were resolved in the field (USFWS Jacksonville Field Office, unpub. data 2008b). See Table 4. Crab trap- related rescues likely involve gear from both commercial and recreational fishers, who use the same type of gear.

Commercial Fishing Gear-related Interactions

The majority of known fishing gear interactions have occurred in Florida waters (280 of 290 known deaths and rescues, including interactions that occurred before 1978). Prior to 1995, when the State of Florida adopted a statewide, in-shore net ban, manatees were known to entangle in a variety of fishing gear used by commercial fishers, including blue crab fishery gear. Subsequent to 1995, entanglements in non-blue crab fishery gear used by commercial fishers are virtually unknown, both in the State of Florida and elsewhere (there is a single record of a manatee being rescued from commercial fishing gear in 1997 in Georgia, when a manatee was rescued from an inshore bait shrimp trawl) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Nill 1998, Smith 1998). However, blue crab fishery gear entanglements continue in Florida. From 2003 to 2007, no manatee deaths and 35 rescues are attributable to the blue crab fisheries.

Given greater fishing effort by commercial blue crab fishers in contrast to blue crab fishing efforts by recreational fishers (which suggests more commercial fishing gear in the water than recreational gear in the water), it's thought that a majority of manatee entanglements in blue crab fishing gear should be attributed to the commercial blue crab fisheries. In the past, efforts to distinguish between animals entangled in commercial blue crab trap gear versus recreational blue crab trap gear were hindered by a lack of gear data collection protocols for rescuers and salvagers and state gear identification requirements were not necessarily adequate to identify gear ownership. Protocols have subsequently been modified, as have state regulations requiring better identification of gear owners, and the attribution of entangling gear to its source has significantly improved.

Two commercial blue crab fisheries identified in NMFS' "2009 List of Fisheries" (73 FR 73032; December 1, 2008) known to entangle Florida manatees include:

Atlantic blue crab trap/pot fishery

> The Category II Atlantic blue crab trap/pot fishery targets blue crabs using pots baited with fish or poultry typically set in rows in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. The fishery occurs year round and involves more than 16,000 vessels/persons. Twenty-seven percent of Florida's 2006 blue crab landings came from Florida's Atlantic Coast Region, within the operational area of the Atlantic blue crab trap/pot fishery (FWC FWRI 2007).

Gulf of Mexico blue crab trap/pot fishery

> The Category III Gulf of Mexico blue crab trap/pot fishery targets blue crabs using pots baited with fish or poultry typically set in rows in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. The fishery occurs year round and involves more than 4,113 vessels/persons. Seventy-three percent of Florida's 2006 blue crab landings came from Florida's Gulf Coast Region, within the operational area of the Gulf of Mexico blue crab trap/pot fishery (FWC FWRI 2007).

Fifty-five percent of known Florida manatee-crab fishery interactions occurring between 2003 and 2007 were documented within the area of the Gulf of Mexico blue crab trap/pot fishery. The majority of these interactions occurred in southwest Florida, with most occurring in Lee County (seven rescues occurred in this county alone) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b). Within the area of the Atlantic blue crab trap/pot fishery, most interactions occurred in east central Florida (Brevard County) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b).

The NMFS' "2009 List of Fisheries" (73 FR 73032; December 1, 2008) also identifies the Category III "Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery" as a fishery known to take Florida manatees.

Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery

The Category III Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery targets a variety of pelagic shrimp species (brown, pink, white, rock, etc.) by means of a large trawl net towed behind a single shrimp trawler. Nets, held open by paired doors, are towed on coastal bottoms for varying lengths of time. This fishery occurs year round and involves more than 18,000 vessels/persons. Shrimp trawling occurs along Florida's Atlantic and Gulf coasts, well outside of Florida shoreline areas regulated pursuant to Florida net ban regulations.

From 2003 to 2007, no manatee deaths or injuries attributable to this fishery have been reported from the Atlantic and Gulf coasts in the southeastern U.S. Furthermore, this commercial fishery is not known to have taken any manatees since 1987, when the last confirmed report of a manatee captured and drowned in this fishery was recorded. (Three unconfirmed deaths were documented in 1990. Necropsy findings and/or circumstances associated with these cases suggested that an inshore bait shrimp fishery may have been responsible for the deaths but definitive information was lacking. A manatee that died in a shrimp trawl in 1997 was captured by a research trawler investigating excluder devices; the researchers used a shrimp trawl, identical to those used by commercial fishers, but they were not engaged in commercial fishing operations.)

STATUS OF STOCK

The Florida manatee is protected by the State of Florida under the Florida Manatee Sanctuary Act of 1978, as amended (§ 379.2431(2), FS). Federally, Florida manatees were originally listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966. The original listing was subsequently adopted under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.), as amended, and manatees continue to be identified as a federally endangered species. As an endangered species, manatees are considered by default to be a "strategic stock" and "depleted" under the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq*.).

The recent threats assessment (Runge *et al* 2007b) states that "watercraft-related mortality is having the greatest impact on manatee population growth and resilience" and "elimination of this threat alone would greatly reduce the probability of quasi-extinction. Anticipated losses of winter warm-water habitat could also be a significant, long-term threat." The threats assessment describes mortality associated with fisheries interactions and red tides as "noticeable" and, when compared to other anthropogenic threats, is thought to have less of an impact on the persistence of the manatee population (Runge *et al* 2007b).

