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 ~~2000~~2001-~~2004~~2005. The "SAR revised" column indicates ~~2006~~ 2007 stock assessment reports that have been revised relative to the ~~2005~~ 2006 reports (Y=yes N=no). If abundance, mortality or PBR estimates have been revised, they are indicated with the letters "a", "m" and "p" respectively. For those species not updated in this edition, the year of last revision is indicated. Unk = unknown and undet=undetermined (PBR for species with outdated abundance estimates is considered "undetermined".

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Northern right whale	Western North Atlantic	NEC	306	0	306	0	0.1	0	~~2.8~~3.2[a]	1.~~6~~[a]4[a]	Y	Y a,m
Humpback whale	Gulf of Maine	NEC	~~902~~847	~~.41~~.55	~~647~~549	0.04	0.1	1.~~3~~1	~~3.0~~4.2[b]	2.~~4~~[b]4[b]	Y	Y a,m,p
Fin whale	Western North Atlantic	NEC	~~2,814~~2,269	~~.21~~.37	~~2,362~~1,678	0.04	0.1	~~4.7~~3.4	~~1.8~~2.4[c]	0.8[c]	Y	Y a,m,p
Sei whale	Nova Scotia	NEC	~~unk~~207	~~unk~~.62	~~unk~~128	0.04	0.1	~~undet~~ 0.34	0.4	0	Y	~~N~~ Y ~~(2005)~~a,m,p
Minke whale	Canadian east coast	NEC	~~2,998~~3,312	~~.19~~.74	~~2,559~~1,899	0.04	0.5	~~26~~19	2.8[d]	2.~~6~~[d]4[d]	N[t]	Y a,m,p
Blue whale	Western North Atlantic	NEC	unk	unk	unk	0.04	0.1	unk	0.2	0	Y	N (2002)
Sperm whale	North Atlantic	NEC	4,804	.38	3,768	0.04	0.1	5.7	0.4	0.2	Y	~~N~~ Y ~~(2005)~~stranding data
Dwarf sperm whale	Western North Atlantic	SEC	395[e]	.40	285[e]	0.04	0.4	2.0	0	0	N	~~N (2005)~~Y
Pygmy sperm whale	Western North Atlantic	SEC	395[e]	.40	285[e]	0.04	0.4	2.0	6	6	Y	Y stranding data~~N (2005)~~
Killer whale	Western North Atlantic	NEC	unk	unk	unk	0.04	unk	unk	0	0	N	N (1995)
Pygmy killer whale	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y stranding data~~N (2005)~~
Northern bottlenose whale	Western North Atlantic	NEC	unk	unk	unk	0.04	unk	unk	0	0	N	~~N~~ Y ~~(1998)~~m
Cuvier's beaked whale	Western North Atlantic	NEC	3,513[f]	.63	2,006[f]	0.04	0.~~5~~4	22	~~0~~1	~~0~~[g]1[g]	Y	~~N~~ Y ~~(2005)~~m
Mesoplodon beaked whales	Western North Atlantic	NEC	3,513[f]	.63	2,006[f]	0.04	0.~~5~~4	22	~~0~~1	~~0~~[g]1[g]	Y	~~N~~ Y ~~(2005)~~m
Mel~~l~~on-headed whale	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y stranding data~~N (2005)~~

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Risso's dolphin	Western North Atlantic	NEC	20,479	.59	12,920	0.04	0.~~48~~5	~~124~~129	~~unk~~40[i]	~~unk~~40(.28)[i]	N	Y a, m, p
Pilot whale, long-finned	Western North Atlantic	NEC	31,139[h]	.27	24,866[h]	0.04	0.5	249	~~unk~~[i]163[h]	~~unk~~[i]163(.09)	N[t]	Y a, m~~,p~~
Pilot whale, short-finned	Western North Atlantic	SEC	31,139[h]	.27	24,866[8]	0.04	0.5	249	163[h]~~unk~~[i]	~~unk~~[i]163(.09)	N[t]	Y a, m~~,p~~
Atlantic white-sided dolphin	Western North Atlantic	NEC	~~51,640~~63,368	.~~38~~27	~~37,904~~50,883	0.04	0.5	~~379~~509	~~unk~~[i]357	~~unk~~[i]~~2~~357(.11)	N[t]	Y a,m~~,~~p
White-beaked dolphin	Western North Atlantic	NEC	~~unk~~2,003	~~unk~~.94	~~unk~~1,023	0.04	0.5	~~unk~~10	0	0	N	Y ~~stranding data~~a, p
Common dolphin	Western North Atlantic	NEC	120,743	.23	99,975	0.04	0.5	1,000	~~unk~~[i]151	~~unk~~[i]151(.11)	N[t]	Y m
Atlantic spotted dolphin	Western North Atlantic	SEC	50,978	.42	35,745[j]	0.04	0.5	357	~~0~~6	~~0~~6(1.0)	N	~~N (2005)~~Y m
Pantropical spotted dolphin	Western North Atlantic	SEC	4,439	.49	3,010	0.04	0.5	30	~~0~~6	6(1.0)~~0~~	N	~~N (2005)~~Y m
Striped dolphin	Western North Atlantic	NEC	94,462	.40	68,558	0.04	0.5	686	0	0	N	~~N (2005)~~Y Stranding data
Fraser's dolphin	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y Stranding data~~N (2005)~~
Clymene dolphin	Western North Atlantic	SEC	6,086	.93	3,132	0.04	0.5	31	0	0	N	Y Stranding data~~N (2005)~~
Spinner dolphin	Western North Atlantic	SEC	unk	unk	unk	0.04	0.5	unk	0	0	N	Y Stranding data~~N (2005)~~
Bottlenose dolphin	Western North Atlantic, offshore	SEC	~~54,739~~81,588[j]	.24	~~71,382~~70,775[j]	0.04	0.~~5~~4	~~714~~566	~~27~~unk[t]	~~27~~unk[t]	N[t]	~~N (2005)~~Y (a, m, p)
Bottlenose dolphin	Western North Atlantic, coastal	SEC	unk[k]	unk[k]	unk[k]	0.04	0.5	unk[k]	unk[k]	unk[k]	Y	Y m
Harbor porpoise	Gulf of Maine/Bay of Fundy	NEC	~~89,700~~89,054	~~.22~~.47	~~74,695~~60,970	0.04	0.5	~~747~~610	~~575~~[l]734[l]	~~574~~652(.~~17~~16)[l]	~~N~~Y	Y a,m,p
Harbor seal	Western North Atlantic	NEC	99,340	.097	91,546	0.12	1.0	5,493	~~927~~893	~~906~~882 (.~~18~~16)	N	Y ~~a,~~m~~,p~~
Gray seal	Western North Atlantic	NEC	unk	unk	unk	0.12	1.0	unk	~~370~~449	~~227~~304(.22)	N	Y a, m
Harp seal	Western North Atlantic	NEC	unk	unk	unk	0.12	0.5	unk	~~406,691~~447,447[m]	~~81~~73(.~~29~~27)	N	Y a, m
Hooded seal	Western North Atlantic	NEC	unk	unk	unk	0.12	0.5	unk	~~6,1405,97~~~~2~~4,818[n]	25(.82)	N	Y a, m

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Sperm whale	Northern Gulf of Mexico Oceanic	SEC	~~1,349~~1,665	.~~23~~20	1,~~114~~409	0.04	0.1	2.~~2~~8	0	0	Y	~~N (2005)~~Y a,p
Bryde's whale	Northern Gulf of Mexico Oceanic	SEC	~~40~~15	~~.61~~1.98	~~25~~5	0.04	0.5	0.~~3~~1	0	0	N	~~N~~Y A,p
Cuvier's beaked whale	Northern Gulf of Mexico Oceanic	SEC	~~95~~65	.~~47~~67	~~65~~39	0.04	0.5	0.~~7~~4	0	0	Y	~~N (2005)~~Y a,p
Blainville's beaked whale	Northern Gulf of Mexico Oceanic	SEC	~~106[15]~~57[o]	~~.41~~1.40	~~76~~24	0.04	0.5	0.~~8[o]~~2[o]	0	0	Y	~~N (2005)~~Y a,p
Gervais' beaked whale	Northern Gulf of Mexico Oceanic	SEC	~~106[15]~~57[o]	~~.41~~1.40	~~76~~24	0.04	0.5	0.~~8[o]~~2[o]	0	0	Y	Y a,p~~N (2005)~~
Bottlenose dolphin	Northern Gulf of Mexico Continental shelf	SEC	~~25,320~~21,531	~~.26~~.28	~~20,414~~17,084	0.04	0.5	~~204~~170	0	0	N	~~N (2005)~~Y (a, p)
Bottlenose dolphin	Northern Gulf of Mexico Coastal	SEC	unk	unk	unk	0.04	0.5	undet	0	0	Y	~~N (2005)~~Y Stranding data
Bottlenose dolphin	Northern Gulf of Mexico Oceanic	SEC	~~2,239~~3,708	.~~41~~42	~~1,607~~2,641	0.04	0.5	~~16~~26	0	0	N	~~N (2005)~~Y a,p
Bottlenose dolphin	Gulf of Mexico bay, sound, and estuarine	SEC	unk	unk	unk	0.04	0.5	undet	unk	unk	Y	~~N (2005)~~Y Stranding data
Atlantic spotted dolphin	Northern Gulf of Mexico (Outer continental shelf and Oceanic)	SEC	~~30,947~~ ~~772~~27,393	.~~27~~23	~~24,752[p]~~6 ~~12~~22,626[p]	0.04	0.5	~~248[p]~~ 226[p]	0	0	N	Y a,p~~N (2005)~~
Pantropical spotted dolphin	Northern Gulf of Mexico Oceanic	SEC	~~91,321~~ 34,067	.~~16~~18	~~79,879~~29,311	0.04	0.5	~~799~~293	0	0	N	Y a,p~~N (2005)~~
Striped dolphin	Northern Gulf of Mexico Oceanic	SEC	~~6,50~~3,325~~5~~	.~~43~~48	~~4,599~~2,266	0.04	0.5	~~46~~23	0	0	N	Y a,p~~N (2005)~~
Spinner dolphin	Northern Gulf of Mexico Oceanic	SEC	~~11,971~~ 1,989	~~.71~~.48	~~6,990~~1,356	0.04	0.5	~~70~~14	0	0	N	~~N (2005)~~Y a,p
Rough-toothed dolphin	Northern Gulf of Mexico (Outer continental shelf and Oceanic)	SEC	~~2,223~~2,942	~~.41~~.46	~~1,595~~2,034[q]	0.04	0.5	~~16[q]~~20[q]	0	0	N	Y a,p~~N (2005)~~
Clymene dolphin	Northern Gulf of Mexico Oceanic	SEC	~~17,355~~ 6,575	~~.65~~.36	~~10,528~~4,901	0.04	0.5	~~105~~49	0	0	N	Y a,p~~N (2005)~~
Fraser's dolphin	Northern Gulf of Mexico Oceanic	SEC	~~726~~unk	~~.70~~unk	~~427~~unk	0.04	0.5	~~4.3~~undet	0	0	N	Y a,p~~N (2005)~~
Killer whale	Northern Gulf of Mexico Oceanic	SEC	~~133~~49	~~.49~~.77	~~90~~28	0.04	0.5	0.~~9~~3	0	0	N	Y a,p~~N (2005)~~
False killer whale	Northern Gulf of Mexico Oceanic	SEC	~~1,038~~777	~~.71~~.56	~~606~~501	0.04	0.5	~~6.1~~5.0	~~1~~0	~~1~~0	N	Y a,m,p~~N (2005)~~

Species	Stock Area	NMFS Ctr.	Nbest	Nbest CV	Nmin	Rmax	Fr	PBR	Total Annual S.I and Mort.	Annual Fish. S.I. and Mort. (cv)	Strategic Status	Revised
Pygmy killer whale	Northern Gulf of Mexico Oceanic	SEC	~~408~~323	.60	~~256~~203	0.04	0.5	2.~~6~~0	0	0	N	Y a,p~~N (2005)~~
Dwarf sperm whale	Northern Gulf of Mexico Oceanic	SEC	~~742[r]~~453[r]	~~.29~~.35	~~584[r]~~340[r]	0.04	0.5	~~5.8~~3.4[r]	0	0	N	Y a,p~~N (2005)~~
Pygmy sperm whale	Northern Gulf of Mexico Oceanic	SEC	453[r]~~742[r]~~	.35~~.29~~	340[r]~~584[r]~~	0.04	0.5	3.4[r]~~5.8[r]~~	0	0	N	Y a,p~~N (2005)~~
Melon-headed whale	Northern Gulf of Mexico Oceanic	SEC	~~3,451~~2,283	~~.55~~.76	~~2,238~~1,293	0.04	0.5	~~22~~13	0	0	N	Y a,p~~N (2005)~~
Risso's dolphin	Northern Gulf of Mexico Oceanic	SEC	~~2,169~~1,589	~~.32~~.27	~~1,668~~1,271	0.04	0.5	~~17~~13	0	0	N	Y a,p~~N (2005)~~
Pilot whale, short-finned[s]	Northern Gulf of Mexico Oceanic	SEC	~~2,388~~716	~~.48~~.34	~~1,628~~542	0.04	0.5	~~16~~5.4	0	0	N	Y a,p~~N (2005)~~

a. The total estimated human-caused mortality and serious injury to right whales is estimated at ~~2.8~~3.2 per year (USA waters, ~~1.6~~2.0; Canadian waters, 1.2). This is derived from two components: 1) non-observed fishery entanglement records at 1.~~6~~ 4 per year (USA waters, 0.~~6~~4; Canadian waters, 1.0), and 2) ship strike records at 1.~~2~~ 8 per year (USA waters, 1.~~0~~6; Canadian waters, 0.2).

b. The total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as ~~3.6~~4.2 per year (USA waters, ~~2.6~~3.8; Canadian waters, 0.~~6~~4~~; St. Vincent and the Grenadines, 0.4~~). This average is derived from two components: 1) incidental fishery interaction records 2.~~6~~ 8 (USA waters, ~~2.0~~2.4; Canadian waters, 0.~~6~~4); 2) records of vessel collisions, ~~0.6~~1.4 (USA waters, ~~0.6~~1.4; Canadian waters, 0).

c. This is based on a review of NMFS records from ~~1999~~2001-~~2003~~2005, that yielded an average of ~~1.8~~ 2.4 human caused mortality; 1.~~0~~ 6 ship strikes (~~all USA waters~~1.2 in USA waters and 0.4 in Canadian waters) and 0.8 fishery interactions/entanglements (0.~~2~~ in Canadian waters, 0.~~4~~ 6 in USA waters and 0.2 in Bermudian waters).

d. During ~~2000~~2001-~~2004~~2005, the USA total annual estimated average human-caused mortality is 2.8 minke whales per year, plus a pending number from the bycatch estimate. This is derived from three components: a yet to be determined number of minke whales per year (CV=??) from USA fisheries using observer data (one minke whale bycatch was observed but this number has yet to be statistically extended), 2.~~6~~ 4 minke whales per year from USA fisheries using strandings and entanglement data, and 0.~~2~~ 4 minke whales per year from ship strikes.

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

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

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

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

i. Preliminary fishery mortality estimates have been generated for the years 2000-2004. The estimates will not be reported until scientific review is complete.

j. Estimates may include sightings of the coastal form.

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

l. The total annual estimated average human-caused mortality is ~~575~~ 736 (CV=.~~17~~16) harbor porpoises per year. This is derived from ~~four~~ three components: ~~515~~ 652 harbor porpoise per year (CV=0.~~17~~16) from USA fisheries using observer and MMAP data, ~~55~~ 79 per year (unknown CV) from Canadian fisheries using observer data, and ~~4~~5.~~2~~ 0 per year from USA unknown fisheries using strandings data.~~, and 1.2 per year from unknown human-caused mortality (a mutilated stranded harbor porpoise).~~

m. The total estimated human caused annual mortality and serious injury to harp seals was ~~406,691~~447,447. Estimated annual human caused mortality in US waters is ~~86~~82, derived from two components: 1) ~~81~~ 73 harp seals (CV=0.~~28~~27) from the observed US fisheries and ~~5~~ 9 from average ~~2000~~2001-~~2004~~ 2005 strandings mortalities resulting from human interactions. The remaining mortality is derived from five components: 1) 2000-2004 average catches of Northwest Atlantic harp seals by Canada, 257,280; 2) 2000-2004 average Greenland Catch, 79,408; 3) 566 average catches in the Canadian Arctic ; 4) 11,541 average bycatches in the Newfoundland lumpfish fishery, ; and 5) 57,810 average struck and lost animals, .

n. This is derived from two components: 1) ~~6,1145,947~~ 4,818 from ~~2000~~2001-~~2004~~ 2005 (~~2000 = 5,988;~~ 2001 = ~~6,414~~3993,960; 2002 = ~~6,0563,675~~7,341[*]; 2003 = ~~6,0566,458~~5,446[*], ~~and~~ 2004=~~6,0566,786~~5,270[*]; and 2005=~~6,417~~3,846)~~)~~ average catches of Northwest Atlantic population of hooded seals by Canada and Greenland; and 2) 25 hooded seals (CV=0.~~80~~82) from the observed U.S. fisheries; [*]~~(2000-2001 average Greenland catches).~~

o. This estimate includes ~~all *Mesoplodon spp*~~Gervais' beaked whales and Blaineville's beaked whales..

p. This is the sum (~~24,707~~27,393) of the minimum number of Atlantic spotted dolphins seen~~-~~ in the outer continental shelf (~~24,612~~27,393) and the oceanic (~~(950~~) regions combined, and the ~~summed~~ PBR is based on the sum.

~~NOTE: The estimate (24,707) is slightly lower than the (24,752) given in this table and in the SAR text. The N_{best} and the N_{min} values in the SAR were calculated from the sum med estimates.~~

q. This is the sum (~~1,442~~2,942) of the minimum number of rough-toothed dolphins seen ~~-~~in the outer continental shelf (~~751~~1,434) and the oceanic (~~691~~1,508) regions combined, and the ~~summed~~ PBR is based on the sum. ~~NOTE: The estimate (1,442) is slightly lower than the (1,595) given in this table and in the SAR text. The N_{best} and the N_{min} values in the SAR were calculated from the sum med estimates.~~

r. This estimate includes dwarf sperm whales and pygmy sperm whales.

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

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

NORTHERN RIGHT WHALE (*Eubalaena glacialis*): Western Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Individuals of the western Atlantic northern right whale population range from wintering and calving grounds in coastal waters of the southeastern United States to summer feeding and nursery grounds in New England waters and northward to the Bay of Fundy ~~and~~ the Scotian Shelf and the 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, arctic Norway and in the old Cape Farewell whaling ground east of Greenland (Jacobsen *et al.* 2004). The Norwegian sighting (in September 1999) 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. Similarly, records from the Gulf of Mexico (Moore and Clark 1963, Schmidly *et al.* 1972) represent either geographic anomalies 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 most 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). The frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear.

Research results suggest ~~that~~ the existence of ~~6~~ six major habitats or congregation areas for western Atlantic northern right whales~~;~~: ~~these are~~ the coastal waters of the southeastern United States~~,~~; the Great South Channel~~,~~; Georges Bank/Gulf of Maine~~,~~; Cape Cod and Massachusetts Bays;~~,~~ the Bay of Fundy~~,~~; and the Scotian Shelf. However, movements within and between habitats may be more extensive than ~~is sometimes~~ thought. Results from satellite tags clearly indicate that sightings separated by perhaps two weeks should not necessarily be assumed to indicate a stationary or resident animal. Instead, telemetry data have shown rather lengthy and somewhat distant excursions, including into deep water off the continental shelf (Mate *et al.* 1997, Baumgartner and Mate 2005). Systematic surveys conducted off the coast of North Carolina during the winters of 2001 and 2002 sighted 8 calves, suggesting the calving grounds may extend as far north as Cape Fear. Four of the calves were not sighted by surveys conducted further south. One of the cows photographed was new to researchers, having effectively eluded identification over the period of its maturation (McLellan *et al.* 2004). The Northeast Fisheries Science Center ~~is conducting~~ conducts an extensive multi-year aerial survey program throughout the Gulf of Maine region; this program is intended to better establish the distribution of right whales, including evaluating inter-annual variability in ~~their~~ right whale occurrence in previously poorly studied habitats.

New England waters are a primary feeding habitat for ~~the~~ right whales, which ~~appears to~~ feed primarily on copepods (largely of the genera *Calanus* and *Pseudocalanus*) in this area. Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (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). Acceptable surface copepod resources are limited to perhaps 3% of the region during the peak feeding season in Cape Cod and Massachusetts Bays (C. Mayo pers. comm.). While feeding in the coastal waters off Massachusetts has been better studied than in ~~most~~ other areas, ~~feeding by~~ right whales feeding has also been observed on the margins of Georges Bank, in the Gulf of Maine, in the Bay of Fundy, and over the Scotian Shelf. The characteristics of acceptable prey distribution in these areas are beginning to emerge (Baumgartner and Mate 2003, Baugartner et al. 2003).~~not well known~~. In addition, New England waters serve as a nursery area for calves. NMFS (National Marine Fisheries Service) and Center for Coastal Studies aerial surveys during springs of 1999-2005~~2~~ found right whales along the Northern Edge of Georges Bank, in Georges Basin, and in various locations in the Gulf of Maine including Cashes Ledge, Platts Bank and Wilkinson Basin. The consistency ~~predictability~~ with which right whales occur in such locations is relatively high~~remains unclear~~, but~~, and~~ these new data further highlight high interannual variability in right whale use of some habitats~~the need for more extensive surveys of habitats that have previously received minimal coverage~~.

Genetic analyses based upon direct sequencing of mitochondrial DNA (mtDNA) have identified five mtDNA haplotypes in the western Atlantic northern right whale (Malik *et al.* 1999). Schaeff *et al.* (1997) compared the genetic variability of North Atlantic and southern right whales (*E. australis*), and found the former to be significantly less diverse, a finding broadly replicated from sequence data by Malik *et al.* (2000). These findings might be indicative of inbreeding in the population, but no definitive conclusion can be reached using current data. Additional work comparing modern and historic genetic population structure in right whales, using DNA extracted from museum and archaeological

specimens of baleen and bone, is also underway (Rosenbaum *et al.* 1997, 2000). Preliminary results suggest that the eastern and western North Atlantic populations were not genetically distinct (Rosenbaum *et al.* 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. Results also suggest that, as expected, the principal loss of genetic diversity occurred during major exploitation events prior to the 20th century.

To date, skin biopsy sampling has resulted in the compilation of a DNA library of ~~almost~~ more than 300 North Atlantic right whales. When work is completed, a genetic profile will be established for each individual, and an assessment provided on the level of genetic variation in the population, the number of reproductively active individuals, reproductive fitness, the basis for associations and social units in each habitat area, and the mating system. Tissue analysis has also aided in sex identification: the sex ratio of the photo-identified and catalogued population appears ~~does not differ significantly from parity~~slightly skewed toward males (196M:187F). Analyses based on both genetics and sighting histories of photographically identified individuals also suggest that in this stock approximately one-third of the females with calves use summer feeding grounds other than the Bay of Fundy (New England Aquarium, unpublished data). As described above, a related question is where individuals other than calving females and a few juveniles overwinter. One or more additional wintering and summering grounds may exist in unsurveyed locations, although it is also possible that missing animals simply disperse over a wide area at these times. Identification of such areas, and the possible threats to right whales there, is ~~recognized as~~ a research priority ~~for research efforts~~.

POPULATION SIZE

Based on a census of individual whales identified using photo-identification techniques and an assumption of mortality of whales not seen in seven years, the western North Atlantic stock size was estimated to be 295 individuals in 1992 (Knowlton *et al.* 1994~~);~~). ~~an~~ An updated analysis using the same method gave an estimate of 299 animals in 1998 (Kraus *et al.* 2001). An IWC workshop on status and trends of western North Atlantic right whales gave a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be substantially greater than this (Best *et al.* 2001). ~~In a~~A review of the photo-id recapture database ~~as it exited~~ on ~~for October~~June 15, 200~~5~~6, indicated that 313~~06~~ individually recognized whales were known to be alive during 2001. Because this was a nearly complete census, it is assumed that this estimate represents a minimum population size~~,~~. ~~and~~ However, no estimate of abundance with an associated coefficient of variation has been calculated for ~~this~~ the population.

Historical Abundance

An estimate of pre-exploitation population size is not available. Basque whalers may have taken ~~substantial numbers of~~ right whales ~~at times~~ during the 1500's in the Strait of Belle Isle region (Aguilar 1986), although genetic analysis has shown that a large percent of the remains found in that area are, in fact, those of bowhead whales (Rastogi *et al.* 2004). T~~, and t~~he stock of right whales may have already been substantially reduced by the time whaling was begun by colonists in the Plymouth area in the 1600's (Reeves and Mitchell 1987~~). ~~). 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 (1987) could conclude only that there were at least ~~some~~ hundreds of right whales present in the western North Atlantic during the late 1600's. In a later study (Reeves *et al.* 1992), a series of population trajectories were plotted using historical data and ~~an~~ assuming a ~~estimated~~ present day population size of 350 ~~were plotted~~animals. The results suggest that there may have been at least 1,000 right whales in ~~this~~ the population during the early to mid-1600's, with the greatest population decline occurring in the early 1700's. 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 ~~the time~~ international protection for right whales came into effect ~~in 1935~~ (Hain 1975, Reeves *et al.* 1992, Kenney *et al.* 1995). However, ~~too~~ little is known about the population dynamics of right whales in the intervening years ~~to state anything with confidence~~.

Minimum Population Estimate

The western North Atlantic population size was ~~known~~ estimated to be at least 313~~06~~ individuals in ~~in *et al.* 2~~2002~~1~~ 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 2002~~1~~, but not recorded in the individual sightings database ~~catalogue~~ as seen during from 1 January 2002 to 15 June 2005~~2001-2004~~. It also does not include any calves known to be ~~*et al.*~~ born during 2002~~1~~, but not yet entered as new animals in the catalog.

Current Population Trend

The population growth rate reported for the period 1986-1992 by Knowlton *et al.* (1994) was 2.5% (CV=0.12), suggesting that the stock was showing signs of slow recovery. However, work by Caswell *et al.* (1999) ~~has~~ suggested that crude survival probability declined from about 0.99 in the early 1980~~'~~s to about 0.94 in the late 1990~~'~~s. The decline was statistically significant. 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 1990~~'~~s. 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 ~~after reviewing several approaches to survival estimation~~ reached similar conclusions regarding the decline in ~~this~~ the population (Clapham 2002).

Some indication of trend ~~may~~ is evident by examination of the minimum number alive as calculated from the ~~15 June 2006~~ individual sightings database, as it existed on June 15 2006, for the years 1995-2002 (Table1). These data indicate a slight increase in the number of catalogued whales during this period, but with significant variation due to apparent losses exceeding gains during 1998-99.

Table 1. Minimum number alive, apparent losses and gains as calculated from the 15 June 2006 individual right whale sightings database for the years 1995-2002

DEMOGRAPHIC	YEAR							
	1995	1996	1997	1998	1999	2000	2001	2002
Minimum number a~~l~~live~~[1]~~[a]	284	297	305	301	293	296	310	313
Losses from previous year	4	8	9	6	11	7	7	16
Gains from previous year	8	21	17	2	3	10	21	19

~~[1]~~[a]Minimum number of catalogued 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 catalogued that year. It does not include calves born that year but not yet catalogued. Later years may increase slightly as the backlog of unmatched but high quality photographs are matched to previously known individuals or become newly identified whales.

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

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).

Since that report, total reported calf production in 92/93 was 9~~8~~; 93/94, 9; 94/95, 7; 95/96, 21~~2~~; 96/97, 19~~20~~; 97/98, 5~~6~~; 98/99, 4; 99/00, 1; 00/01, 31; 01/02, 21; 02/03, 19; 03/04, 16~~7~~ :~~and~~ 04/05~~,~~ 28 and 05/06 19 [mean 14.9~~8 SE=2.7~~, (13.0-17.1; 95% C.I)]. However, this total calf production should be reduced by reported calf mortalities: 2 mortalities in 1993, 3 in 1996, 1 in 1997, 1 in 1998, 4 in 2001 and 2 in 2002. During 2002, 2 mortalities and 1 serious injury involved what were likely calves from 00/01. Of the three calf mortalities in 1996, available data suggested one was not included in the reported ~~22~~ 21 mother/calf pairs, resulting in a total of ~~23~~ 22 calves born. During 04/05 calving season, 3 adult females were found dead with near term fetuses. Eleven of the ~~22~~ 21 mothers in 1996 were observed with calves for the first time (i.e., were "new" mothers~~)~~ that year). Three of these were at least 10 years old, 2 were 9 years old, and 6 were of unknown age. An updated analysis of calving interval through the 1997/1998 season suggests that mean calving interval increased since 1992 from 3.67 years to more than 5 years, a significant trend (Kraus *et al.* 2001). This

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

The annual population growth rate during 1986-1992 was estimated to be 2.5% (CV=0.12) using photo-identification techniques (Knowlton *et al.* 1994). A population increase rate of 3.8% was estimated from the annual increase in aerial sighting rates in the Great South Channel, 1979-1989 (Kenney *et al.* 1995). However, as noted above, more recent work indicated that the population was in decline in the 1990's (Caswell *et al.* 1999, Best *et al.* 2001).

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~~a~~, Best *et al.* 2001), which may reflect lowered recruitment and/or high juvenile mortality. In addition, it is possible that the apparently low reproductive rate is due in part to an unstable age structure or to reproductive senescence on the part of some females. However, little data are available on either factor ~~are poor;~~and senescence has ~~been demonstrated in relatively few mammals (including humans, pilot whales, and killer whales) and is currently un~~not been documented for any baleen whale.

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is specified as the product of minimum population size, one-half the maximum net productivity rate and a "recovery" factor for endangered, depleted, threatened stocks, or stocks of unknown status relative to OSP (MMPA Sec. 3. 16 U.S.C. 1362, Wade and Angliss 1997). The recovery factor for right whales is 0.10 because this species is listed as endangered under the Endangered Species Act (ESA). However, in view of the population decline indicated by recent demographic analyses (Caswell *et al.* 1999, Best *et al.* 2001), the PBR for this population is set to zero.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period 2001 through 2005, the minimum rate of annual human-caused mortality and serious injury ~~For the period 2000 through 2004, the total estimated human-caused mortality and serious injury~~ to right whales ~~is estimated at~~averaged ~~2.8~~3.2 per year (U.S. waters, ~~1.6~~2.0; Canadian waters, 1.2). This is derived from two components: 1) non-observed fishery entanglement records at 1.~~6~~ 4 per year (U.S. waters, 0.~~6~~4; Canadian waters, 1.0), and 2) ship strike records at 1.~~2~~ 8 per year (U.S. waters, 1.~~0~~6; Canadian waters, 0.2). 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 Nelson *et al.* 2007.

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 1 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 most 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 harmful 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 ~~was~~ is likely to lead to mortality. We therefore limited the serious injury designation to only those reports that had substantiated evidence that the injury, whether from entanglement or vessel collision, was likely to lead to the whale's death (Cole *et al.* 2005, Nelson *et al.* 2007).~~.~~

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 ~~the~~ a whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. There was no forecasting of how the entanglement or injury may increase the whale's susceptibility to further injury, namely from additional entanglements or vessel collisions. This conservative approach likely underestimates serious injury rates.

With these caveats, the total estimated annual average human-induced mortality and serious injury incurred by this stock (including fishery and non-fishery related causes) ~~was~~ is 2.8 right whales per year (U.S. waters 1.6; Canadian waters, 1.2). As with entanglements, some injury or mortality due to ship strikes is almost certainly ~~passes~~ 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 ~~figure~~ estimate of 2.8 right whales per year must be regarded as a minimum estimate (Nelson *et al.* 2007).

Further, the small population size and low annual reproductive rate of right whales suggest that human sources of mortality may have a greater effect relative to population growth rates ~~than~~ for other whales. The principal factors believed to be retarding growth and recovery of the population are ship strikes and entanglement with fishing gear. Between 1970 and 1999, a total of 45 right whale mortalities were recorded (IWC 1999, Knowlton and Kraus 2001). Of these, 13 (28.9%) were neonates that are believed to have died from perinatal complications or other natural causes. Of the remainder, 16 (35.6%) were ~~determined to be the result of~~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 1). From ~~2000~~ 2001 through ~~2004~~2005, ~~8~~ 7 of ~~14~~ 16 records of mortality or serious injury (including records from both USA and Canadian waters) involved entanglement or fishery interactions. Information from an entanglement event~~The reports~~ often does not ~~contain~~ include the detail necessary to assign the entanglements to a particular fishery or location.

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period ~~2000~~ 2001 through ~~2004~~2005, there were at least five documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious injury determination. ~~On 7/9/00, #2746, a three-year-old of unknown gender, was seen with a line running through either side of the mouth and bridled behind the blowholes, while another portion of the line pinned the left flipper to the whale's flank. A nine-year-old female, #2223, was sighted on 8/18/00 with line tightly wrapped across her back, running through the mouth, and possibly wrapped on the left flipper. Subsequent sightings prior to the disentanglement revealed that the line across the back was beginning to tighten.~~ On 7/20/01, #2427, a seven-year-old male was sighted off Portsmouth, New Hampshire, with line wrapped tightly around the rostrum and through the mouth. The whale was disentangled later that day, and subsequent resightings indicated that the injuries were healing. However, observers also noted that the whale's baleen was damaged, and that the whale was holding its head high out of the water and not diving ~~nearly~~ as frequently as other whales in the area. A yearling male, #3120, first sighted off the North Carolina coast on 4/7/02, may have avoided serious injury due to being partially disentangled on 8/25/02 by researchers in the Bay of Fundy, Canada. An unidentified right whale was disentangled ~~off Campobello Island~~in the Bay of Fundy, Canada on 7/09/03. The gear was tentatively identified as US lobster gear and other unknown gear. ~~And lastly, o~~On 12/6/04, a one-year-old of unknown gender, #3314, was sighted with line wrapped on both its head and tail which would likely be fatal. Following more than three weeks of attempts, the constricting fishing gear was removed. On December 3, 2005, #3445--the 2004 calf of #2145--was first sighted off Brunswick, Georgia, with line across its back and around its right flipper. Over 300 feet of trailing line was removed. This whale was resighted 6/12/2006 apparently gear free.

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).

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

In a recent analysis of the scarification of right whales, a total of 75.6% of 447 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, ~~each year~~annually, between 14% and 51% of right whales are involved in entanglements (Knowlton *et al.* 2005). Entanglement records from 1970 through 2004 maintained by NMFS Northeast Regional Office (~~NOAA~~ NMFS, unpublished data) ~~from 1970 through 2004~~ included at least 92 right whale entanglements or possible entanglements, including right whales in weirs, ~~entangled~~ in gillnets, and in trailing line and buoys. An additional record (M. J. Harris, pers. comm.) reported a 9.1-10.6m right whale entangled and released south of Ft. Pierce, Florida, in March 1982 (this event occurred during a sampling program and was not related to a commercial fishery). Incidents of entanglements in groundfish gillnet gear, cod traps, and herring weirs in waters of Atlantic Canada and the U.S. east coast were summarized by Read (1994). In ~~6~~ six records of right whales becoming entangled in groundfish gillnet gear in the Bay of Fundy and Gulf of Maine between 1975 and 1990, the ~~right~~ whales were either released or escaped on their own, although several whales ~~have been~~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~~;~~. ~~however, t~~ 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 ~~2000~~ 2001 through ~~2004~~ 2005 have been summarized in Table 1. For this time frame, the average reported mortality and serious injury to right whales due to ship strikes was 1.~~2~~ 8 whales per year (U.S. waters, 1.~~0~~6; Canadian waters, 0.2). In 2000, two right whales were sighted in the Bay of Fundy with large open wounds that were likely the result of collisions with vessels. Right whale #2820, a male of unknown age, was first seen injured on 7/9/00. He was sighted intermittently throughout the remainder of that summer, ~~and~~ was seen again in the Bay of Fundy in 2001 and seen once in 2002 . The second whale, #2660, ~~is~~ was a five-year-old female who was sighted with a wound on the left side of her head, just forward of the blowholes. She has was seen with a calf in December 2005~~not been resighted since~~. Although both of these injuries ~~had~~ave ~~a~~were gruesome in appearance, in the absence of a chronic stressor (i.e., entangling fishing gear), they were apparently~~are likely~~ not fatal.