The Service and its recovery partners have taken significant steps to reduce the number of human caused manatee mortalities and injuries. To address the threat of watercraft collisions, the most significant source of human-caused mortality and injury, the Service and FWC have adopted manatee protection areas (Federal manatee refuges and sanctuaries and State manatee protection zones) in areas of high manatee use and potential watercraft conflict. Water control structures have been retrofitted with devices that eliminate crushings and many culverts and pipes have been grated to prevent manatee entrapment.

Efforts have also been made to reduce the incidence of lethal and non-lethal entanglements in and ingestion of marine debris, including fishing gear (Spellman *et al.*, 2003 and 1999). Manatees entangled in or ingesting marine debris are rescued each year by the manatee rescue and rehabilitation program; manatee mortalities and serious injuries are minimized as a result of this activity (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Nill 1998, Smith 1998). The Service has funded studies to

assess manatee behavior in the presence of fishing gear and to identify "manatee-safe" crab fishing gear that, if used, will minimize the number of manatee-crab trap entanglements (Bowles *et al.* 2003 and Bowles 2000). Derelict crab trap removals and monofilament removal and recycling programs are helping to reduce the likelihood of manatee interactions with this gear (Koelsch *et al.* 2003). In February 2009, FWC adopted regional blue crab harvest closures across the state; derelict crab traps are removed during the closures, further reducing the likelihood of crab trap gear entanglements (FWC 2009).

While the threats posed by watercraft and the anticipated loss of wintering habitat on the Florida manatee are significant, the threat posed by commercial fishery activities is very small and has a comparatively lesser impact on the persistence of the Florida manatee population. The number of lethal and live takes of manatees in blue crab trap/pot fishery gear during the past year (no lethal takes and nine live takings) is well below the calculated PBR level of 12 takings. Over the past five years, there have been no lethal takings of manatees in the blue crab fishery and a total of 35 non-lethal takings of crab fishery gear-entangled manatees (rescued by the manatee rescue and rehabilitation program), an average of 6.8 takes per year. Similarly, there are no known lethal or non-lethal takes of manatees in the shrimp trawl fishery for this period. Therefore, the annual estimated level of incidental mortality and serious injury due to the shrimp trawl fishery is zero. Given the largely non-lethal effect of these takings, total commercial fishery mortality and serious injury for this stock is less than the calculated PBR and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate.

Inasmuch as an optimal sustainable population (OSP) level has not been identified for the Florida manatee, we do not know what this stock's status is in relation to OSP. In the face of existing threats, "the Florida manatee population is exhibiting positive growth, good reproductive rates, and high adult survival throughout most of the state" (USFWS 2007).

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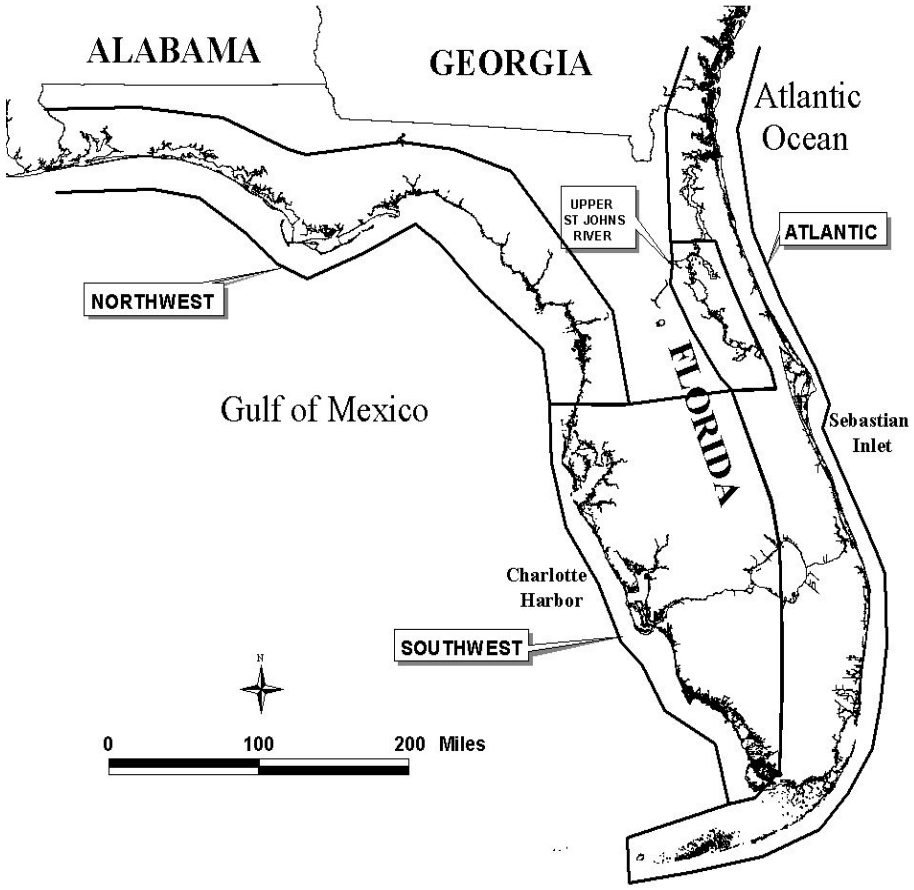


Figure 1. Florida manatee distribution within the four designated regional management units. USFWS (2001).

Table 1. Demographic indicators for Florida manatees by management unit.