Table 2~~1~~. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, January 2001~~0~~ through December 2005~~4~~.

Date[a]	Report Type[b]	Sex, age, ID	Location[a]	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh inter	
~~3/01/00~~	~~serious injury~~	~~Adult male #1130~~	~~6mi east of Manomet, MA~~		~~P~~	~~Line apparently constricting left flipper; flipper discolored; abnormal cyamid distribution; bullet buoy trailing, line weighted down between whale and buoy; no gear recovered~~
3/17/01	mortality	Male calf	Assateague, VA	P		Large fresh propeller gashes on dorsal caudal and acute muscular hemorrhage

6/8/01	serious injury	Adult male #1102	58 mi east of Cape Cod, MA		P	Entangling gear deeply embedded; numerous signs of poor health including emaciation, skin discoloration, and abnormal cyamid distribution
6/18/01	mortality	female calf	Long Island, NY	P		Dorsal propeller wounds, sub-dermal hemorrhage
11/3/01	mortality	14 m Adult male #1238	Magdellen Islands, Canada		P	Thoroughly wrapped up in Danish Seine gear, whale seen alive and well five months earlier
7/6/02	mortality	11 m female #3107	Observed alive ~~Off~~ off Briar Island, NS Canada		P	carcass ashore on Nantucket, MA; caudal peduncle severely lacerated where entangled; gear consistent with inshore lobster fishery
8/22/02	serious injury	Adult female #1815	Scotian Shelf, Canada		P	line tightly wrapped around head and tail stock; no gear recovered
8/22/02	mortality	12.6m female 1y.o.	off Ocean City, MD	P		large laceration on dorsal surface
8/30/02	serious injury	#3210 age & sex unknown	Bay of Fundy, NS		P	line tightly wrapped around rostrum, resighted in 2004 in poor condition; no gear recovered
1/14/03	serious injury	Adult female #2240	Jacksonville, FL		P	body condition poor; no gear recovered
10/02/03	mortality	Adult female #2150	Digby, NS	P		Large fracture in skull, sub-dermal hemorrhage
2/7/04	mortality	Adult female #1004	Virginia Beach, VA	P		Severe subdermal bruising, complete fracture of rostrum and laceration of oral rete.
9/6/04	mortality	Adult female #2301	Roseway Basin, NS		P	Extensive constricting line on head and left flipper. Found dead March 3, 2005 on Ship Shoal Island, VA.
11/24/04	mortality	Adult female #1909	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed.
1/12/05	mortality	Adult female #2143	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
3/10/05	serious injury	#2425 age & sex unknown	Cumberland Island, GA	P		45' power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
4/28/05	mortality	Adult female #2617	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures

a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (~~Cole~~ Nelson *et al.* ~~2005~~2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

STATUS OF STOCK

The size of this stock is considered to be extremely low relative to OSP in the U.S. Atlantic EEZ, and this species is listed as endangered under the ESA. The North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham *et al.* 1999). A Recovery Plan has been published for the North Atlantic right whale and is in effect (NMFS 2005). Three critical habitats, Cape Cod Bay/Massachusetts Bay, Great South Channel, and the Southeastern U.S. were designated by NMFS (59 FR 28793, June 3, 1994). A National Marine Fisheries Service ESA 1996 review of Northern Right Whale status concluded that the western North Atlantic population of the northern right whale remains endangered [Note that 'northern right whale' is nomenclature that is now outdated in the scientific literature but not yet modified in rule makings. Scientific literature recognizes north Atlantic and north Pacific right whales as two distinct species]; 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 has been a minimum of ~~2.8~~3.2 right whales per year from ~~2000~~ 2001 through ~~2004~~2005. Given that PBR has been set to zero, no mortality or serious injury for this stock can be considered insignificant. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and also because the Northern right whale is an endangered species. ~~Relative to populations of southern right whales, there are also concerns about growth rate, percentage of reproductive females, and calving intervals in this population.~~

REFERENCES CITED

Aguilar, A. 1986. A review of old Basque whaling and its effect on the right whales of the North Atlantic. Rep. int. Whal. Commn., Special Issue 10:~~-~~191-199.

Angliss, R.P., and D.P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. NOAA Technical Memorandum, National Marine Fisheries-OPR-13.

Baumgartner, M.F., T.V.N. Cole, R.G. Campbell, G.J. Teegarden, and E.G. Durbin. 2003. Associations between North Atlantic ~~R~~right ~~W~~whales and ~~T~~their ~~P~~prey, *Calanus finmarchicus*, ~~O~~over ~~D~~diel and ~~T~~tidal ~~T~~time ~~S~~scales. Mar~~ine~~. Eco~~logy~~. Prog~~ress~~. Series. 264:~~-~~155-166.

Baumgartner, M.F. and B.R. Mate. 2003. Summertime foraging ecology of North Atlantic right whales. Marine Ecology Progress Series. 264:~~-~~123-135.

Baumgartner, M.F. and B.R. Mate. 2005. Summer and fall habitat of North Atlantic right whales (*Eubalaena glacialis*) inferred from satellite telemetry. Can~~adian~~. J~~ournal~~. of Fisheries and Aquatic Sciences. 62:527-543.

Best, P.B., J.L. Bannister, R.L. Brownell, Jr., and G.P. Donovan (eds.). 2001. Right whales: worldwide status. J. Cetacean Res. Manage. (Special Issue) 2. 309 pp.

Caswell, H., S. Brault, and M. Fujiwara. 1999. Declining survival probability threatens the North Atlantic right whale. Proc. Natl. Acad. Science USA 96:~~-~~3308-3313.

Clapham, P.J. (ed.) 2002. Report of the working group on survival estimation for North Atlantic right whales. Available from the Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.

Clapham, P.J., S.B. Young, and R.L. Brownell, Jr. 1999. Baleen whales: conservation issues and the status of the most endangered populations. Mammal Review 29:~~-~~35-60.

Cole, T.V.N., D.L. Hartley, and R.M. Merrick. 2005. Mortality and serious injury determinations for large whale stocks along the eastern seaboard of the United States, 1999-2003. U. S. Dep Commer., NOAA-National Marine Fisheries Service-NEFSC Ref. Doc. 05-08; 20 pp. ~~Available from National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

Fujiwara, M. and H. Caswell. 2001. Demography of the endangered North Atlantic right whale. Nature 414:537–41.

Hain, J.H.W. 1975. The international regulation of whaling. Marine Affairs J. 3:~~-~~28-48.

Hamilton, P.K., A.R. Knowlton, M.K. Marx, and S.D. Kraus. 1998. Age structure and longevity in North Atlantic right whales *Eubalaena glacialis* and their relation to reproduction. ~~Marine~~ Mar. ~~Ecology~~ Ecol. ~~Progress~~ Prog. Series 171:~~-~~285-292.

~~Hamilton, P.K., M.K. Marx, and S.D. Kraus. 1998. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*) as a method of assessing human impacts. Final report to the Northeast Fisheries Science Center, Contract No. 4EANF-6-0004.~~

IWC. 1999. Report of the workshop on the comprehensive assessment of right whales worldwide. J. Cetacean Res. Manage. 1 (supplement):~~-~~119-120.

Jacobsen, K, M. Marx, and N. Øien. 2004. Two-way trans-Atlantic migration of a north Atlantic right whale (*Eubalaena glacialis*). Mar. Mammal Sci. 20:161–166.

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

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

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

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

Knowlton, A.R. and S.D. Kraus. 2001. Mortality and serious injury of North Atlantic right whales (*Eubalaena glacialis*) in the North Atlantic Ocean. J. Cetacean Res. Manage. (Special Issue) 2:~~-~~193-208.

Knowlton, A.R., S.D. Kraus, and R.D. Kenney. 1994. Reproduction in North Atlantic right whales (*Eubalaena glacialis*). Can. J. ~~Zoology~~ Zool. 72:~~-~~1297-1305.

Knowlton, A.R., M.K. Marx, H.M. Pettis, P.K. Hamilton, and S.D. Kraus. 2005. Analysis of scarring on North Atlantic right whales (*Eubalaena glacialis*): monitoring rates of entanglement interaction 1980-2002. Final Report to the National Marine Fisheries Service, Contract #43EANF030107. Available from: New England Aquarium, Central Wharf, Boston, MA 02110.

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

Kraus, S.D., P.K. Hamilton, R.D. Kenney, A. Knowlton, and C. K. Slay. 2001. Reproductive parameters of the North Atlantic right whale. J. Cetacean Res. Manage. (Special Issue) 2:~~-~~231-236.

Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.K. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek, D.A.Pabst, A. J. Read, and R.M. Rolland. 2005. North Atlantic Right Whales in Crisis. Science 309(5734):~~-~~561-562.

Krauss, S.D., R.M Pace, and T.R. Frasier, 2007. High investment, low return: the strange case of reproduction in *Eubalaena glacialis*. Pages 172- 199 *in*: Krauss, S.D. and R.M Rolland, (eds.), The Urban Whale: North Atlantic right whales at the crossroads. Harvard University Press, Cambridge, MA. 2007.

Malik, S., M.W. Brown, S.D. Kraus, A. Knowlton, P. Hamilton, and B.N. White. 1999. Assessment of genetic structuring and habitat philopatry in the North Atlantic right whale (*Eubalaena glacialis*). Can. J. Zool. 77: 1217-1222.

Malik, S., M.W. Brown, S.D. Kraus, and B.N. White. 2000. Analysis of mitochondrial DNA diversity within and between North and South Atlantic right whales. Mar. Mammal Sci. 16:~~-~~545-558.

Mate, B.M., S.L. Nieukirk, and S.D. Kraus. 1997. Satellite-monitored movements of the northern right whale. J. Wildl. Manage. 61:~~-~~1393-1405.

Mayo, C.A. and M.K. Marx. 1990. Surface foraging behaviour of the North Atlantic right whale, *Eubalaena glacialis*, and associated zooplankton characteristics. Can. J. Zool. 68:~~-~~2214-2220.

McLellan, W.A., E. Meagher, L. Torres, G. Lovewell, C. Harper, K. Irish, B. Pike, and A.D. Pabst. 2004. Winter right whale sightings from aerial surveys of the coastal waters of the US Mid-Atlantic. Presented at the 15th Biennial Conference on the Biology of Marine Mammals.

Moore, J.C. and E. Clark. 1963. Discovery of right whales in the Gulf of Mexico. Science 141(3577):~~-~~269.

Nelson, M., M. Garron, R.L. Merrick, R.M. Pace and T.V.N. Cole. 2007. Mortality and serious injury determinations for large whale stocks along the United. States Eastern Seaboard and Adjacent Canadian Maritimes, 2001-2005. U. S. Dep. Commer., Northeast Fish. Sci Cent. Ref. Doc. 07-05. 18 pp.

NMFS [National Marine Fisheries Service]. 2005. Recovery plan for the North Atlantic right whale (*Eubalaena glacialis*). National Marine Fisheries Service, Silver Spring, Maryland.

Rastogi, T., M.W. Brown, B.A. McLeod, T.R. Frasier, R.Grenier, S.L. Cumbaa, J. Nadarajah, and B.N. White. 2004. Genetic analysis of 16th-century whale bones prompts a revision of the impact of Basque whaling on right and bowhead whales in the western North Atlantic. Can. J. Zool. 82:1647–1654

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int.Whal. Commn., Special Issue 15:-133-147.

Reeves, R.R., R. Rolland, and P. Clapham (eds.). 2001. Report of the workshop on the causes of reproductive failure in North Atlantic right whales: new avenues of research. NOAA-National Marine Fisheries Service-NEFSC Ref. Doc. 01-16. 46 pp. ~~Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.~~

Reeves, R.R. and E. Mitchell. 1987. Shore whaling for right whales in the northeastern United States. Contract Report No. NA85-WCC-06194, Southeast Fisheries Science Center, Miami, FL, 108 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

Reeves, R.R., J.M. Breiwick, and E. Mitchell. 1992. Pre-exploitation abundance of right whales off the eastern United States. Pages 5-7. ~~In~~*in*: J. Hain (ed.). The right whale in the western North Atlantic: A science and management workshop, 14-15 April 1992, Silver Spring, Maryland. NOAA-National Marine Fisheries Service-NEFSC Ref. Doc. No. 92-05. 88 pp. ~~Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.~~

Rosenbaum, H.C., M.S. Egan, P.J. Clapham, R.L. Brownell, Jr., and R. DeSalle. 1997. An effective method for isolating DNA from non-conventional museum specimens. ~~Molecular~~ Mol. ~~Ecology~~ Ecol. 6:-677-681.

Rosenbaum, H.C., M.S. Egan, P.J. Clapham, R.L. Brownell, Jr., S. Malik, M.W. Brown, B.N. White, P. Walsh, and R. DeSalle. 2000. Utility of North Atlantic right whale museum specimens for assessing changes in genetic diversity. ~~Conservation~~ Conserv. ~~Biology~~ Biol. 14:-1837-1842.

Schaeff, C.M., S.D. Kraus, M.W. Brown, J. Perkins, R. Payne, and B.N. White. 1997. Comparison of genetic variability of North and South Atlantic right whales (*Eubalaena*) using DNA fingerprinting. Can. J. ~~Zoology~~ Zool. 75:-1073-1080.

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

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 Technical Memorandum, National Marine Fisheries Service-OPR-12. U.S. Dept. of Commerce, Washington, D.C. 93 pp.

~~February~~April~~April 2006~~~~January~~ 2007

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 ~~which encompasses~~ 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 ~~recently~~ made to reclassify the Gulf of Maine as a separate feeding stock; this was based upon the strong fidelity by individual whales to this region, and the attendant assumption that, were this subpopulation wiped out, repopulation by immigration from adjacent areas would not occur on any reasonable management timescale. ~~—~~This reclassification has subsequently been supported by new genetic ~~analysis~~ 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 ~~recent~~ 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 ~~stock for the purpose of management~~ (IWC 2002).

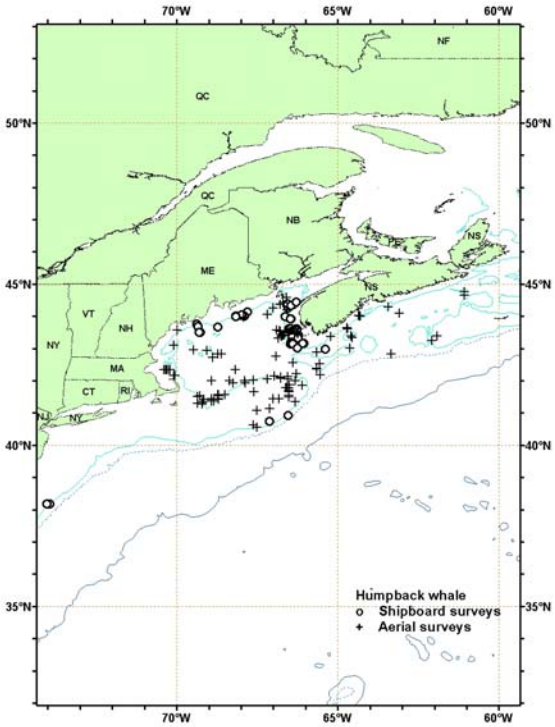


Figure 1. *Distribution of humpback whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth*

During the summers of 1998 and 1999, the Northeast Fisheries Science Center conducted surveys for humpback whales on the Scotian Shelf~~. The objective of these surveys was~~ to establish the occurrence and population identity of the animals found in this region, which lies between the well-studied populations of the Gulf of Maine and Newfoundland. Photographs from both surveys have now been compared to 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 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 (~~26~~28%, n=10 of 36 whales) and northern (27%, *n*=4 of 15 whales) ends of the Scotian Shelf, despite the additional distance of nearly 100 nautical miles (one whale was observed in both areas). In contrast, all (36 of 36) humpback whales identified by the same NMFS surveys elsewhere in the Gulf of Maine (including Georges Bank, southwestern Nova Scotia and the Bay of Fundy) had been previously observed in the Gulf of Maine region. The sighting histories of the 14 Scotian Shelf whales matched to the Gulf of Maine suggested that many of them were transient through the latter area. There were no matches between the Scotian Shelf and any North Atlantic feeding ground, except the Gulf of Maine; however, instructive comparisons are compromised by the often low sampling

effort in other regions in recent years. Overall, ~~while it is not possible to define the Gulf of Maine population by drawing a strict geographical boundary,~~ it appears that the effective range of many members of ~~this~~ the Gulf of Maine stock does not extend onto the Scotian Shelf. ~~Further work on the Scotian Shelf was conducted in August 2002 and August 2003; this sampling extended further north and east as far as the Laurentian Channel, and the results are expected to further clarify the issue of stock identity from this region. A very low match rate between these two years (only one animal was resighted in the region in both 1998 and 1999) supports the hypothesis that the Scotian Shelf is host to a larger population of humpback whales than was previously thought. However, preliminary analysis of photographs collected in 2002 and 2003 revealed multiple inter-annual matches; it is not yet clear whether a suitably precise abundance estimate can be calculated from these data.~~

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

~~It is apparent that n~~Not all whales migrate to the West Indies every winter, and ~~that~~ significant numbers of animals are found in mid- and high-latitude regions at this time (Clapham *et al.* 1993; Swingle *et al.* 1993). An increased number of sightings of humpback whales in the vicinity of the Chesapeake and Delaware Bays occurred in 1992 (Swingle *et al.* 1993). Wiley *et al.* (1995) reported 38 humpback whale strandings ~~which~~ occurred during 1985-1992 in the U.S. mid-Atlantic and southeastern states. Humpback whale strandings increased, particularly along the Virginia and North Carolina coasts, and most stranded animals were sexually immature; 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 ~~are~~ 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; Florida DEP unpublished data). Whether the increased sightings represent a distributional change, or are simply due to an increase in sighting effort and/or whale abundance, is ~~presently~~ unknown.

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

In New England waters, ~~Feeding~~ feeding is the principal activity of humpback whales ~~in New England waters~~, and their distribution in this region has been largely correlated to prey species and abundance, although behavior and bottom topography are factors in foraging strategy (Payne *et al.* 1986, 1990). Humpback whales are frequently piscivorus when in ~~these~~ 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 1970~~'~~s 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 1970~~'~~s and early 1980~~'~~s, and humpback distribution appeared to have shifted to this area (Payne *et al.* 1986). An apparent reversal began in the mid 1980~~'~~s, and herring and mackerel increased as sand lance again decreased (Fogarty *et al.* 1991). Humpback whale abundance in the northern Gulf of Maine increased ~~dramatically~~ 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 ~~more~~ traditional locations of herring occurrence. In 1996 and 1997, sand lance and therefore humpback whales were once again abundant in the Stellwagen Bank area. However, unlike previous cycles, when an increase in sand lance corresponded to a decrease in herring, herring remained relatively abundant in the northern Gulf of Maine, and humpbacks correspondingly continued to occupy this portion of the habitat, where they also fed on euphausiids (unpublished data, Center for Coastal Studies and College of the Atlantic).

In early 1992, a major research ~~initiative~~ program known as the Years of the North Atlantic Humpback (YONAH) (Smith *et al.* 1999) was initiated. This ~~project~~ 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

Population estimates have been generated for the total North Atlantic population of humpback whales as well as for the Gulf of Maine stock. The estimate of 11,570 humpback whales (CV=0.068) is regarded as the best available for the North Atlantic, although because YONAH sampling was not spatially representative in the feeding grounds, this value is negatively biased. The best recent estimate for the Gulf of Maine stock is 847 whales (CV=0.55), derived from the 2006 aerial survey. This estimate is not significantly different from the 1999 estimate of 902 (CV=0.41).

North Atlantic Population

The overall North Atlantic population (including the Gulf of Maine), ~~was estimated~~derived from genetic tagging data collected by the YONAH project ~~in~~ on the breeding ~~range~~ grounds, was estimated to be ~~at~~ 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Palsbøll *et al.* 1997). Since the sex ratio in this population is known to be even (Palsbøll *et al.* 1997), the excess of males is presumed ~~to be~~ a result of sampling bias, lower rates of migration among females, or sex-specific habitat partitioning in the West Indies; whatever the reason, the combined total is an underestimate of overall population size ~~in this ocean~~. Photographic mark-recapture analyses from the YONAH project ~~gave~~ provided an ocean-basin-wide estimate of 11,570 ~~for~~ 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). ~~The estimate of 11,570 (CV=0.068) is regarded as the best available estimate for the North Atlantic, although because YONAH sampling was not spatially representative in the feeding grounds, this figure is negatively biased.~~ In the northeastern North Atlantic, Øien (2001) estimated from sighting survey data that there were 889 (CV=0.32) humpback whales in the Barents and Norwegian Seas region.

Gulf of Maine stock - earlier estimates

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

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

Gulf of Maine Stock - Recent surveys and abundance estimates

In ~~the third approach, data were used from a 28 July to 31 August~~ 1999 a line-transect sighting survey was conducted from 28 July to 31 August by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212km. However, in light of the information on stock identity of Scotian Shelf humpback whales noted above, only the portions of the survey covering the Gulf of Maine were used; surveys blocks along the eastern coast of Nova Scotia were excluded. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) ~~that~~ which accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000). These surveys yielded an estimate of 816 humpbacks (CV=0.45). However, given that the rate of exchange between the Gulf of Maine and both the Scotian Shelf and mid-Atlantic region is not zero, this estimate is likely to be ~~somewhat~~ conservative. Accordingly, inclusion of data from 25% of the Scotian Shelf survey area (to reflect the match rate of 25% between the Scotian Shelf and the Gulf of Maine) gives an estimate of 902 whales (CV=0.41).

An abundance estimate of 521 (CV=0.67) humpback whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 359 (CV=0.75) humpback whales was obtained from a line-transect sighting survey conducted from 12 June to 4 August 2004 by a ship and plane. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100 m depth contour on the southern Georges Bank to the lower Bay of Fundy;

while the Scotian shelf south of Nova Scotia was not surveyed.

An ~~estimate of~~ abundance estimate ~~for an August 2002 survey was 521 (CV=0.67), 359 (CV=0.75) for June-July 2004, and~~of 847 animals (CV=0.55) ~~for~~ 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.) ~~The summer 2002, 2004 and 2006 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawerence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~ Because the Scotian shelf was surveyed in only 2006, the 25% correction factor (described above) was applied to only the 2006 abundance estimate.

~~Since the mark-recapture figures for abundance and minimum population size given above falls above the lower bound of the CV of the line transect estimate, and given the known exchange between the Gulf of Maine and the Scotian Shelf, we have chosen to use the latter as the best estimate of abundance for Gulf of Maine humpback whales. Thus, the 2006 aerial line transect abundance estimate (847) is considered the best recent abundance estimate.~~

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Gulf of Maine humpback whales is 847~~902~~ aimals (CV=0.~~41~~55). ~~–~~The minimum population estimate for this stock is 549 animals~~647~~.

Table 1. Summary of abundance estimates for Gulf of Maine humpback whales. ~~CCS = Center for Coastal Studies. COA = College of the Atlantic.~~

Month/Year	Type	N	CV	Source
~~1992/93~~	~~Mark-recapture estimate~~	~~652~~	~~0.29~~	~~Clapham *et al.* (2003)~~
~~1997~~	~~Minimum known to be alive~~	~~497~~	~~-~~	~~CCS + COA data~~
July/August 1999	Line transect, including a portion of the Scotian Shelf stratum	902	0.41	Palka 2000, Clapham *et al.* 2003
Aug 2002	S. Gulf of Maine to Maine	521	0.67	
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	359	0.75	
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	847	0.55	

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Barlow and Clapham (1997) ~~applied~~ applying an interbirth interval model to photographic mark-recapture data, ~~and~~ 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~~s~~ 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) ~~was~~ 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 ~~are not available~~were not provided (because maturation parameters could not be estimated), both estimates of population growth rate are outside the 95% confidence intervals of the previous estimate of 6.5% for the period 1979 to 1991 (Barlow and Clapham 1997). It is unclear whether this apparent decline is an artifact resulting from a shift in distribution; indeed, such a shift occurred during exactly the period (1992-1995) in which survival rates declined. It is possible that this shift resulted in calves born in those years imprinting on (and thus subsequently returning to) areas other than those in which intensive sampling ~~occurs~~occured. If the decline is ~~a~~ real, ~~phenomenon~~ it may be related to known high mortality among young-of-the-year whales in the waters of the U.S. mid-Atlantic states. However, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth.

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 549~~647~~. The maximum productivity rate is the default value of 0.04. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the Gulf of Maine humpback whale stock is 1.1~~3~~ whales.

ANNUAL HUMAN-CAUSED SERIOUS INJURY AND MORTALITY

For the period ~~2000~~ 2001 through ~~2004~~2005, the minimum annual rate of ~~total estimated~~ human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged~~is estimated as~~ 4.2~~3.02.6~~ animals per year (U.S. waters, 3.8~~2.42.2~~; Canadian waters, 0.~~6~~4). ~~-~~This value includes ~~average is derived from~~ incidental fishery interaction records, 2.8~~4 0~~ (U.S. waters, 2.4~~1.86~~; Canadian waters, 0.~~6~~4); and records of vessel collisions, 1~~0~~.4~~6~~ (U.S. waters, 1.4~~0.6~~; Canadian waters, 0) (~~see~~ Nelson *et al.* 2007).

In contrast to previous stock assessments reports, these averages include ~~There were additional~~ 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~~. These records represent an additional minimum annual average of 2.01.6 human-caused mortalities and serious injuries to humpbacks over the time period, of which 1.20.8 per year are attributable to incidental fishery interactions and 0.8 per year are attributable to vessel collisions~~. In past reports, only events involving whales confirmed to be members of the Gulf of Maine stock were counted against the PBR. This year, 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.

~~Beginning with the 2001 Stock Assessment Report,~~ Canadian records were incorporated into the mortality and serious injury rates, to reflect the effective range of this stock as described above. ~~In addition, records from the southeastern and mid-Atlantic states involving individuals that could not be identified as members of the Gulf of Maine stock were tallied separately. Conversely, records involving unidentified individuals reported between New York and the Bay of Fundy were assumed to be whales from the Gulf of Maine stock. It is also important to stress that serious injury determinations are made based upon the best available information at the time of writing; these determinations may change with the availability of new information.~~ For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.

~~To better assess human impacts (both vessel collision and gear entanglement), and considering the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies. The literature and review of records described here suggest that there are~~

~~significant human impacts beyond those recorded in the fishery observer data. For example, a study of entanglement-related scarring on the caudal peduncle of 134 individual humpback whales in the Gulf of Maine suggested that between 48% and 65% had experienced entanglements (Robbins and Mattila 2001). Decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts.~~

Serious injury was defined in 50 CFR part 229.2 ~~to be~~as an injury that ~~was~~ is likely to lead to mortality. We therefore limited ~~the~~ 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 ~~the~~ 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~~ 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 ~~are~~ represent a minimum estimate.

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

Background

As with right whales, human impacts (vessel collisions and entanglements) ~~are factors which~~ may be slowing recovery of the humpback whale population. ~~There is an average of 4 to 6 entanglements of humpback whales a year in waters of the southern Gulf of Maine and additional reports of vessel collision scars (unpublished data, Center for Coastal Studies).~~ 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 ~~6~~ six (30%) had major injuries possibly attributable to ship strikes, and ~~5~~ five (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses ~~which were~~ suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley *et al.* (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region ~~has recently been~~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 5 of the dead whales indicate that some were small for their age, and histories of live whales further indicate that the population contains a greater percentage of mature animals than was suggested by the stranded sample.

~~In their study of entanglement rates estimated from caudal peduncle scars,~~ Robbins and Mattila (2001) ~~found~~ reported that males were more likely to be entangled than females. Their scarring data ~~also~~ suggested that yearlings were more likely than other age classes to be involved in entanglements. Finally, female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting that entanglement may significantly impact reproductive success.

Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of ~~collisions~~ 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 ~~that were~~ entangled in 1988 died (Lien *et al.* 1988). Two humpbacks were reported entangled in fishing gear in Newfoundland and Labrador waters in 2005. One towed away the gear and was not re-sighted, and the other was released alive (Ledwell and Huntington 2006). Eighty-four humpbacks were reported entangled in fishing gear in Newfoundland and Labrador from 2000-2006 (W. Ledwell, pers. comm.). Volgenau *et al.* (1995) ~~also summarized existing data and concluded~~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 ~~are the gear that has been~~were the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

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

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 ~~since 1989~~, 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 200m isobath northeast of Cape Hatteras~~;~~. ~~in~~ In early summer 1995, a humpback was entangled and dead in a pelagic drift gillnet on southwestern Georges Bank. Additional reports of mortality and serious injury relevant to comparison to PBR, as well as description of total human impacts, are contained in records maintained by NMFS. A number of these records (11 entanglements involving lobster pot/trap gear) from the 1990-1994 period were ~~cause~~ the basis used to reclassify the lobster fishery (62 FR 33, Jan. 2, 1997).

For this report, the records of dead, injured, and/or entangled humpbacks (found either stranded or at sea) for the period ~~2000~~ 2001 through ~~2004~~ 2005 were reviewed. ~~Out of 175 records, 159 were eliminated from further consideration due to an absence of any evidence of human impact or, in the case of an entangled whale, it was documented that the animal had become disentangled (10 were disentangled in 2003 alone). Of the remaining records, the Gulf of Maine stock sustained 4 mortalities attributable to fishery interactions and 8 cases of serious injuries ●12 records in the five-year period (Table 2). In addition, 3 mortalities and 3 serious injuries were documented in the southeastern and mid-Atlantic states that involved interactions with fisheries. At the time of this writing, no genetic results were available to identify which of these cases may have involved whales from the Gulf of Maine stock.~~Humpbacks were involved in 162~~6~~ reported events. Of these, 70~~2~~ of the 79~~80~~ reported entanglements could be confirmed. Entanglements accounted for eight mortalities and six serious injuries. ~~Due to there being~~With no evidence to the contrary, all events were assumed to involve~~Whales identified as~~ members of the Gulf of Maine stock~~ accounted for five of the entanglement mortalities and eight of the entanglement serious injuries.~~ While these records are not statistically quantifiable in the same way as ~~the observed~~ observer fishery records, they provide some indication of the frequency of entanglements.

Table 2. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, January ~~2000~~ 2001 - December ~~2004~~2005. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock. This is in contrast to prior reports. ~~Records from the Gulf of Maine humpback whale stock are indicated by an asterisk (*) following the date. Stock identification of the remaining records awaits genetic analysis results. These may identify additional Gulf of Maine whales.~~

Date[a]	Report Type[b]	Sex, age, ID length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
~~1/8/00~~	~~serious injury~~	~~9.9m estimated~~	~~30mi east Cape Lookout, NC~~		~~P~~	~~whale swam off with 600' of sea trout sink gillnet, a chain anchor and a high flyer in tow~~
~~8/4/00*~~	~~serious injury~~	~~10.7m estimated~~	~~Bay of Fundy, Canada~~		~~P~~	~~line wrapped on head with weighted trailing line giving tension, no gear recovered~~
~~9/6/00*~~	~~serious injury~~	~~<1 yr old, calf of "Giraffe"~~	~~8 nm north of Race Pt., Cape Cod, MA~~		~~P~~	~~single line wrapped across back; constriction will increase as whale grows, no gear recovered~~

~~10/14/00~~	~~serious injury~~	~~9.9m estimated~~	~~off Ocean City Inlet, MD~~		~~P~~	~~heavily entangled in line; constrictive – fresh wounds noted; no gear recovered~~
~~10/20/00*~~	~~serious injury~~	~~10 yr old male "Tribble"~~	~~Stellwagen Bank, MA~~		~~P~~	~~entangled in green poly line on multiple body parts; appears constrictive, no gear recovered~~
1/25/01	mortality	6.9m estimated	Avon, NC	P		extensive hemorrhaging along left thoracic, clean cut through center of vertebrae; ship strike
4/07/01	mortality	7.6m juvenile male	Emerald Isle, NC		P	entanglement around peduncle caused extensive edema, hemorrhaging, no gear recovered
4/08/01	mortality	7.9m juvenile male	Myrtle Beach, SC	S	P	pre-mortem evidence of chronic line entanglement; severe prop wounds, no gear recovered
4/09/01*	mortality	8.8m juvenile female "Inland"	offshore of Sandbridge, Virginia Beach		P	found anchored in sink gillnet croaker fishery gear; line wraps around rostrum had immobilized the whale
7/29/01*	mortality	8.5m juvenile female	floating south of Verrazano Bridge, NY	P		large laceration on left side of head, extensive fracturing of skull
10/01/01*	mortality	11.4m 3 yr old female "Pitfall"	Duxbury Beach, MA	P		massive fracturing to skull, focal bruising indicative of pre-mortem ship strike
2/08/02	mortality	8.4m juvenile female	off Cape Henry, VA	P		three large lacerations, hemorrhaging, broken bones
3/24/02	mortality	8.0m juvenile male	off Virginia Beach, VA		P	deep cuts on caudal peduncle and tail indicative of embedded line, no gear recovered
6/03/02*	mortality	9.9m	off Cape Elizabeth, ME		P	deep cuts on caudal peduncle indicative of embedded line, state water lobster fishery
6/17/02*	serious injury	10.2m estimated	Cape Cod, MA		P	fluke severely damaged by line, whale emaciated
8/01/02*	mortality	9.3m male	Long Island, NY	P		large hematoma posterior to blow holes
10/01/02*	mortality	7.5m female calf	Plymouth, MA		P	found wrapped in line, extensive bruising, no gear recovered

6/06/03	mortality	8.3m female	Chesapeake Bay mouth, VA	P		major trauma to right side of head, hematoma
7/09/03*	serious injury	calf of Shockwave	Bay of Fundy, Canada		P	constricting entanglement on a young whale, no gear recovered
7/12/03	serious injury	unknown	Oregon Inlet, NC		P	entangled in substantial amount of gear, no gear recovered
8/15/03*	mortality	7.3m (est)calf	Petit Manan Island, ME		P	floating offshore wrapped in line
8/16/03*	serious injury	unknown	Cape Cod, MA		P	poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system and surface buoy system and endline
8/18/03*	serious injury	unknown	Cape Cod, MA		P	extensive entanglement, no gear recovered
7/11/04*	serious injury	"Lucky" subadult	Briar Island, NS		P	entanglement on a young whale
10/03/04*	mortality	15m (est) unknown	Georges Bank		P	fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	8.0m calf	Bethany Beach, DE	P		hematoma and skeletal fracturing

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

b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (NelsonCole *et al.* 20075) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989). The whales subsequently stranded or were recovered in the vicinity of Cape Cod Bay and Nantucket Sound, and it is highly likely that other unrecorded mortalities occurred during this event which went unrecorded. In July 2003, another Unusual Mortality Event was recorded in offshore waters when an estimated minimum of 12-15 humpback whales died in the vicinity of the Northeast Peak of Georges Bank. Preliminary tests of samples taken from some of these whales tested 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 is currently unknown.

During the first six months of 1990, seven dead juvenile (7.6 to 9.1 m long) humpback whales stranded between North Carolina and New Jersey. The significance of these strandings is unknown, but is a cause for some concern.