Management Unit	Population Growth Rate (per year)	Minimum Population Size	Annual Conditional Reproductive Rate	Adult Survival Rates	Comments
Northwest	**4.0%** **(95% CI 2.0 to 6.0%)** **1986 – 2000** (Runge *et al.* 2007a)	**377** (FWC Manatee Synoptic Aerial Surveys 2009)	**0.43** **(95% CI 0.22 – 0.54)** **1982 – 1999** (Kendall *et al*. 2004)	**0.959** **SE 0.006** **1986 – 2000** (Runge *et al.* 2007a)	The number of manatees throughout the region, including Crystal River and Kings Bay, has been increasing since the 1960s. A recent high count of 274 manatees was documented in 2005 (Kleen, *pers. comm*. 2006).
Upper St. Johns River	**6.2%** **(95% CI 3.7 to 8.1%)** **1990 – 1999** (Runge *et al.* 2004)	**112** (FWC Manatee Synoptic Aerial Surveys 2009)	**0.61** **(95% CI 0.51 – 0.71)** **1980 – 2000** (Runge *et al.* 2004)	**0.960** **SE 0.011** **1990 – 1999** (Langtimm *et al.* 2004)	The number of manatees using Blue Spring has increased significantly. A recent high count of manatees (182) was documented during the 2005 – 2006 winter season (Hartley, *pers. comm.* 2006). At this site, survival of 1st year calves was estimated at 0.810 (0.727 – 0.873) and 2nd year calves at 0.915 (0.827-0.960) (Langtimm *et al.* 2004).
Atlantic Coast	**3.7%** **(95% CI 1.1 to 5.9%)** **1986 – 2000** (Runge *et al.* 2007a)	**1447** (FWC Manatee Synoptic Aerial Surveys 2009)	**0.38** **(95% CI 0.29 – 0.47)** **1982 – 1999** (Kendall *et al*. 2004)	**0.963** **SE 0.010** **1986 – 2000** (Runge *et al.* 2007a)	In contrast to FWC's estimate, Craig and Reynolds (2004) estimated the population size of animals using Atlantic Coast power plants in 2001 at 1606 (Bayesian credible interval: 1353 – 1972) They also identified trends in corrected aerial counts: 1982-1989, 5 to 7%;1990-1993, 0 to 4%; and, since 1994: 4 to 6%.
Southwest[1]	**-1.1%** **(95% CI -5.4 to +2.4%)** **1995 – 2000** (Runge *et al.* 2004)	**1364** (FWC Manatee Synoptic Aerial Surveys 2009)	**0.60** **(95% CI 0.42 – 0.75)** **1993 – 1997** (Koelsch 2001)	**0.908** **SE 0.019** **1995 – 2000** (Langtimm *et al.* 2004)	Estimated conditional, annual reproductive rate based on warm weather data from Sarasota Bay only, may not be representative of other regions.

[1]Parameter estimates for the Southwest have broader confidence intervals than those for the other management units. This is due to a number of factors, including: fewer years of photo-identification monitoring data, turbid water making photography difficult, and warmer weather in the south reducing the number of cold days when manatees are available for photography. Nonetheless, the current parameter estimates are the first published for this region and therefore reflect the best available information. More reliable information is expected for this management unit as geographic coverage, sample size, and years of study increase over time.

Table 2. All manatee deaths (number of deaths, percent of annual total), 2003-2007. (Source: FWC FWRI Manatee Mortality Statistics 2008)

Year	Human-caused Mortality	Perinatal	Cold Stress	Other[2]	Total
2003	85 (22%)	72 (19%)	48 (13%)	178 (46%)	383
2004	76 (27%)	72 (26%)	52 (18%)	82 (29%)	282
2005	94 (24%)	89 (22%)	29 (7%)	186 (47%)	398
2006	96 (23%)	70 (17%)	21 (5%)	233 (55%)	420
2007	82 (25%)	59 (18%)	19 (6%)	162 (50%)	322
TOTAL	433 (24%)	362 (20%)	169 (9%)	841 (47%)	1805
5-Year Avg.	86.6	72.4	33.8	168.2	361

[1]Numbers include reported, dead manatees that were salvaged and confirmed/verified carcasses that were not salvaged (included in "Other").

[2]Includes known and/or suspected red tide deaths, including 96 in 2003, 92 in 2005, 62 in 2006, and 38 in 2007.

Table 3. Manatee mortality due to marine debris, 2003-2007. (Source: FWC FWRI Manatee Mortality Statistics 2008)

Year	Crab trap(s) and associated gear	Net(s) and asociated gear	Fishing line, tackle, and associated gear	Rope and miscellaneous marine debris	Total no. of deaths
2003		**1**	**1**	**1**	**3**
2004			**1**		**1**
2005					**0**
2006			**3**		**3**
2007		**1**	**1**	**1**	**3**
TOTAL	**0**	**2**	**6**	**2**	**10**
5-Year Avg.	**0.00**	**0.40**	**1.20**	**0.40**	**2.00**

Note: numbers only include reported dead manatees that were salvaged. Numbers do not include reported, dead manatees that were not salvaged.

Table 4. Manatee rescue, rehabilitation, and release, 2003-2007. (Source: USFWS Jacksonville Field Office, unpub. data 2008b)

Year	Crab trap(s) and associated gear		Net(s) and asociated gear		Fishing line, tackle, and associated gear		Rope and miscellaneous marine debris		Total no. of rescues
	Rescues	Assist and Releases	Rescues	Assist and Releases	Rescues	Assist and Releases	Rescues	Assist and Releases	
2003	3	5			1	3	3	1	16
2004	4	4	1		1	4	1	1	16
2005	1	4				3	3	2	13
2006		5		2		3		5	15
2007	1	8		2		1	1	7	20
TOTAL	9	26	1	4	2	14	8	16	80
5-Year Avg.	1.80	5.20	0.20	0.80	0.40	2.80	1.60	3.20	16.00

Note: numbers only include reported, distressed manatees that were either rescued or assisted and released. Numbers do not include reported, distressed manatees that were not rescued.