As reported by Wiley *et al.* (1995), injuries possibly attributable to ship strikes are more common and probably more serious than those from entanglements. In the NMFS records for 20010 through 20054, 120 records had some evidence of a collision with a vessel. Of these, 87 were mortalities as a result of the collision, and 2 did not have sufficient information to confirm the collision as the cause of death. The remaining incident occurred on 10/4/01 and involved a whale-watch vessel. Photos taken at the time of the collision confirmed that the injury was minor and follow-up documentation provided evidence that the injury sustained had healed. No whale involved in the recorded vessel collisions had been identified as a member of a stock other than Three of 7 cases of mortality from a vessel collision

~~involved whales identified as members of the~~the Gulf of Maine stock at the time of this writing (Nelson *et al*. 2007) ~~(7/29/01, 10/1/01 and 8/1/02; see Table 2)~~.

STATUS OF STOCK

The status of the North Atlantic humpback whale population was the topic of an International Whaling Commission Comprehensive Assessment in June 2001, and again in May 2002~~;~~. T~~t~~hese meetings conducted a detailed review of all aspects of ~~this~~ the population (IWC 2002). Although ~~the most~~ recent estimates of abundance indicate continued population growth, the size of the humpback whale stock may be below OSP in the U.S. Atlantic EEZ. This is a strategic stock because the humpback whale is listed as an endangered species under the ESA. A Recovery Plan has been published and is in effect (NMFS 1991). There are insufficient data to reliably determine current population trends for humpback whales in the North Atlantic overall. The average annual rate of population increase was estimated at 3.1% (SE=0.005, Stevick *et al.* 2003). As noted above, a ~~recent~~n 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 ~~and~~ or approaching zero mortality and serious injury rate. In particular, the continued high level of mortality among humpback whales off the U.S. mid-Atlantic states (Barco *et al.* 2002) is ~~cause for considerable~~a concern given that ~~at least some~~many of these animals are known to be from the Gulf of Maine. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the North Atlantic humpback whale is an endangered species.

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

REFERENCES CITED

Angliss, R.P., and D.P. DeMaster. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: report of the serious injury workshop 1-2 April 1997, Silver Spring, Maryland. NOAA Technical Memorandum NMFS-OPR-13, January 1998.

Balcomb, K.C. and G. Nichols. 1982. Humpback whale censuses in the West Indies. Rep. ~~Int~~int. ~~Whaling~~ Whal. Comm~~ission~~n. 32:-401-406.

Barco, S., W. A. McLellan, J. Allen, R. Asmutis, R. Mallon-Day, E. Meagher, D. A. Pabst, J. Robbins, R. Seton, R. M. Swingle, M. T. Weinrich, and P. J. Clapham. 2002. Population identity of humpback whales in the waters of the U.S. mid-Atlantic states. J. Cetacean Res. Manage. 4:135-141.

Barlow, J., and P.J. Clapham. 1997. A new birth-interval approach to estimating demographic parameters of humpback whales. Ecology 78:535-546.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Brandão, A., D.S. Butterworth, and M.R. Brown. 2000. Maximum possible humpback whale increase rates as a function of biological parameter values. J. Cetacean Res. Manage. 2 (supplement): 192-193.

Christensen, I., T. Haug, and N. Øien. 1992. Seasonal distribution, exploitation and present abundance of stocks of large baleen whales (Mysticeti) and sperm whales (*Physeter macrocephalus*) in Norwegian and adjacent waters. ICES J. Mar~~ine~~. Sci.~~ence~~ 49:-341-355.

Clapham, P.J. and C.A. Mayo. 1987. Reproduction and recruitment of individually identified humpback whales, *Megaptera novaeangliae*, observed in Massachusetts Bay, 1979-1985. Can. J. ~~Zoology~~ Zool. 65:-2853-2863.

Clapham, P.J., L.S. Baraff, C.A. Carlson, M.A. Christian, D.K. Mattila, C.A. Mayo, M.A. Murphy, and S. Pittman. 1993. Seasonal occurrence and annual return of humpback whales, *Megaptera novaeangliae*, in the southern Gulf of Maine. Can. J. ~~Zoology~~ Zool. 71:~~-~~440-443.

Clapham, P.J., M.C. Bérubé, and D.K. Mattila. 1995. Sex ratio of the Gulf of Maine humpback whale population. ~~Marine~~ Mar. Mammal ~~Science~~ Sci. 11:~~-~~227-231.

Clapham, P.J., J. Barlow, T. Cole, D. Mattila, R. Pace, D. Palka, J. Robbins, and R. Seton. 2003. Stock definition, abundance and demographic parameters of humpback whales from the Gulf of Maine. J. Cetacean Res. Manage. 5:~~-~~13-22.

Clapham, P.J., J. Robbins, M. Brown, P. Wade, and K. Findlay. 2001. A note on plausible rates of population growth for humpback whales. J. Cetacean Res. Manage. 3 (suppl.):~~-~~196-197.

~~Cole, T.V.N., D.L. Hartly, and R.L. Merrick. 2005. Mortality and serious injury determinations for large whale stocks along the eastern seaboard of the United States, 1999-2003. U. S. Dep. Commer., Northeast Fish. Science Cent. Ref. Doc. 05-08; 20 pp.~~

Fogarty, M.J., E.B. Cohen, W.L. Michaels, and W.W. Morse. 1991. Predation and the regulation of sand lance populations: An exploratory analysis. ICES Marine Science Symp. 193:~~-~~120-124.

Geraci, J.R., D.M. Anderson., R.J. Timperi, D.J. St. Aubin~~,~~, G.A. Early, J.H. Prescott, and C.A. Mayo. 1989 Humpback whales (*Megaptera novaeangliae*) fatally poisoned by dinoflagellate toxins. Can. J. Fish. Aquat. Science 46:1895-1898.

IWC. 2002. Report of the Scientific Committee. Annex H: Report of the Sub-committee on the Comprehensive Assessment of North Atlantic humpback whales. J. Cetacean Res. Manage. 4 (supplement):230-260 .

Katona, S.K., and J.A. Beard. 1990. Population size, migrations, and feeding aggregations of the humpback whale (*Megaptera novaeangliae*) in the western North Atlantic ocean. Rep. Int. Whaling Commission. Special Issue 12:295-306.

Larsen, A.H., J. Sigurjónsson, N. Øien, G. Vikingsson, and P.J. Palsbøll. 1996. Population genetic analysis of mitochondrial and nuclear genetic loci in skin biopsies collected from central and northeastern North Atlantic humpback whales (*Megaptera novaeangliae*): population identity and migratory destinations. Proceedings of the Royal Society of London B 263:~~-~~1611-1618.

Ledwell, W., and J. Huntington, 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans, St. John's, Newfoundland, CANADA. 18 pp.

Levenson, C., and W.T. Leapley. 1978. Distribution of humpback whales (*Megaptera novaeangliae*) in the Caribbean determined by a rapid acoustic method. J. Fish. Res. Board Can. 35:1150-1152.

Lien, J., W. Ledwell, and J. Naven. 1988. Incidental entrapment in inshore fishing gear during 1988: A preliminary report to the Newfoundland and Labrador Department of Fisheries and Oceans, 15 pp.

Mattila, D.K. and P.J. Clapham. 1989. Humpback whales and other cetaceans on Virgin Bank and in the northern Leeward Islands, 1985 and 1986. Can. J. ~~Zoology~~ Zool. 67:2201-2211.

Mattila, D.K., P.J. Clapham, S.K. Katona, and G.S. Stone. 1989. Population composition of humpback whales on Silver Bank. Can. J. ~~Zoology~~ Zool. 67:281-285.

Mattila, D.K., P.J. Clapham, O. Vásquez, and R. Bowman. 1994. Occurrence, population composition and habitat use of humpback whales in Samana Bay, Dominican Republic. Can. J. ~~Zoology~~ Zool. 72:1898-1907.

Nelson, M., M. Garron, R.L. Merrick, R.M. Pace and T.V.N. Cole. 2007. Mortality and serious injury determinations for large whale stocks along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2001-2005. U. S. Dep. Commer., Northeast Fish. Sci.~~ence~~ Cent. Ref. Doc. 07-05~~;~~. 18 pp. ~~Available from National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

NMFS [National Marine Fisheries Service]. 1991. Recovery plan for the humpback whale (*Megaptera novaeangliae*). National Marine Fisheries Service, Silver Spring, MD, 105 pp.

Øien, N. 2001. Humpback whales in the Barents and Norwegian Seas. Paper SC/53/NAH21 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. ~~Int~~int. ~~Whaling~~ Whal. Comm~~ission~~n (special issue) 16:27-50.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. U. S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc.~~NMFS, Northeast Fisheries Science~~

~~Center Ref. Doc.~~ 00-07~~;~~. 29 pp. ~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.~~

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7

Paquet, D., C. Haycock, and H. Whitehead. 1997. Numbers and seasonal occurrence of humpback whales (*Megaptera novaeangliae*) off Brier Island, Nova Scotia. Can. Field Nat. 111: 548-552.

Palsbøll, P.J., J. Allen,, M. Bérubé, P.J. Clapham, T.P. Feddersen, P. Hammond, H. Jørgensen, S. Katona, A.H. Larsen, F. Larsen, J. Lien, D.K. Mattila, J. Sigurjónsson, R. Sears, T. Smith, R. Sponer, P. Stevick, and N. Øien. 1997. Genetic tagging of humpback whales. Nature 388: 767-769.

Palsbøll, P.J., P.J. Clapham, D.K. Mattila, F. Larsen, R. Sears, H.R. Siegismund, J. Sigurjónsson, O. Vásquez, and P. Arctander. 1995. Distribution of mtDNA haplotypes in North Atlantic humpback whales: the influence of behavior on population structure. Mar. Eco. Prog. Series ~~Marine Ecology Progress Series~~ 116: 1-10.

Palsbøll, P.J., J. Allen, T. H. Anderson, M. Bérubé, P.J. Clapham, T.P. Feddersen, N. Friday, P. Hammond, H. Jørgensen, S.K. Katona, A.H. Larsen, F. Larsen, J. Lien, D.K. Mattila, F.B. Nygaard, J. Robbins, R. Sponer, R. Sears, J. Sigurjónsson, T.D. Smith, P.T. Stevick, G. Vikingsson, and N. Øien. 2001. Stock structure and composition of the North Atlantic humpback whale, *Megaptera novaeangliae*. Paper SC/53/NAH11 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Payne, P.M., J.R. Nicholas, L. O'Brien, and K.D. Powers. 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. Fish. Bull. 84:~~-~~271-277.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham, and J.W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. 88: 687-696.

Price, W.S. 1985. Whaling in the Caribbean: historical perspective and update. Rep. ~~Int~~int. ~~Whaling~~ Whal. Comm~~ission~~n 35:~~-~~413-420.

Reiner, F., M.E. Dos Santos, and F.W. Wenzel. 1996. Cetaceans of the Cape Verde archipelago. ~~Marine~~ Mar. Mammal ~~Science~~ Sci. 12:~~-~~434-443.

Robbins, J. and D.K. Mattila. 2001. Monitoring entanglements of humpback whales (*Megaptera novaeangliae*) in the Gulf of Maine on the basis of caudal peduncle scarring. Paper SC/53/NAH25 presented to the International Whaling Commission Scientific Committee. Available from IWC, 135 Station Road, Impington, Cambridge, UK.

Smith, T.D., J. Allen, P.J. Clapham, P.S. Hammond, S. Katona, F. Larsen, J. Lien, D. Mattila, P.J. Palsbøll, J. Sigurjónsson, P.T. Stevick, and N. Øien. 1999. An ocean-basin-wide mark-recapture study of the North Atlantic humpback whale (*Megaptera novaeangliae*). ~~Marine~~ Mar. Mammal ~~Science~~ Sci. 15:1-32.

Stevick, P.T., J. Allen, P.J. Clapham, N. Friday, S.K. Katona, F. Larsen, J. Lien, D.K. Mattila, P.J. Palsbøll, J. Sigurjónsson, T.D. Smith, N. Øien, and P.S. Hammond. 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Mar~~ine~~. ~~Ecology~~ Eco. ~~Progress~~ Prog. Series 258: 263-273.

Stevick, P., N. Øien and D.K. Mattila. 1998. Migration of a humpback whale between Norway and the West Indies. ~~Marine~~ Mar. Mammal ~~Science~~ Sci. 14:~~-~~162-166.

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. McLellan, and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. ~~Marine~~ Mar. Mammal ~~Science~~ Sci. 9:~~-~~309-315.

Volgenau, L., S.D. Kraus, and J. Lien. 1995. The impact of entanglements on two substocks of the western North Atlantic humpback whale, *Megaptera novaeangliae*. Can. J. ~~Zoology~~ Zool. 73:~~-~~1689-1698.

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 Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, DC. 93 pp.

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

Whitehead, H. and M.J. Moore. 1982. Distribution and movements of West Indian humpback whales in winter. Can. J. Zoology 60: 2203-2211.

Wiley, D.N., R.A. Asmutis, T.D. Pitchford, and D.P. Gannon. 1995. Stranding and mortality of humpback whales, *Megaptera novaeangliae*, in the mid-Atlantic and southeast United States, 1985-1992. Fish. Bull. 93: 196-205.

Winn, H.E., R.K. Edel and A.G. Taruski. 1975. Population estimate of the humpback whale (*Megaptera novaeangliae*) in the West Indies by visual and acoustic techniques. J. Fish. Res. Bd. Can. 32: 499-506.

~~April 2006~~January 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

Fin whales are common in waters of the U. S. ~~-~~Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Figure 1). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978-82. While much remains unknown, the magnitude of the ecological role of the fin whale is impressive. In this region fin whales are probably the dominant large cetacean species ~~in~~ during all seasons, ~~with~~ having the largest standing stock, the largest food requirements, and therefore the largest impact on the ecosystem of any cetacean species (Kenney *et al.* 1997; Hain *et al.* 1992).

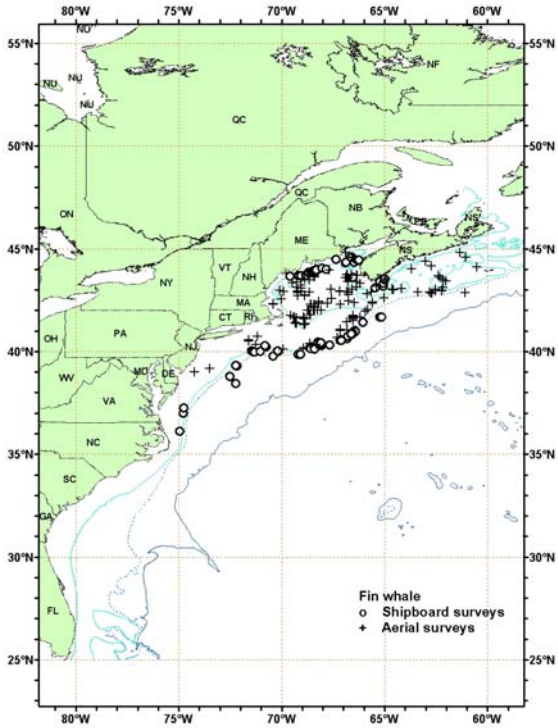


Figure 1. *Distribution of fin whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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

Hain *et al.* (1992), based on an analysis of neonate stranding data, suggested that calving takes place during ~~approximately four months from~~ October to January in latitudes of the U.S. mid-Atlantic region; however, it is unknown where calving, mating, and wintering occurs for most of the population ~~occurs~~. Results from the Navy's SOSUS program (Clark 1995) indicate a substantial deep-ocean ~~component to~~distribution of fin whales ~~distribution~~. It is likely that fin whales occurring in the U. S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. However, the popular notion that entire fin whale populations make distinct annual migrations like some other mysticetes has questionable support in the data; in the North Pacific, year-round monitoring of

fin whale calls found no evidence for large-scale migratory movements (Watkins *et al*. 2000).

POPULATION SIZE

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

Earlier abundance estimates

~~FiveTwo estimates of abundance from line-transect surveys are available; from 1995, 1999, 2002, 2004, and 2006 (Tab;e 1).~~ An abundance of 2,200 (CV=0.24) fin whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane. The survey covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 1995).

Recent surveys and abundance estimates

An estimate of abundance ~~more recent estimate~~ of 2,814 (CV=0.21) fin whales was derived from a 28 July to 31 August 1999 line-transect sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000).

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

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

An abundance of 2,269 (CV=0.37) fin whales was estimated from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 2000m 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 estimate of abundance for the August 2002 survey was 2,933 (CV=0.49), 1,925 (CV=0.55) for June-July 2004, and 2,269 (CV=0.37) for August 2006. The summer 2002, 2004 and 2006 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawerence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia wereas not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~

~~The August 20062 latter abundance estimate (2,269933) is considered the best available for the western North Atlantic fin whale because it is relatively recent and it provides an estimate when the largest portion of the population was within the study area. However, this estimate must be considered extremely conservative in view of the known range of the fin whale in the entire western North Atlantic, the uncertainties regarding population structure and exchange between surveyed and unsurveyed areas, and aerial data having not been corrected for *g(0)*. Estimates for animals identified as fin whales were estimated separated from animals identified as either a fin or sei whales. The final estimate~~

~~of fin whales was the sum of the estimate of animals identified as fin whales andplus a proportion of the estimate of animals identified as fin or sei whales, where the proportion was defined as the percent of fin whales out of the total number of positively identified fin whales and sei whales.~~

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

Month/Year	Area	N_{best}	CV
Jul-Aug 1999	Georges Bank to mouth of Gulf of St. Lawrence	2,814	0.21
Aug 2002	S. Gulf of Maine to Maine	2,933	0.49
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	1,925	0.55
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. ~~Lawrence~~Lawrence	2,269	0.37

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for fin whales is 2,~~933~~269~~2,814~~ (CV=0.37~~49~~~~21~~). The minimum population estimate for the western North Atlantic fin whale is 1,678~~985~~~~2,362~~.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,678~~985~~~~2,362~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.10 because the fin whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic fin whale is 3.4~~.04.7~~.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period 2001 through 2005, the minimum annual rate of human-caused mortality and serious injury to fin whales was 2.4 per year (U.S. waters, 1.8; Canadian waters, 0.4; Bermudian waters, 0.2). This value includes incidental fishery interaction records, 0.8 (U.S. waters, 0.6; Canadian waters, 0; Bermudian waters, 0.2); and records of vessel collisions, 1.6 (U.S. waters, 1.2; Canadian waters, 0.4) (Nelson *et al.* 2007). N~~There was n~~o reported fishery-related mortality or serious injury to fin whales ~~in fisheries~~was observed by NMFS during 2001 through 2005.