11/2009

WEST INDIAN MANATEE *(Trichechus manatus)*
PUERTO RICO STOCK
(Antillean subspecies, Trichechus manatus manatus)

U.S. Fish and Wildlife Service, Caribbean Field Office, Boquerón, Puerto Rico

STOCK DEFINITION AND GEOGRAPHIC RANGE

Manatees belong to the Order Sirenia with two known families. Family Dugongidae is represented by the extant genera *Dugong* that is found in the Indo-Pacific region and the extinct genera *Hydromalis* the only member of the order adapted to cold water. Family Trichechidae is represented by one genus *Trichechus* and three species: *T. senegalensis*, the West African manatee, *T. inunguis*, the Amazonian manatee, and *T. manatus*, the West Indian manatee. The West Indian manatee is distributed in Caribbean coastal areas and river systems from Virginia, USA to Espiritu Santo, Brazil (Shoshani 2005).

Hatt (1934) recognized two *T. manatus subspecies:* the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). Domning and Hayek (1986) tentatively divided the West Indian manatee into the Florida manatee *T. m. latirostris* and the Antillean manatee *T. m. manatus* based on cranial characters. They suggested that 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.

García-Rodríguez *et al.* (1998) compared mitochondrial DNA (mtDNA) from eight locations of *T. manatus* and found that despite the sharing of sixteen haplotypes (a segment of DNA containing closely linked gene variations that are inherited as a unit) among these locations, there was a strong geographic structuring of mtDNA diversity in three sites: Florida and the West Indies, the Gulf of Mexico to the Caribbean rivers of South America, and the northeast Atlantic coast of South America; units which are not concordant with the previous sub-species designations. Vianna *et al.* (2005) studied 291 samples mtDNA from the four Sirenia species, including samples of *T. manatus* from 10 countries. Colombia has the highest diversity of haplotypes with eight, while Puerto Rico has three haplotypes and the Dominican Republic only has two. Although Puerto Rico and the Dominican Republic share haplotype A with Florida, Vianna *et al.* (2005) found a high differentiation between the manatees in Florida, and the manatees in the Dominican Republic and Puerto Rico.

Slone *et al*. 2006 indicates that haplotype (mitochondrial DNA) distribution is further geographically divided in Puerto Rico. For example, only the A haplotype (haplotype also unique to Florida) was found along the north of the island and B haplotype was observed from the south shore. The authors found a mixture of A and B haplotype located along the eastern and western ends of the island, suggesting mixing between the south and north groups. Furthermore, the mitochondrial DNA is maternally inherited and is not reflective of the additional gene flow from males. Radio-tagging techniques in Puerto Rico have documented general behavior of manatee populations, in which males seem to move more extensively than females (Slone *et al.* 2006). Males may travel hundreds of kilometers while mother/calf distribution patterns could be more restricted. The authors state that if male movements are made during the breeding season, then relatively healthy mixing between geographical areas established by females might be expected. Further research by Kellogg (2008) indicates that nuclear DNA subpopulation separation was not as severe, suggesting that the manatees in Puerto Rico do travel and breed throughout the population to some degree.

The Antillean manatee is found in eastern Mexico and Central America, northern and eastern South America, and in the Greater Antilles (Lefebvre *et al.* 1989). It inhabits riverine and coastal systems in the subtropical Western Atlantic Coastal Zone from the Bahamas to Brazil, including the Gulf of Mexico. The distribution of the Antillean manatee extends eastward only to Puerto Rico, except for one 1988 report in St. Thomas, U.S. Virgin Islands; however, transient animals are know to occur in the Lesser Antilles (Lefebvre *et al*. 2001).

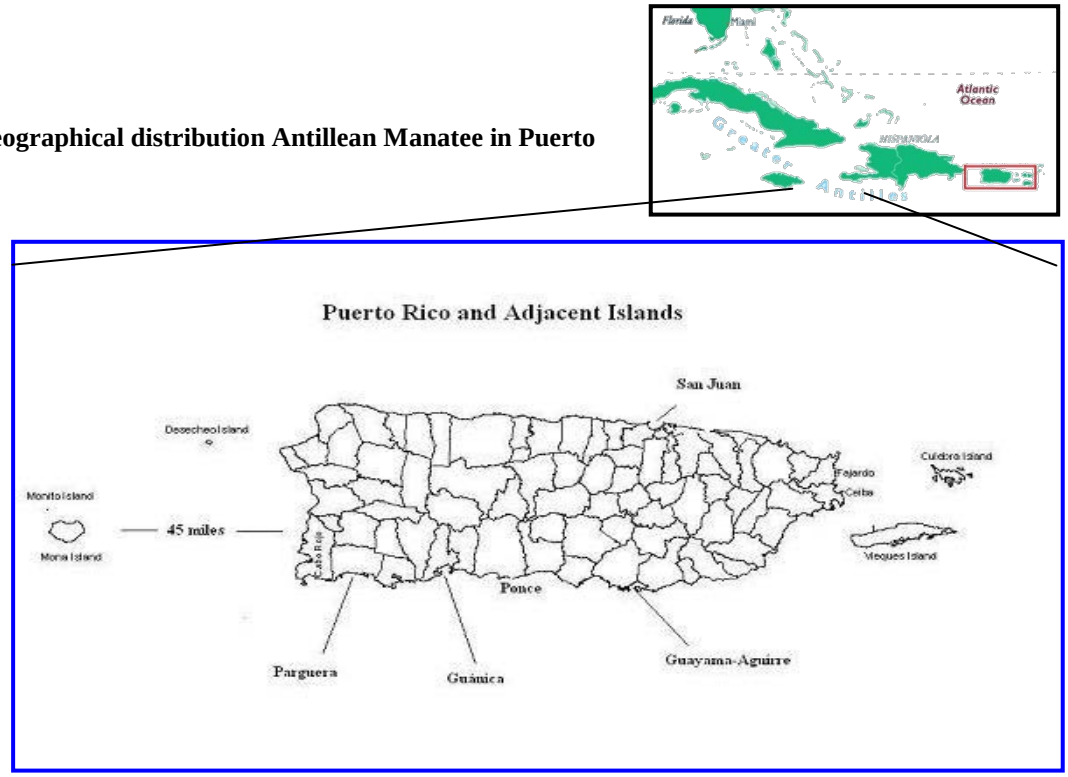
Genetically, the Puerto Rico population is isolated from the Florida manatee and has an additional haplotype when compared to the Dominican Republic. Antillean manatees occur around Hispaniola. While only a 90-mile stretch separates the two islands, manatee sightings have only occurred in areas close to the coast in Puerto Rico. The prevailing winds and currents are mostly from the northeast. This possibly creates a barrier to regular migration. Mona Island is located mid-way between Hispaniola and Puerto Rico. Extensive studies of Taino Indian archeological

evidence did not reveal manatee bones, suggesting that manatees were not readily available as a food item here. Additionally, threats by commercial and artisanal fisheries and conservation efforts are different between islands. For these reasons, we have made a determination to treat the Puerto Rico population of the Antillean manatee as a separate stock.

Powell *et al.* (1981) describes the manatee population in Puerto Rico as small and widely distributed. Rathbun *et al.* (1985) states that the population of manatees in Puerto Rico was not even and that distribution did not vary from 1976-78, when Powell conducted his studies. All studies suggest that manatees in Puerto Rico are most often detected in protected areas around cays, in secluded bays and shallow seagrass beds east of San Juan, the east, south, and southwest coasts, and not far from fresh water sources. The manatees are most consistently detected in two areas: Jobos Bay area between Guayama and Salinas, Fajardo and Roosevelt Roads Naval Station, Ceiba (Powell *et al.* 1981; Rathbun *et al.* 1985; Freeman and Quintero 1990; Mignucci-Giannoni *et al.* 2004: US Fish and Wildlife Service 2007, USFWS unpublished data 2007). Manatees are not abundant on the north coast, although they are seen in areas immediately to the west of San Juan (Powell *et al.* 1981; Mignucci-Giannoni 1989).

Five offshore islands are the most significant biogeographic features in Puerto Rico: (west to east) are Desecheo, Mona, Caja de Muertos, Culebra, and Vieques islands (Figure 1). Manatees have not been detected in the first three. Manatees have not been seen in the Mona Passage or Mona Island, 45 miles west of Puerto Rico. This passage may constitute a migratory barrier to the area since it is permeated by a strong east to west current and high surfs. Although there is available habitat in Caja de Muertos Island, manatees have not been detected by any of the authors suggesting they prefer available habitat closer to the coast. The island lacks fresh water, and easterly strong currents and high surf are prevalent between Caja de Muertos and the south coast of Puerto Rico that may hinder traveling to this island. Vieques Island seems to be within the range of the species (14 miles) and manatees have been seen traveling to and from the east coast (Magor 1979). This suggests that the manatees in Vieques may be a subset of the east coast populations as increased numbers were detected from the east coast and there were often decreased detection around Vieques and vise versa. Manatees have been reported irregularly in Culebra Island through the years; the individuals usually staying only for a couple of weeks. In 2006, a 5-foot manatee was photographed close to Tamarindo Beach on the east side of Culebra (Teresa Tallevast 2006 pers. com.). Although Culebra Island has available habitat, it lacks fresh water, which may hinder longer stays by manatees. The U.S. has jurisdictional responsibilities for the Antillean subspecies only in Puerto Rico and the U.S. Virgin Islands.

Figure 1. Geographical distribution Antillean Manatee in Puerto Rico



POPULATION SIZE

Barrett (1935) suggests that in pre-columbian times manatees in Puerto Rico were so plentiful along the coast, swamps, and bayous that the Spaniards gave the Arawak name Manatí to a locality. He noticed that when he visited the island that silting-up of the waters behind the town of Manatí drove the manatees out to sea. Evermann (1900) describes the manatee in Puerto Rico as rare. Erdmann (1970) describes that manatees were rare around Puerto Rico and absent from the Virgin Islands. In the absence of replicable population estimates, it is unclear if population size was greater in the past than today. Manatees are seen in groups of up to 8 individuals but never in large aggregations. With 350 miles of coastline and fresh water readily available, manatees appear to exploit most protected nearshore shallow bays and coves and move between sites. This makes them more difficult to detect from shore or during surveys.

Minimum Population Estimate

Deutsch *et al.* (2007) estimated the population levels of mature Antillean manatees at 2,600 in all of the 41 countries of the wider Caribbean but, optimistic 'estimates' from researchers and peers suggests the it may actually be in the range of 5,600 individuals. Deutsch *et al.* (2007) describes the population size in Puerto Rico at a minimum of 128 with a projected population estimate of 300. The exact number of Antillean manatees known to occur in Puerto Rico is unknown. Aerial surveys have been used to obtain distribution patterns or determine minimum population counts in some areas (Magor 1979, Rice 1990, and Mignucci-Giannoni *et al.* 2003, 2004) or throughout the island (Powell *et al.* 1981; Freeman and Quintero 1990; Rathbun *et al.* 1985; USFWS 2007 unpublished data). Each survey was different, with surveys conducted several months in various years, surveys every month for a year, and surveys of unequal number of months for 12 years. In spite of the high variability between and within surveys, the data can be used to determine the highest number of manatees sighted within a time period (one island survey).