~~The number of fin whales taken at 3 whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974). Reports of non-directed takes of fin whales are fewer over the last two decades than for other endangered large whales such as right and humpback whales. There was no reported fishery-related mortality or serious injury to fin whales in fisheries observed by NMFS during 2000 2001 through 20042005. A review of NMFS records from 20010 through 2004 2005 yielded an average of 1.82.4 human-caused mortalities and serious injuries per year year; 0.8 per~~

~~year resulting from fishery interactions/entanglements (U.S. waters, 0.46; Canadian waters, 0.2; Bermudian waters, 0.2), and 1.0~~ 6 ~~due to vessel collisions--all in U.S. waters(U.S. waters, 1.2; Canadian waters, 0.4) (Table 1).~~

Fishery-Related Serious Injury and Mortality

No confirmed fishery-related ~~mortality~~ mortalities or serious ~~injury~~ injuries of fin whales ~~was~~ have been reported in the NMFS Sea Sampling bycatch database. A review of the records of stranded, floating or injured fin whales for the period ~~2000~~ 2001 through ~~2004~~ 2005 on file at NMFS found three records with substantial evidence of fishery interactions causing mortality, and one record resulting in serious injury (Table 1), which results in an annual rate of serious injury and mortality of 0.8 fin whales from fishery interactions. While these records are not statistically quantifiable in the same way as the ~~observed~~ observer fishery records, they give a minimum ~~estimate~~ count of ~~the frequency of~~ entanglements for the~~is~~ species. In addition to the records above, there are were ~~5~~ five additional records of entanglement within the period that either lacked substantial evidence for a serious injury determination, or ~~that~~ did not provide the detail necessary to determine if an entanglement had been a contributing factor in the mortality.

Table 1. Confirmed human-caused mortality and serious injury records of western North Atlantic fin whales, January ~~2000~~ 2001 - December ~~2004~~2005.

Date[a]	Report Type[b]	Sex, age, ID length	Location[a]	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
~~12/11/00~~	~~mortality~~	~~10.9m female~~	~~New York harbor~~	~~P~~		~~hemorrhage and fractured bones on right side~~
1/2/01	mortality	18.1m female	New York harbor	P		dorsal abrasion marks, hematoma
2/1/01	mortality	14.5m female	Port Elizabeth, NJ	P		very fresh carcass hung on ship's bow
9/19/01	mortality	10.7m unknown	off Bermuda		P	extensive fresh entanglement marks; no gear recovered
7/28/02	mortality	unknown	Georges Bank		P	heavy line seen on tail stock, appeared embedded; no gear recovered

2/12/04	serious injury	unknown	Pea Island, NC		P	Entangled whale noticeably emaciated; no gear recovered
2/25/04	mortality	16.3m female	Port Elizabeth, NJ	P		Displaced vertebrae, ruptured aorta
6/30/04	mortality	12m est. unknown	Georges Bank		P	Fresh dead; heavy line constricting mid-section; no gear recovered
9/26/04	mortality	15m est. unknown	St. Johns, NB	P		Fresh carcass on bow of ship
3/26/05	mortality	11m male	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/05	mortality	13.7m male	Southampton, NY	P		Subdermal hemorrhaging
8/23/05	mortality	18.8m female	Port Elizabeth, NJ	P		Brought in on bow of ship
9/11/05	mortality	16.3m female	Bonne Esperance, QC	P		Bottom jaw completely severed/broken

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

b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (~~Cole~~ Nelson *et al.* ~~2005~~2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

After reviewing NMFS records for ~~2000~~ 2001 through ~~2004~~2005, ~~5~~ eight were found that had sufficient information to confirm the cause of death as collisions with vessels (Table 1) (Nelson *et al.* 2007). These records constitute an annual rate of serious injury or mortality of 1.~~0~~ 6 fin whales from vessel collisions ~~with vessels~~. NMFS data ~~holdings~~ include six additional records of fin whale collisions with vessels, but the available supporting documentation ~~was~~ is insufficient to determine if the whales sustained mortal injuries from the encounters. The number of fin whales taken at 3 whaling stations in Canada from 1965 to 1971 totaled 3,528 whales (Mitchell 1974). Reports of non-directed takes of fin whales are fewer over the last two decades than for other endangered large whales such as right and humpback whales.

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine the population trend for fin whales. The total level of human-caused mortality and serious injury is unknown. ~~The records on hand at~~ NMFS records represent coverage of only a portion of the area surveyed for the population estimate for the stock. The total U.S. fishery-related mortality and serious injury for this stock derived from the available records is not less than 10% of the calculated PBR, and therefore cannot be considered insignificant and approaching the ZMRG. This is a strategic stock because the fin whale is listed as an endangered species under the ESA. A Draft Recovery Plan for fin whales has been prepared and is available for review (~~National Marine Fisheries Service~~NMFS 2006)~~currently awaiting legal clearance~~ .

REFERENCES CITED

Agler, B.A., R.L. Schooley, S.E. Frohock, S.K. Katona, and I.E. Seipt. 1993. Reproduction of photographically identified fin whales, *Balaenoptera physalus*, from the Gulf of Maine. J. Mamm. 74(3):-577-587.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Technical Memorandum NMFS-OPR-6. U.S. Department of Commerce, Washington, DC. 73 pp.

Bérubé, M., A.Aguilar, D. Dendanto, F. Larsen, G. Notarbartolo di Sciara, R. Sears, J. Sigurjónsson, J. Urban-R., and P.J. Palsbøll. 1998. Population genetic structure of North Atlantic, Mediterranean and Sea of Cortez fin whales, *Balaenoptera physalus* (Linnaeus 1758): analysis of mitochondrial and nuclear loci. Mol. Ecol. 15: 585-599.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Clapham, P.J. and I.E. Seipt. 1991. Resightings of independent fin whales, *Balaenoptera physalus*, on maternal summer ranges. J. Mamm. 72:~~-~~788-790.

Clark, C.W. 1995. Application of U.S. Navy underwater hydrophone arrays for scientific research on whales. Rep. int. Whal. Commn~~.~~ 45:~~-~~210-212.

Donovan, G. P. 1991. A review of IWC stock boundaries. Rep. int. Whal. Commn~~.~~ (Special Issue 13):~~-~~39-68.

Hain, J.H.W., M.J. Ratnaswamy, R.D. Kenney, and H.E. Winn. 1992. The fin whale, *Balaenoptera physalus*, in waters of the northeastern United States continental shelf. Rep. int. Whal. Commn~~.~~ 42:~~-~~653-669.

Kellogg, R. 1929. What is known of the migration of some of the whalebone whales. Ann. Rep. Smithsonian Inst. 1928:~~-~~467-494.

Kenney, R.D., G.P. Scott, T.J. Thompson, and H.E. Winn. 1997. Estimates of prey consumption and trophic impacts of cetaceans in the USA northeast continental shelf ecosystem. J. Northw. Atl. Fish. Sci. 22:~~-~~155-171.

Mizroch, A.A., D.W. Rice, and J.M. Breiwick. 1984. The fin whale, *Balaenoptera physalus*. Mar. Fisheries Rev. 46: 20-24.

Mitchell, E. 1974. Present status of northwest Atlantic fin and other whale stocks. Pages 109-169. *In:* W. E. Schevill (ed), The whale problem: A status report. Harvard University Press, ~~-~~Cambridge, Massachusetts, 419 pp.

Nelson, M., M. Garron, R.L. Merrick, R.M. Pace and T.V.N. Cole. 2007. Mortality and serious injury determinations for large whale stocks along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2001-2005. U. S. Dep. Commer., Northeast Fish. Sci~~ence~~. Cent. Ref. Doc. 07-05~~;~~. 18 pp. ~~Available from National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

NMFS [National Marine Fisheries Service]. 2006. Draft recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD. (Available at http://www.nmfs.noaa.gov/pr/recovery/plans.htm)

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int. Whal. Commn~~.~~ (Special Issue) 16: 27-50.

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. U.S. Dep. Commer., Northeast Fish. Sci. Cent.~~NMFS, Northeast Fisheries Science Center~~ Ref. Doc. 00-07~~;~~. 29 pp.

~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.~~

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). *In:* Proceedings of the workshop on ~~E~~estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs. 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03~~;~~. 41 pp. ~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. (http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf)~~

Seipt, I.E., P.J. Clapham, C.A. Mayo, and M.P. Hawvermale. 1990. Population characteristics of individually identified fin whales, *Balaenoptera physalus*, in Massachusetts Bay. Fish. Bull., U.S. 88:~~–~~271-278

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 Technical Memorandum NMFS-OPR-12. U.S. Dept. of Commerce, Washington, DC. 93 pp.

Watkins, W.A., M.A. Daher, G.M. Reppucci, J.E. George, D.L. Martin, N.A. DiMarzio, and D.P. Gannon. 2000. Seasonality and distribution of whale calls in the North Pacific. Oceanography 13:-62-67.

~~December 2005~~~~January~~~~March~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

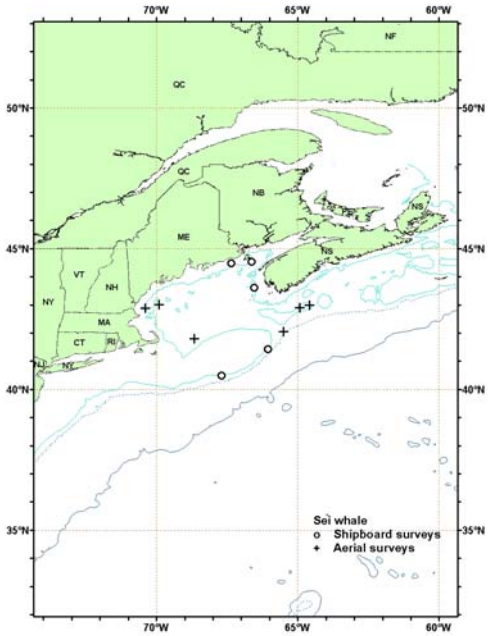


Figure 1. *Distribution of sei whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

Indications are that, at least during the feeding season, a major portion of the ~~Northwest Atlantic~~Nove~~e~~a Scotia sei whale ~~population~~ stock is centered in northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) - the Gulf of Maine and Georges Bank. The period of greatest abundance there is ~~in~~ spring, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys in 1999, 2000 and 2001 found concentrations of sei and right whales along the Northern Edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain *et al.* 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, south of Nantucket, in the spring of 2001. Similarly, Mitchell (1975) reported that sei whales off Nova Scotia were often distributed closer to the 2,000 m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. Although known to take piscine prey, sei whales (like right whales) are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn *et al.* 2002). In years of reduced predation on copepods by other predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (R.D. Kenney, pers. comm.; Payne *et al.* 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling et al. 1993). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide (Jonsgård and Darling 1977).

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

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

POPULATION SIZE

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

Earlier abundance estimates

Mitchell and Chapman (1977), based on tag-recapture data, estimated the Nova Scotia, Canada, stock to contain between 1,393 and 2,248 sei whales. Based on census data, they estimated a minimum Nova Scotian population of 870 sei whales. An abundance estimate of 280 sei whales was ~~estimated~~ generated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). The estimate is based on data collected during the spring when the greatest proportion of the population off the northeast U.S. coast appeared in the study area. This estimate does not include a correction for dive-time or for g(0), the probability of detecting an animal group on the track line. The CETAP report suggested, however, that correcting the estimated abundance for dive time would increase the estimate to approximately the same as Mitchell and Chapman's (1977) tag-recapture estimate. This estimate is more than 20 years out of date and thus almost certainly does not reflect the current true population size; in addition, the estimate has a high degree of uncertainty (i.e., it has a large CV), and it was estimated just after cessation of extensive foreign fishing operations in the region. ~~There are no recent abundance estimates for the sei whale.~~ As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

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

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

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

~~An estimate of abundance for the August 2002 survey was 71 (CV=1.01), 386 (CV=0.85) for June-July 2004, and 207 (CV=0.62) for August 2006 (Table 1). The summer 2002, 2004 and 2006 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawerence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~

~~The August 20064 abundance estimate (207386) is considered the best available for the Nova Scotia stock of sei~~

~~whales because it is recent and it provides an estimate when the largest portion of the population was within the study area. However, this estimate must be considered extremely conservative in view of the known range of the sei whale in the entire western North Atlantic, and the uncertainties regarding population structure and exchange between surveyed and unsurveyed areas.~~

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

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	71	1.01
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	386	0.85
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	207	0.62

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). A current minimum population size ~~cannot be estimated because there are no current abundance estimates (within the last 10 years)~~ is 128~~208~~.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~unknown208~~128. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sei whale is listed as endangered under the Endangered Species Act (ESA). PBR for the Nova Scotia stock of the sei whale is ~~unknown because the minimum population size is unknown~~0.3~~4~~.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There was no reported fishery-related mortality or serious injury to sei whales in fisheries observed by NMFS during ~~1999~~2001-~~2003~~2005. A review of NMFS stranding and entanglement records from ~~1999~~ 2001 through ~~2003~~ 2005 yielded an average of 0.4 human-caused mortalities per year as a result of two ship strikes (Nelson *et al.* 2007). The carcass of a 13-meter female was recovered on May 2, 2001, in New York harbor after it slid off the bow of an arriving ship. Freshness of the carcass and hemorrhaging around the dorsal impact area indicated the strike was pre-mortem. The second record within the period was an 11-meter male discovered February 19, 2003, outside of Norfolk Naval Base in Norfolk, VA. A large gash into muscle tissue extended from behind dorsal midline on left side almost all the way around to the ventral midline on the right sides through blubber layer and into some muscle. Histopathology results supported perimortem trauma. The only other NMFS record of a human-caused sei whale mortality was from November 17, 1994, when a sei whale carcass was observed on the bow of a container ship as it docked in Boston, Massachusetts.

Fishery Information

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

Table 1. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2001- 2005.

Date[a]	Report Type[b]	Sex, age, ID	Location[a]	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
5/2/01	mortality	13.0 m female	New York Harbor	P		Fresh carcass hung on ship's bow; hemorrhaging
2/19/03	mortality	11.0m male	Norfolk, VA 36 58'N 76 21'W	P		Large gash into muscle, hemotoma and abrasions

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

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine ~~the~~ population trends for sei whales. The total level of U.S. fishery-caused mortality and serious injury is unknown, but the rarity of mortality reports for this species suggests that this level is insignificant and approaching a zero mortality and serious injury rate. This is a strategic stock because the average annual human-related mortality and serious injury exceeds PBR, and because the sei whale is listed as an endangered species under the ESA. A Recovery Plan for sei whales has been written and is awaiting legal clearance.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. NOAA Tech. Memo. NMFS-OPR-6. U.S. Department of Commerce, Washington, DC. 73 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Donovan, G. P. 1991. A review of IWC stock boundaries. Rep. int. Whal. Commn (Special Issue) 13:-39-68.

Flinn, R.D., A.W. Trites, and E.J. Gregr. 2002. Diets of fin, sei, and sperm whales in British Columbia: An analysis of commercial whaling records, 1963-1967. Mar. Mammal Sci. 18(3):663-679.

Hain, J. H. W., M. A. M. Hyman, R. D. Kenney, and H. E. Winn. 1985. The role of cetaceans in the shelf-edge region of the northeastern United States. Mar. Fish. Rev. 47(1):-13-17.

Jonsgård, Å, and K. Darling. 1977. On the biology of the Eastern North Atlantic sei whale, Balaenoptera borealis Lesson. Rep. int. Whal. Commn (Special Issue) 1:124-129.

Mitchell, E. 1975. Preliminary report on Nova Scotia fishery for sei whales (*Balaenoptera borealis*). Rep. ~~Int~~int. Whal. Commn~~.~~ 25:-218-225.

Mitchell, E. and D. G. Chapman. 1977. Preliminary assessment of stocks of northwest Atlantic sei whales (*Balaenoptera borealis*). Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 1: 117-120.

Nelson, M., M. Garron, R.L. Merrick, R.M. Pace and T.V.N. Cole. 2007. Mortality and serious injury determinations for large whale stocks along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2001-2005. U. S. Dep. Commer., Northeast Fish. Science Cent. Ref. Doc. 07-05, 18 pp.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int. Whal. Commn (Special Issue) 16:27-50.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). *In*: Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham, and J.W. Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull., U.S. 88: 687-696.

Schilling, M.R., I. Seipt, M.T. Weinrich, S.E. Frohock, A.E. Kuhlberg, and P.J. Clapham. 1993. Behavior of individually identified sei whales, *Balaenoptera borealis*, during an episodic influx into the southern Gulf of Maine in 1986. Fish. Bull., U.S. 90(4): 749-755.

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. U.S. Dept. of Commerce, Washington, DC. 93 pp.

~~April 2006~~~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

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

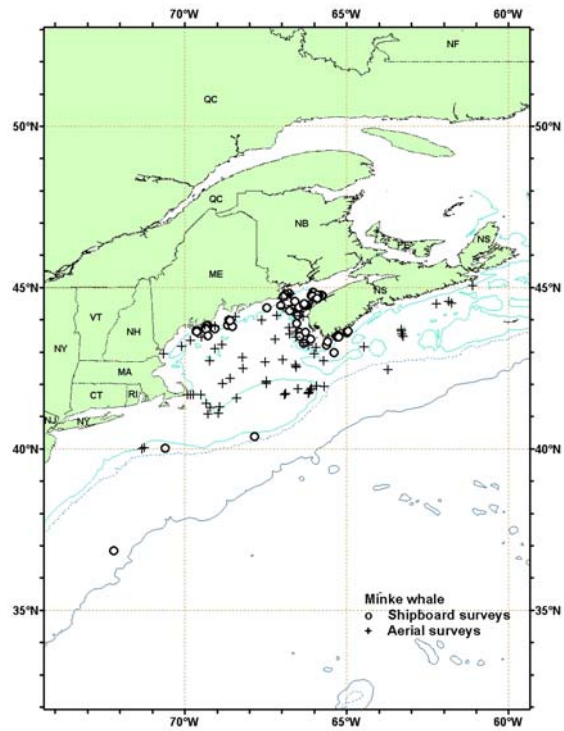


Figure 1. *Distribution of minke whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

POPULATION SIZE

The total number of minke whales in the Canadian East Coast population is unknown. However, ~~seven~~ ten estimates are available for portions of the habitat: a 1978-1982 estimate; a shipboard survey estimate from the summers of 1991 and 1992; a shipboard estimate from June-July 1993; an estimate made from a combination of shipboard and aerial surveys conducted during July to September 1995; an aerial survey estimate of the entire Gulf of St. Lawrence conducted in August to September 1995; an aerial survey estimate from the northern Gulf of St. Lawrence conducted during July and August 1996; ~~and~~ an aerial/shipboard survey conducted from Georges Bank to the mouth of the Gulf of St. Lawrence during July and August 1999; and aerial surveys conducted during the summers of 2002, 2004, and 2006 (Table 1; Figure 1~~).~~). The best available current abundance estimate for minke whales, 3,312~~1,390~~ (CV=0.74~~51~~), is obtained from the 2006 aerial survey because this survey is recent and covered the largest portion of the animal's habitat.