Powell *et al.* (1981) detected an average of 22.6 manatees during ten surveys with the highest count of 51. They found that manatee population in Puerto Rico appears to be small and widely distributed. Rathbun *et al.* (1985) determined that manatees sighted per survey averaged 43.6 (S.D. = 13.1) with a minimum count of 20 and a maximum of 62, higher than previously reported. The Service conducted 23 aerial surveys from 1991 to 2002 and one survey in 2009. The average number of manatees sighted was 67 (S.D. = 20) per survey, with a high of 117, a low of 22. The average number of adults was 63.40 per survey and calf numbers averaged 4.72 per survey. The 2009 survey counted a total of 72 manatees, including 64 adults and eight calves. We have determined 72 is the most current minimum population estimate for the Puerto Rico stock of the Antillean manatee.

Current Population Trends

Quantitative information is limited regarding trends in the abundance of the Antillean manatee in Puerto Rico and the U.S. Virgin Islands. In Puerto Rico, Deutsch *et al.* (2007) describes the manatee as stable. USFWS (2007) also suggests that the Puerto Rico population of the West Indian manatees is at least stable and possibly slightly increasing due to increasing numbers detected in annual surveys. Plotted data from all surveys through time suggest an increase in detection in spite of differences in observer experience (Figure 2). Detection conditions varied between surveys and within surveyed areas mostly due to heterogeneous habitats. However, since mass mortality and numbers of stranded/dead manatees have not exceeded 13 per year (Mignucci-Giannoni 2006, DNER 2009 unpublished data), high variability between surveys may be related to detection rather than actual numbers of manatees.

The mean number of manatees per survey increased from 22.6 manatees (Powell *et al.* 1981) to 43.6 manatees per survey (Rathbun *et al.* 1985). From 1994 to 2009, surveys produced a mean of 68.12 manatees per survey. The proportion of calves detected per survey was about the same with 6.4% in 1979-1980 (Powell *et al.* 1981), 7.6% in 1984-1985 (Rathbun *et al.* 1985), and 6.9% in 1991–2009. In 2009, seven years since the 2002 survey, one synoptic survey detected a total of 72 manatees sighted, eight of which were calves; this figure is closer to the average detection levels of previous surveys. Although the average manatee sighted per survey has increased by about 40% since 1985, the average number of manatees per surveys has been maintained relatively stable since 1991.

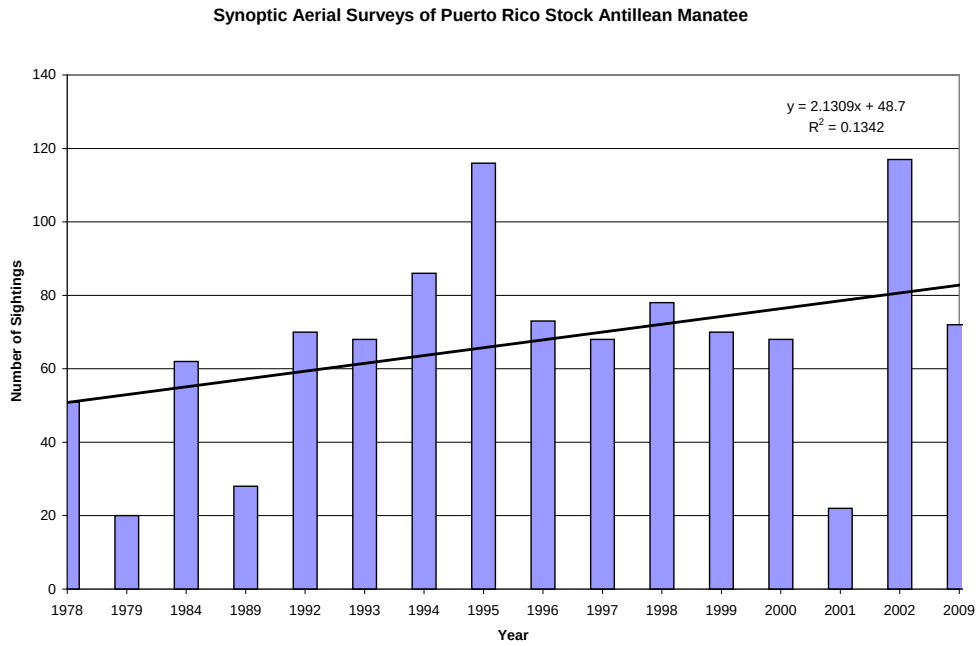


Figure 2. Synoptic Aerial Surveys Puerto Rico Stock of Antillean Manatee

Efforts to quantify population levels and trends are ongoing as part of a cooperative agreement between North Carolina State University, Puerto Rico's Department of Natural and Environmental Resources (DNER), and the U.S. Fish and Wildlife Service, Caribbean Field Office. The cooperators will conduct aerial surveys and develop a statistically robust population model incorporating factors such as detection probability of manatees in heterogeneous habitats.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Marine Mammal Protection Act (MMPA) defines net productivity rate as "the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to natural mortality." Since 1994 to 2009, an average of 63.22 adults and 4.96 calves has been reported from synoptic surveys. Mignucci-Giannoni (2006) reports that 23.9% of all mortality detected were those of dependent calves. For instance, in 2002, aerial surveys detected 6 calves, while mortality records only show 1 dependent calf. At present, we do not have clear data on recruitment; however, based on previously reported data, the mortality rates of dependent calves from natural causes remains the same. Similarly, the natural death for all ages remains at about 43%. The number of calves detected per year has not changed dramatically and they usually are in concordance to the total number of sightings. However, in the absence of a statistical value on net productivity rates we have followed the recommendation of using a 0.04 value for manatees and cetaceans (NMFS 2005).