Earlier estimates

An abundance estimate of 320 minke whales (CV=0.23) was derived from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982).

~~—~~An abundance estimate of 2,650 (CV=0.31) minke whales was obtained from two shipboard line-transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy

region. ~~This abundance estimate is a weighted average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance, using methods as described in Palka (1995).~~

An abundance estimate of 330 minke whales (CV=0.66) was calculated from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993).

An abundance estimate of 2,790 (CV=0.32) minke whales was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka ~~Unpublished Ms~~2006~~.~~). ~~Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom isobaths, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom depth contour, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour. Data collection and analysis methods were described in Palka (1996).~~

Kingsley and Reeves (1998) estimated there were 1,020 (CV=0.27) minke whales in the entire Gulf of St. Lawrence in 1995 and 620 minke whales (CV=0.52) in the northern Gulf of St. Lawrence in 1996~~ (Table 1)~~. During the ~~August – September~~ 1995 survey, 8,427 km of track lines were flown in an area encompassing 221,949 km^2 in August - September. During the ~~July – August~~ 1996 survey, 3,993 km of track lines were flown in an area encompassing 94,665 km^2 in July - August.

Recent surveys and abundance estimates

~~Data were analyzed using Quenouille's jackknife bias reduction procedure on line-transect methods that model the left truncated sighting curve. These estimates were uncorrected for visibility biases such as *g(0)*, the probability of detecting a group on the track line.~~

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

An abundance estimate of 756~~480~~ (CV=0.90~~64~~) minke whales was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1~~; Palka 2006~~). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

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

An abundance estimate of 3,312~~1,390~~ (CV=0.74~~52~~) minke whales was generated from an aerial survey conducted in August 2006 ~~-~~which surveyed 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.).

~~The best available current abundance estimate for minke whales, 2,998 (CV=0.19), the 1999 Georges Bank to Gulf of St. Lawrence estimate, because this survey is recent.~~

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

Month/Year	Area	N_{best}	CV

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

Month/Year	Area	N_{best}	CV
July-Aug 1999	Georges Bank to mouth of Gulf of St. Lawrence	2,998	0.19
Aug 2002	S. Gulf of Maine to Maine	756~~480~~	0.90~~64~~
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	600	0.61
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	3,312~~1,390~~	0.74~~52~~

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for minke whales is ~~2,998~~3,312~~1,390~~ animals (CV=0.~~19~~74~~52).~~). ~~-~~The minimum population estimate for the Canadian East Coast minke whale is ~~2,559~~1,899~~921~~ animals.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~2,998~~1,899~~921~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, or threatened stocks, or stocks of unknown status, relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the Canadian east coast minke whale is 1~~26~~9~~.2~~.

ANNUAL HUMAN-CAUSED MORTALITY AND INJURY

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

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

During ~~2000~~ 2001 to ~~2004~~2005, the U.S. total annual estimated average human-caused mortality was 2.8

minke whales per year (CV=unknown), plus an unknown bycatch estimate from the Northeast bottom trawl fishery. This is derived from three components: an unknown number of minke whales per year from U.S. fisheries using observer data, 2.~~6~~ 4 minke whales per year (unknown CV) from U.S. fisheries using strandings and entanglement data, and 0.~~2~~ 4 minke whales per year from ship strikes (Nelson *et al.* 2007). During 1997 to 2001, there were no confirmed mortalities or serious injuries in Canadian waters as reported by the various, small-scale stranding and observer data collection programs in Atlantic Canada. No additional information is available on Canadian mortalities from 2002 to present.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Little information is available about fishery interactions that took place before the 1990s. Read (1994) reported that a minke whale was found dead in a Rhode Island fish trap in 1976. A minke whale was caught and released alive in the Japanese tuna longline fishery in 3,000 m of water, south of Lydonia Canyon on Georges Bank, in September 1986 (Waring *et al.* 1990).

Two minke whales were observed taken in the Northeast sink gillnet fishery between 1989 and the present. The take in July 1991, south of Penobscot Bay, Maine resulted in a mortality, and the take in October 1992, off the coast of New Hampshire near Jeffreys Ledge, was released alive.

A minke whale was trapped and released alive from a herring weir off northern Maine in 1990.

Four minke whale mortalities were observed in the Atlantic pelagic drift gillnet fishery during 1995.

One minke whale was reported caught in an Atlantic tuna purse seine off Stellwagen Bank in 1991(D. Beach, NMFS NE Regional Office, pers. comm.) and another in 1996. The minke caught during 1991 was released uninjured after a crew member cut the rope wrapped around the tail. The minke whale caught during 1996 escaped by diving beneath the net.

One minke whale, reported in the strandings and entanglement database maintained by the New England Aquarium and the Northeast Regional Office/NMFS, was taken in a 6-inch gill net on 6 July 1998 off Long Island, New York. This take was assigned to the mid-Atlantic gillnet fishery. No other minke whales have been taken in this fishery during observed trips in 1993 to ~~2004~~2005.

U.S.

Northeast Bottom Trawl

The fishery is active in New England waters in all seasons. Detailed fishery information is reported in Appendix III. One freshly dead minke whale was caught in 2004 on the northeast tip of Georges Bank in US waters (Table 2). ~~The~~ An expanded bycatch estimate ~~is pending~~has not been generated. With only one observed take, it is not possible to obtain an accurate bycatch estimate.

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

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 7 minke whale mortalities and serious injuries that were attributed to the lobster fishery during 1990 to 1994; 1 in 1990 (may be serious injury), 2 in 1991 (1 mortality and 1 serious injury), 2 in 1992 (both mortalities), 1 in 1993 (serious injury) and 1 in 1994 (mortality) (1997 List of Fisheries 62FR33, January 2, 1997). The 1 confirmed minke whale mortality during 1995 was attributed to the lobster fishery. No confirmed mortalities or serious injuries of minke whales occurred in 1996. From the 4 confirmed 1997 records, 1 minke whale mortality was attributed to the lobster trap fishery. One minke whale was disentangled and released alive from lobster gear on 21 August 2002 (Table 4). One minke whale mortality was attributed to this fishery for ~~2003~~ 2002 (Tables 3 and 5). The 28 June 2003 mortality, while wrapped in lobster gear, cannot be confirmed to have become entangled in the area, and so is not attributed to the fishery. Annual mortalities due to this fishery, as determined from strandings and entanglement records that have been audited, were 1 in 1991, 2 in 1992, 1 in 1994, 1 in 1995, 0 in 1996, 1 in 1997, 0 in 1998 to ~~2002~~2001, 1 in ~~2003~~2002, and ~~and~~ 0 in ~~2004~~2003 to 2005. Estimated average annual mortality related to this fishery during ~~2000~~ 2001 to ~~2004~~ 2005 was 0.2 minke whales per year (Table 3; 10/15/02 animal in Table 5).

Unknown Fisheries

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, include 36 records of minke whales within U.S. waters for 1975-1992. The gear include

unspecified fishing nets, unspecified cables or lines, fish traps, weirs, seines, gillnets, and lobster gear. A review of these records is not complete. One confirmed entanglement was an immature female minke whale, entangled with line around the tail stock, ~~that~~which came ashore on the Jacksonville, Florida jetty on 31 January 1990 (R. Bonde, USFWS, Gainesville, FL, pers. comm.).

The audited NE Regional Office/NMFS entanglement/stranding database contains records of minke whales, of which the confirmed mortalities and serious injuries from the last five years are reported in Table 5. Mortalities (and serious injuries) that were likely a result of a fishery interaction with an unknown fishery include 3 (0) in 1997, 3 (0) in 1999, 1 (1) in 2000, 2 (0) in 2001, ~~2~~ 1 (0) in 2002, ~~4~~ 5 (0) in 2003, 2 (0) in 2004 and 0 (0) in ~~other years~~2005. Examination of minke entanglement records from 1997 indicates that 4 out of 4 confirmed records of mortality were likely a result of fishery interactions. One was attributed to the lobster pot fishery (see above), and three were not attributed to any particular fishery because the information from the entanglement event often did~~reports do~~ not contain the necessary details. Of the five mortalities in 1999, two were attributed to an unknown trawl fishery and three to some other fishery. Of the two interactions with an unknown fishery in 2000, ~~1~~ one was a mortality and one was a serious injury. In 2001, the ~~2~~ two confirmed fishery interactions were both from an unknown fishery. In 2002, there was one mortality in an unknown fishery. In 2003, 4 of 5 confirmed mortalities were due to interactions with an unknown fishery. In 2004, of the three confirmed mortalities, two were due to an interaction with an unknown fishery (Tables 3 and 5). In 2005 there were no mortalities attributed to fishery interactions.

In general, an entangled or stranded cetacean could be an animal that is part of an expanded bycatch estimate from an observed fishery and thus it is not possible to know if an entangled or stranded animal is an additional mortality. During 1997 to 2003 and in 2005, no minke whales were observed taken in any fishery observed by the NEFSC Observer Program, therefore, the strandings from ~~1997 to 2003~~those years ~~a mortality~~ in which mortalities were attributable to ~~a~~ fishery interactions can be added into the human-caused mortality estimate. During ~~2000~~ 2001 to ~~2004~~2005, as determined from strandings and entanglement records, the estimated average annual mortality is 2.~~4~~ 0 minke whales per year in unknown fisheries (Table 3).

CANADA

~~In Canadian waters, minke whale interactions with fishing gear are not well quantified or recorded, though some records are available.~~ Read (1994) reported interactions between minke whales and gillnets in Newfoundland and Labrador, in cod traps in Newfoundland, and in herring weirs in the Bay of Fundy. Hooker *et al.* (1997) summarized bycatch data from a Canadian fisheries observer program that placed observers on all foreign fishing vessels operating in Canadian waters, on between 25% and 40% of large Canadian fishing vessels (greater than 100 feet long), and on approximately 5% of smaller Canadian fishing vessels. During 1991 through 1996, no minke whales were observed taken.

Herring Weirs

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

Other Fisheries

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

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

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

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

fishing gear in Newfoundland for 2000 to 2006 (W. Ledwell, pers. comm.)

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Bottom Trawl	~~00~~01-~~04~~05	~~TBD~~unk	Obs. Data	.01, .01, .03, .04, .05	~~0,~~ 0, 0, 0, 1, 0	~~TBD[e]~~unk[c]	~~TBD[e]~~unk[c]	~~TBD[3]~~unk[3]
Total								~~TBD[3]~~unk[3]

a) Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Fisheries Science Center (NEFSC) Fisheries Observer Program.
b) Observer coverage for trawl fishery is measured in trips.
c) Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery ~~for the years 2000-2004 is in progress. The estimates will not be reported until the analysis and scientific review is~~has not been generated.~~ complete~~.

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

Fishery	Years	Vessels	Data Type [a]	Assigned Mortality	Mean Annual Mortality
G~~OM and mid~~Northeast/Mid-Atlantic Lobster Trap/Pot	~~00~~01-~~04~~05	1997=6880 2000=7539 licenses	Entanglement & Strandings	~~0,~~ 0, ~~0~~1, ~~1~~0, 0, 0	0.2
Unknown Fisheries	~~00~~01-~~04~~05	NA	Entanglement & Strandings	~~2,~~ 2, 1, 5, 2, 0	2.~~4~~0
TOTAL					2.~~6~~2 (unk)

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

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

Fishery	Years	Ratio	Injured	Uninjured
Lobster trap pot	None	NA~~1~~	1[a]	0
Pelagic longline	01-05	0	0	1[b]

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

Table 5. Summarized records of mortality and serious injury likely to result in mortality. Canadian East Coast stock of minke whales, January ~~2000~~ 2001 - December ~~2004~~2005. This listing includes only confirmed records related to U.S. commercial fisheries and/or ship strikes in U.S. waters. Causes of mortality or injury, assigned as primary or secondary, are based on records maintained by NMFS/NER and NMFS/SER.

Date[a]	Report Type[b]	Sex, age, ID	Location[a]	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	

~~8/11/00~~	~~serious injury~~	~~unk sex and size~~	~~Port Clyde, ME (43º55'N 69º11'W)~~		~~P~~	~~Unknown fishery. Dark line with several bullet buoys. Unusual minke behavior – whale probably anchored. No gear recovered.~~
~~10/3/00~~	~~mortality~~	~~unk sex and size~~	~~Rockland ME (44º05'N 69º01'W)~~		~~P~~	~~Unknown fishery. Very fresh carcass with fresh entanglement wounds on tail stock. No gear recovered.~~
8/17/01	mortality	male, 3.9m	Middletown, RI (41º28'N 71º15'W)		P	Unknown fishery. Severe rope entanglement around mouth and rostrum caused malnutrition and infection.
12/13/01	Mortality	unk sex, 7m (est)	Massachusetts Bay, MA (42º21'N 70º43'W)		P	Unknown fishery. Pictures show evidence of fairly fresh entanglement marks on tail stock and across tail flukes. No gear recovered.
7/17/02	Mortality	female, 4.6m (est)	Bar Harbor, ME (44º18.22'N 68º07.43'W)		P	Unknown fishery. Carcass had a rope scar on the peduncle with associated hemorrhaging. Additional bruising around the epiglottis and larynx. No gear recovered.
10/15/02	Mortality	female, 5.1m	Gloucester, MA (42º36'N 70º39W)		P	Whale was entangled through the mouth and around the pectoral flippers. Gear from state water lobster fishery was still on the whale.
5/24/03	Mortality	male, 7.6m	Gloucester, MA (42º40.8'N 70º39.6'W)		P	Unknown fishery. Line marks on head and dorsal fin, no line present. Cut across back anterior to dorsal fin. No gear recovered.
5/31/03	Mortality	Female 3.6m (est)	Martha's Vineyard, MA (41º21.0'N 70º47.5'W)		P	Unknown fishery. Whale stranded live wrapped in about 15 feet of 5.5 inch mesh netting, probably trawl gear.
6/28/03	Mortality	male, 9.1m	Chatham, MA (41º40'N 69º55'W)		P	Lobster fishery. Wrapped in lobster gear.

8/9/03	Mortality	sub-adult female, 3.5m (est)	Harwich, MA (41º37.3'N 70º03.0'W)		P	Unknown fishery. Hemorrhaging in areas with net marks on whale. ~~Gear not found~~No gear recovered.
9/13/03	Mortality	Sub-adult female, 6m (est)	Casco Bay, ME (43º42'N 69º58'W)		P	Unknown fishery. Fresh dead. External chaffing marks and belly slit open. No gear recovered.
5/6/04	Mortality	female, 7.7m	Martha's Vinyard, MA (41º21'N 70º40'W)		P	Unknown fishery. Constricting line marks on peduncle. Indications of drowning from internal exam.
6/1/04	Mortality	female, 6.5m	Chatham, MA (41º 41'N 69º56'W)	P		Ship strike. Large area of subdermal hemorrhaging.
7/19/04	Mortality	female, 7.9m	Eastham, MA (41º54'N 69º58'W)		P	Unknown fishery. Extensive entanglement markings. No gear recovered.
5/23/05	Mortality	5.9m male subadult	Port Elizabeth, NJ (40° 41'N 74° 09'W)	P		Ribs shattered, liver ruptured, evidence of internal hemorrhaging

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

~~c.~~b. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (~~Cole~~ Nelson *et al.* ~~2005~~2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

Other Mortality

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

U.S.

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

During 1999 to 2003, no minke whale was confirmed struck by a ship. During 2004 and 2005, one minke whale mortality was contributed to a ship strike in each year (Table 5). Thus, during ~~2000~~ 2001 to ~~2004~~2005, as determined from stranding and entanglement records, the estimated annual average was 0.~~2~~ 4 minke whales per year struck by ships.

In October 2003, an Unusual Mortality Event was declared involving minke whales and harbor seals along the coast of Maine. Two of the seven criteria established to designate such an event were met by these species. Specifically, there was a marked increase in mortalities when compared with historical records, and the mortalities were occurring in a localized area of the Maine coast. From September 11-30, 2003, nine minke whales were reported along the mid-coast to southern Maine. Results from analyses for biotoxins failed to show the presence of either saxitoxin or domoic acid (by ELISA and Receptor Binding Assay). Most whale carcasses that were examined appeared to be in good body condition immediately prior to death. Since October 2003, the number of minke whale stranding reports has returned to normal. There were two minke whale stranding mortalities in NC in 2005 but in neither case could cause of death be attributed to human causes (Nelson *et al.* 2007).

CANADA

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

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

Table 6. Documented number of stranded minke whales along the coast of Nova Scotia during 2001 to 2005 by year, according to records maintained by the Canadian Marine Animal Response Society.

Area	YEAR					
	2001	2002	2003	2004	2005	Total
Nova Scotia	1	4	3	0	3	11

Table 6. Documented number of stranded minke whales along the coast of Nova Scotia during 2000 to 2004 by year, according to records maintained by the Canadian Marine Animal Response Society.						
Area	Year					
	2000	2001	2002	2003	2004	Total
Nova Scotia	0	1	4	3	0	8

STATUS OF STOCK

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

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Cole, T.V.N., D.L. Hartly, and R.L. Merrick. 2005. Mortality and serious injury determinations for large whale stocks along the eastern seaboard of the United States, 1999-2003. U. S. Dep. Commer., Northeast Fish. Science Cent. Ref. Doc. 05-08; 20 pp.