POTENTIAL BIOLOGICAL REMOVAL

The West Indian manatee is federally listed as endangered. The Service has recent survey data, which indicate the Puerto Rico stock of the West Indian (Antillean manatee) is relatively stable.

The potential biological removal (PBR) formula was developed during the 1994 amendments to the MMPA as a tool to reduce incidental commercial fisheries-related marine mammal mortalities and serious injuries to insignificant levels. PBR is the product of three elements: the minimum population estimate (N_{min}), half of the maximum net productivity rate (0.5 R_{max}), and a recovery factor (F_r). Recovery factor values range between 0.1 and 1.0 and population simulation studies demonstrate that a default value of 0.1 should be used for endangered (depleted) stocks and a default value of 0.5 should be used for threatened stocks or stocks of unknown status (NMFS 2005).

The recovery factor for the Puerto Rico stock of the Antillean manatee should be between 0.1 and 0.5. Though the population is stable, the default value of 0.1 is used due to the small size of the population and the current endangered

status. Given a minimum population estimate of 72 and an R_{max} of 0.04 (because it is unknown) the PBR for Puerto Rico stock of the Antillean manatees is as follows:

$$\mathbf{PBR = (N_{min})\ (½ \text{ of } R_{max})\ (F_r)}$$

$N_{min} = 72$
$R_{max} = 4.0\%$
$F_1 = 0.1$

PBR = (72) (0.02) (0.1) = 0. 144 (or 0)

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Rescues

From 1990 to 2005 a total of 23 manatees were rescued by the Caribbean Stranding Network (CSN) (Mignucci-Giannoni 2006). Of these, 21 were calves; one was a sub-adult and one an adult. Two were rehabilitated and released, two were released immediately after rescue, 17 died in rehabilitation, and one died in transport, and one is currently in rehabilitation. Of the four manatees that were released, only one has died; one year after its release. Since 2005, only two manatees were rescued, one adult died in transport and a calf was in rehabilitation at the Juan A. Rivero Zoo in Mayaguez for almost a year. This manatee died in July 2009 due to an intestinal infection. An average of 1.4 calves is rescued every year, but most have died due to illness (Mignucci-Giannon1 2006; DNER 2009 unpublished data).

Mortality

Carcass salvage efforts were initiated in April 1974 by the Service and local entities and continued through 1989. The CSN then initiated a dedicated salvage, rescue, and rehabilitation program, assuming responsibility for all carcass recovery efforts in Puerto Rico. Currently, carcass salvage efforts are performed by DNER. From 1990 through 2008, a total 130 manatees have been found dead (Mignucci-Giannoni 2006; DNER 2009 unpublished data).

There is no record in Puerto Rico of serious injury to manatees by propellers, except the mortality of a mating herd impacted by a big vessel in 2006. In Puerto Rico, single Antillean manatee strandings are the rule. Only one multi-individual manatee death was recorded in 2006 when 5 adult individuals, 4 males and one female, were impacted by a big vessel in San Juan Bay. Unlike Florida, mass mortality does not occur in Puerto Rico since the etiological cause, red tide, or need for warm water habitats do not present an issue to a coastal tropical marine species. Moreover, except for mating herds, manatee groups detected during aerial surveys are small, mostly single sightings or 2-3 individuals (e.g., mother, year calf, and immature adult).

	Natural		**Human**	**Undetermined**	**Total**
	Dependent Calves/Perinatal	**Illness**	**Watercraft**		
Year					
2004	**2**	**1**		**5**	**8**
2005	**4**	**1**	**2**	**1**	**8**
2006	**2**	**3**	**5**	**2**	**12**
2007	**2**	**1**		**2**	**5**
2008	**1**	**1**	**2**	**4**	**8**
Totals	**11 (27%)**	**7 (17%)**	**9 (22%)**	**14 (34%)**	**41**
5-Year Avg.	**2.2**	**1.4**	**1.8**	**2.8**	**8.2**

Table 1. Manatee mortality from 2004 to 2008. (Mignucci-Giannoni 2006. Data 2000-2005; DNER 2009. Data 2006-2008)

During the 2004-2008 period a total of 41 manatees were reported dead (Table 1). Natural Causes comprised most of reported cases 18 (44%) while watercraft related death were 9 (22%). In most cases, manatees are killed by a blunt trauma to the head, which produces an internal hemorrhage and subsequent death. In 2006, an unusual manatee death was reported when a mating heard was impacted by the propellers of a big vessel. Other than this event, necropsies did not report propeller marks like in Florida. The cause of death in most of cases, i.e., 14, was deemed as Undetermined (34%). The Undetermined cause of death (COD) category means that assessment of a natural or human related cause was negative (no evidence that COD can be assigned to any of the available categories, either natural or human related).

In most cases, the reporting of a stranded manatee takes days. Warm water and remote locations of stranding may hinder recovery of manatee carcasses, making it difficult to conduct a timely determination of mortality. The DNER's Marine Mammal Stranding Program has developed a protocol to report and quickly act on marine mammal strandings, mostly manatees. This program is institutionalized and first responders are usually DNER rangers that have the mandate and capacity to quickly act to increase detection and prevent death of animals. Because of this system, the number of strandings currently reported by DNER may help to provide a better estimate of manatee mortality in Puerto Rico. We will continue to support their efforts to determine if this mortality trend continues and what relationship it has to other population parameters.

Until the mid 1980's, some coastal families captured manatees for special events. Manatees were captured in gill and/or turtle nets purposely or inadvertently during fishing activities. Mignucci-Giannoni *et al.*, (1993) indicates that from 1974 until 1988, 41.5 percent of the documented mortality was attributed to poaching. He indicated that meat was sold to ready buyers, although the extent to which this occurred was unknown. After the rescue of a baby manatee in 1991, and subsequent media uproar because its mother was poached, capture by fisherman has been virtually eliminated.

Fisheries

The fisheries in the U.S. Caribbean are multi-species, multi-gear, artisanal in nature, and principally coral reef-based (NOAA 2004). Boats used are wooden or fiberglass, 17-21 feet long. Traps are the most common used gear but line is almost as common now. Traps are deployed in the shallow nearshore zone around coral reefs in algal plains, sand, and seagrass beds but, not on top of corals at depths ranging from 20-62 meters. Among fishers, 68% use buoys to mark the trap line and 32% use none at all. Matos-Caraballo (2004) reported that, of interviewed commercial fishers, 36% were full time and 64% part time fishers. A total of 17% fished in the shore, 83% on the continental shelf. Within gears, 5% use beach seines, 36% gillnets, 14% trammel, and 45% used cast nets.

Seventeen species of marine mammals have been described from Puerto Rican and U.S. and British Virgin Island waters (Mignucci-Giannoni 1989). However, NOAA (2004), reports that the commercial and recreational fisheries under jurisdiction of the Caribbean Council are listed as Category III fisheries, the category with the lowest level of serious injury and mortality to marine mammals. The two Category III commercial fisheries that have been identified in NMFS' "2009 List of Fisheries" (73 FR 73032; December 1, 2008) as known to take Antillean manatees are the Caribbean gillnet, which involves more than 991 vessels/persons and the Caribbean haul/beach seine fishery, which involves 15 vessels/persons. However, neither the DNER nor the Service has data to support that there is take by these commercial/artisanal fisheries, including entanglement with fishing gear, collisions with fishing vessels, and bycatch.

In the past, the carcass recovery program described few fisheries interaction incidents with manatees and several reports were anecdotal. Nets have been banned altogether in the U.S. Virgin Islands except for shallow small nets for bait fish. In Puerto Rico Regulation 678 of the 2004 Fisheries Law have prohibited some types of nets and limit the deployment and size of others. All haul/beach seine nets have been prohibited in Puerto Rico. Gill and trammel nets have been prohibited from use in river mouths, rivers and lagoons (DNER 2004). Mesh size should not be less than 2 inches or more than 6 inches when stretched. This measure, although targeted to prevent sea turtle poaching, may further prevent the accidental entanglement of manatees. Commonwealth, NMFS and Service law enforcement measures currently in place are curtailing turtle poaching with a positive effect to manatees. We believe that fisheries interactions, either intentional or accidental, may not significantly affect the status of the Puerto Rico stock of the Antillean manatee. We acknowledge that there may be limits to the data available because, although unlikely, it is possible take could occur and may not be observed or reported. However, protocols for necropsies and assigning probable cause of death categories are reviewed thoroughly. Table 1 of this SAR shows watercraft as the only human related deaths. The only possible evidence for commercial fisheries interaction would be within the 34%

undetermined COD category. In addition, we believe that manatees injured by commercial fisheries interactions would most likely present signs of the activity and every necropsy includes a specific evaluation of human interactions. From 1990-2008, only one manatee had a COD potentially related to commercial fisheries interaction. In 2006, one freshly dead manatee was found with its right flipper entangled in monofilament; however the COD was undetermined. In accordance with the previous statements and the presence of current bans and restrictions in place prohibiting the use of nets, the Service believes that incidental mortality and serious injury related to commercial fisheries in Puerto Rico and the U.S. Virgin Islands should be considered minimal or approaching zero.

STATUS OF STOCK

The West Indian manatee is listed as endangered under provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.), as amended and a Recovery Plan developed in 1986 for the Puerto Rico population of the Antillean subspecies (USFWS 1986). As an endangered species, the Puerto Rico stock of Antillean manatees is considered a strategic stock and depleted as defined in Section 3(19) of the Marine Mammal Protection Act of 1972, as amended.

We currently do not have sufficient information on the Puerto Rican manatee population to determine the Optimum Sustainable Population (OSP). The Antillean manatee is not impacted by cold spells and red tide like Florida manatees and it is mostly a coastal species. This precludes the use of Florida data on survival rates and reproduction to reach an OSP.

The main threats to the species in Puerto Rico are watercraft collisions and habitat degradation (e.g., marine construction activities, propeller scarring on sea grass beds, impacts on sea grass beds related to anchoring, oil spills, and availability of fresh water sources). A number of mechanisms are in place to lessen the impact of these factors. There is a strong outreach and education effort and a gill net prohibition in place. Most development activities within the water are reviewed by the Corps of Engineers and the Service based on provisions in the Endangered Species Act and the Marine Mammal Protection Act. Therefore, the U.S. Fish and Wildlife Service, when engaged in consultation under the ESA related to manatees, will provide recommendations to consulting agencies to avoid a take.

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