Donovan, G.P. 1991. A review of IWC stock boundaries. Rep. int Whal. Commn Special Issue 13: 39-68.

Hooker, S.K., R.W. Baird, and M.A. Showell. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission meeting in Bournemouth, UK.

IWC [International Whaling Commission]. 1991. Appendix 11. Biological parameters of North Atlantic minke whales in Annex F Report of the sub-committee on North Atlantic Minke whales. Rep. int Whal. Commn 41:160.

IWC [International Whaling Commission]. 1992. Annex K. Report of the working group on North Atlantic Minke trials. Rep. int Whal. Commn 42: 246-251.

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

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:1529-1550.

Ledwell, W., and J. Huntington, 2006. Whale, leatherback sea turtles. And basking shark entrapments in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2005. Report to the Department of Fisheries and Oceans, St. John's, Newfoundland, CANADA. 18 pp.

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Canadian Field-Naturalist 114(1): 46-61.

Mitchell, E.D. 1991. Winter records of the minke whale (*Balaenoptera acutorostrata* Lacepede 1804) in the southern North Atlantic. Rep. int Whal. Commn 41: 455-457.

Nelson, M., M. Garron, R.L. Merrick, R.M. Pace, and T.V.N. Cole. 2007. Mortality and serious injury determinations for large whale stocks along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2001-2005. U. S. Dep. Commer., Northeast Fish. Science Cent. Ref. Doc. 07-05, 18 pp.

NMFS [National Marine Fisheries Service]. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine Mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50. *In*: A. Bjρrge and G.P. Donovan (eds.) Biology of the Phocoenids. Rep. int Whal. Commn Special Issue 16.

~~Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA NMFS-NEFSC Ref. Doc. 96-04, 37 pp.~~

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NOAA/NMFS/NEFSC Ref. Doc. 00-07, 29 pp.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). *In:* Proceedings of the workshop on estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs. 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03, 41 pp.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn Special Issue 15:133-147.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry, and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull., U.S. 88(2): 347-360.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of the sperm whale in the U.S. Exclusive Economic Zone (EEZ) occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Figure 1). Waring *et al.* (1993; 2001) suggest that this offshore distribution is more commonly associated with the Gulf Stream edge and other features. However, the sperm whales that occur in the eastern U.S. Atlantic EEZ likely represent only a fraction of the total stock. The nature of linkages of the U.S. habitat with those to the south, north, and offshore is unknown. Historical whaling records compiled by Schmidly (1981) suggested an offshore distribution off the southeast U.S., over the Blake Plateau, and into deep ocean waters. In the southeast Caribbean, both large and small adults, as well as calves and juveniles of different sizes are reported (Watkins *et al.* 1985). Whether the northwestern Atlantic population is discrete from northeastern Atlantic is currently unresolved. The International Whaling Commission recognizes one stock for the North Atlantic. Based on reviews of many types of stock studies, (i.e., tagging, genetics, catch data, mark-recapture, biochemical markers, etc.) Reeves and Whitehead (1997) and Dufault *et al.* (1999) suggest that sperm whale populations have no clear geographic structure. Recent ocean wide genetic studies (Lyrholm and Gyllensten 1998; Lyrholm *et al.* 1999) indicate low genetic diversity, but strong differentiation between potential social (matrilineally related) groups. Further, the ocean-wide findings, combined with observations from other studies, indicate stable social groups, site fidelity, and latitudinal range limitations in groups of females and juveniles (Whitehead ~~2003~~2002). In contrast, males migrate to polar regions to feed and return to more tropical waters to breed. There exists one tag return of a male tagged off Browns Bank (Nova Scotia) in 1966 and returned from Spain in 1973 (Mitchell 1975). Another male taken off northern Denmark in August 1981 had been wounded the previous summer by whalers off the Azores (Reeves and Whitehead 1997). In the U.S. Atlantic EEZ waters, there appears to be a distinct seasonal cycle (CETAP 1982; Scott and Sadove 1997). In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar but now also includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf (inshore of the 100 m isobath) south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf is at its highest level, and there remains a continental shelf edge occurrence in the mid-Atlantic bight. Similar inshore (<200 m) observations have been made on the southwestern (Kenney, pers. comm) and eastern Scotian Shelf, particularly in the region of "the Gully" (Whitehead *et al.* 1991).

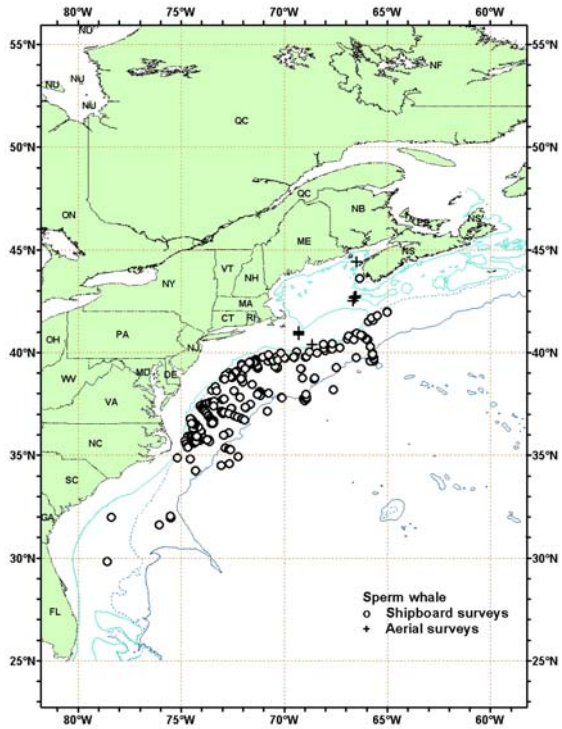


Figure 1. *Distribution of sperm whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1,000m, and 4,000m depth contours.*

Geographic distribution of sperm whales may be linked to their social structure and their low reproductive rate and both of these factors have management implications. Several basic groupings or social units are generally recognized — nursery schools, harem or mixed schools, juvenile or immature schools, bachelor schools, bull schools or pairs, and solitary bulls (Best 1979; Whitehead *et al.* 1991; Christal *et al.* 1998). These groupings have a distinct geographical distribution, with females and juveniles generally based in tropical and subtropical waters, and males more wide-ranging and occurring in higher latitudes. Male sperm whales are present off and sometimes on

the continental shelf along the entire east coast of Canada south of Hudson Strait, whereas, females rarely migrate north of the southern limit of the Canadian EEZ (Reeves and Whitehead 1997; Whitehead ~~2003~~2002). Off the northeast U.S., CETAP and NMFS/NEFSC sightings in shelf-edge and off-shelf waters included many social groups with calves/juveniles (CETAP 1982; Waring *et al.* 1992, 1993). The basic social unit of the sperm whale appears to be the mixed school of adult females plus their calves and some juveniles of both sexes, normally numbering 20-40 animals in all. There is evidence that some social bonds persist for many years (Christal *et al.* 1998).

POPULATION SIZE

Total numbers of sperm whales off the U.S. or Canadian Atlantic coast are unknown, although several estimates from selected regions of the habitat do exist for select time periods. Sightings were almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best recent abundance estimate for sperm whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 4,804 (CV =0.38), where the estimate from the northern U.S. Atlantic is 2,607 (CV =0.57), and from the southern U.S. Atlantic is 2,197 (CV =0.47). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat. Because all the sperm whale estimates presented here were not corrected for dive-time, they are likely downwardly biased and an underestimate of actual abundance. The average dive-time of sperm whales is approximately 30 - 60 min (Whitehead *et al.* 1992; Watkins *et al.* 1993; Amano and Yoshioka 2003; Watwood *et al.* 2006), therefore, the proportion of time that they are at the surface and available to visual observers is assumed to be low.

Although the stratification schemes used in the 1990-2004 surveys did not always sample the same areas or encompass the entire sperm whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990- 2004 data suggest that, seasonally, at least several thousand sperm whales are occupying these waters. Sperm whale abundance may increase offshore, particularly in association with Gulf Stream and warm-core ring features; however, at present there is no reliable estimate of total sperm whale abundance in the western North Atlantic.

Earlier abundance estimates

An abundance of 219 (CV=0.36) sperm whales was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance of 338 (CV=0.31) sperm whales was estimated from an August 1990 shipboard line transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (~~Anonymous~~ NMFS 1990; Waring *et al.* 1992). An abundance of 736 (CV=0.33) sperm whales was estimated from a June and July 1991 shipboard line- transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). An abundance of 705 (CV=0.66) and 337 (CV=0.50) sperm whales was estimated from line transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11, respectively (~~Anonymous~~ NMFS 1991). An abundance of 116 (CV=0.40) sperm whales was estimated from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance of 623 (CV=0.52) sperm whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (NMFS 1994). An abundance of 2,698 (CV=0.67) sperm whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 1996). An abundance of 2,848 (CV=0.49) sperm whales was estimated from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN). An abundance of 1,181 (CV=0.51) sperm whales was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

~~An abundance of 116 (CV=0.40) sperm whales was estimated from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (Anonymous NMFS 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993). Estimates include school-size bias, if applicable, but do not include corrections~~

~~for *g(0)* or dive-time. Variability was estimated using bootstrap resampling techniques.~~

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

~~An abundance of 2,698 (CV=0.67) sperm whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka *et al.* Unpubl. Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 and 1,000 fathom isobaths, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom isobath, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1,000 fathom isobath. Data collection and analysis methods used were described in Palka (1996).~~

~~An abundance of 2,848 (CV=0.49) sperm whales was estimated from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºEN) (Figure 1; Table 1; Palka *et al.* Unpubl. Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 1,181 (CV=0.51) sperm whales was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºEN) (Figure 1; Mullin and Fulling 2003). This estimate is a recalculation of the same data reported in previous SARs. For more details see Mullin and Fulling (2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993) where school size bias and ship attraction were accounted for.~~

~~The best 1998 abundance estimate for sperm whales is the sum of the estimates from the two U.S. Atlantic surveys, 4,029 (CV=0.38), where the estimate from the northern U.S. Atlantic is 2,848 (CV=0.49) and from the southern U.S. Atlantic is 1,181 (CV=0.51). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

Recent surveys and abundance estimates

An abundance of 2,607 (CV=0.57) for sperm whales was estimated from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (about 38ºN) to the Bay of Fundy (about 45ºN) (~~Figure~~ Table 1; Palka ~~Unpub. Ms~~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 (~~Figure 1;~~ Palka ~~unpub.).~~2006).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ~~≥~~ > 50m) between Florida and Maryland (27.5 and 38ºN) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye ~~binocluars~~binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias (*g(0)*) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka, 1995; Buckland *et al.*, 2001). The resulting abundance estimate for sperm whales between Florida and Maryland was 2,197 (CV =0.47)(Table 1).

~~The best 2004 abundance estimate for sperm whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 4,804 (CV =0.38), where the estimate from the northern U.S. Atlantic is 2,607 (CV =0.57), and from the southern U.S. Atlantic is 2,197 (CV =0.47). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

~~Because all the sperm whale estimates presented here were not corrected for dive-time, they are likely downwardly biased and an underestimate of actual abundance. The average dive time of sperm whales is approximately 30 – 60 min (Whitehead *et al.* 1991~~1992~~; Watkins *et al.* 1993; Peter Madsen, Woods Hole Oceanographic Institution, pers. comm.~~ Amano and Yoshioka 2003; Watwood *et al.* 2006~~), therefore, the proportion of time that they are at the surface and available to visual observers is assumed to be low.~~

~~Although the stratification schemes used in the 1990-2004 surveys did not always sample the same areas or~~

~~encompass the entire sperm whale habitat, they did focus on segments of known or suspected high use habitats off the northeastern U.S. coast. The collective 1990–2004 data suggest that, seasonally, at least several thousand sperm whales are occupying these waters. Sperm whale abundance may increase offshore, particularly in association with Gulf Stream and warm core ring features; however, at present there is no reliable estimate of total sperm whale abundance in the western North Atlantic.~~

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~2,848~~	~~0.49~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~1,181~~	~~0.51~~
~~Jul-Sep 1998~~	~~Gulf of St. Lawrence to Florida (COMBINED)~~	~~4,029~~	~~0.38~~
Jun-Aug 2004	Maryland to the Bay of Fundy	2,607	0.57
Jun-Aug 2004	Florida to Maryland	2,197	0.47
Jun-Aug 2004	Bay of Fundy to Florida (COMBINED)	4,804	0.38

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for sperm whales is 4,804 (CV =0.38). The minimum population estimate for the western North Atlantic sperm whale is 3,539.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. While more is probably known about sperm whale life history in other areas, some life history and vital rates information is available for the northwest Atlantic. These include: calving interval is 4-6 years; lactation period is 24 months; gestation period is 14.5-16.5 months; births occur mainly in July to November; length at birth is 4.0 m; length at sexual maturity 11.0-12.5 m for males and 8.3-9.2 m for females; mean age at sexual maturity is 19 years for males and 9 years for females; and mean age at physical maturity is 45 years for males and 30 years for females (Best 1974; Best *et al.* 1984; Lockyer 1981; Rice 1989).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 3,539. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because the sperm whale is listed as endangered under the Endangered Species Act (ESA). PBR for the western North Atlantic sperm whale is 7.0.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

During ~~1999~~2001-~~2003~~2005, human caused mortality was 0.~~4~~ 2 sperm whales per year (CV=unknown). This is derived from ~~three~~ two components: 0 sperm whales per year (CV=unknown) from U.S. fisheries using observer data ~~;, 0.2 sperm whales based on the 2000 stranding of a sperm whale off Florida which had fishing gear in its blow hole;~~ and 0.2 sperm whales per year from ship strikes.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

Several sperm whale entanglements have been documented. In July 1990, a sperm whale was entangled and subsequently released (injured) from the now prohibited pelagic drift gillnet near the continental shelf edge on southern Georges Bank. This resulted in an estimated annual fishery-related mortality and serious injury of 4.4 (CV=1.77) for 1990. In August 1993, a dead sperm whale, with longline gear wound tightly around the jaw, was found floating about 20 miles off Mt Desert Rock. In October 1994, a sperm whale was successfully disentangled from a fine- mesh gillnet in Birch Harbor, Maine. During June 1995, one sperm whale was entangled with "gear in/around several body parts" then released injured from a pelagic drift gillnet haul located on the shelf edge between Oceanographer and Hydrographer Canyons on Georges Bank. In May 1997, a sperm whale entangled in net with three buoys trailing was sighted 130 nm~~i~~ northwest of Bermuda. No information on the status of the animal was provided.

Other Mortality

Four hundred twenty-four sperm whales were harvested in the Newfoundland-Labrador area between 1904 and -1972 and 109 male and no female sperm whales were taken near Nova Scotia in 1964-1972 (Mitchell and Kozicki 1984) in a Canadian whaling fishery. There was also a well-documented sperm whale fishery based on the west coast of Iceland. Other sperm whale catches occurred near West Greenland, the Azores, Madeira, Spain, Spanish Morocco, Norway (coastal and pelagic), Faroes, and British coastal. At present, because of their general offshore distribution, sperm whales are less likely to be impacted by humans and those impacts that do occur are less likely to be recorded. There has been no complete analysis and reporting of existing data on this topic for the western North Atlantic.

During 1994-2000, eighteen sperm whale strandings have been documented along the U.S. Atlantic coast between Maine and Miami, Florida (NMFS unpublished data). One 1998 and one 2000 stranding off Florida showed signs of human interactions. The 1998 animal's head was severed, but it is unknown if it occurred pre- or post-mortem. The 2000 animal had fishing gear in the blowhole. In October 1999, a live sperm whale calf stranded on eastern Long Island, and was subsequently euthanized. Also, a dead calf was found in the surf off Florida in 2000.

During 2001 to ~~2003~~2005, ~~ten~~ fifteen sperm whale strandings were documented along the U.S. Atlantic coast and in Puerto Rico and the EEZ according the NER and SER strandings databases (Table 2). Except for the sperm whale struck by a naval vessel in the EEZ in 2001, ~~–~~there were no confirmed documented signs of human interactions on the other ~~nine~~ animals.

Table 2. Sperm Whale (*Physeter macrocephalus*) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTAL
Massachusetts	1	1	-	-	-	2
North Carolina	-	-	2	1	-	3
South Carolina	-	1	-	-	-	1
Florida	-	2	2	1	1	6
EEZ	1[1]	-	-	-	-	1
Puerto Rico	-	-	-	1	1	2
TOTAL	**2**	**4**	**4**	**3**	**2**	**15**

[1] U.S. Navy reported ship strike

~~Table 2. Sperm whale (*Physeter macrocephalus*) reported stranding along the U.S. Atlantic coast.~~

~~STATE~~	~~2001~~	~~2002~~	~~2003~~	~~TOTAL~~
~~Massachusetts~~	~~1~~	~~1~~	~~–~~	~~1~~

North Carolina	—	—	2	2
South Carolina	—	1	—	1
Florida	—	2	2	4
EEZ	1[1]	—	—	1
TOTAL	2	4	4	9

[1] U.S. Navy reported ship strike

In eastern Canada, 5 6 dead strandings were reported in Newfoundland/Labrador in 1987-1995 2005; 13 20 dead strandings along Nova Scotia in 1988-1996 2005; 7 9 dead strandings on Prince Edward Island in 1988-1991 2005; 2 dead strandings in Quebec in 1992; 5 dead strandings in New Brunswick in 2005; and 13 animals in 8 stranding events on Sable Island, Nova Scotia in 1970-1998 (Reeves and Whitehead 1997; Hooker *et al.* 1997; Lucas and Hooker 2000). Sex was recorded for 11 of the 13 Sable island animals, and all were male, which is consistent with sperm whale distribution patterns (Lucas and Hooker 2000).

Recent mass strandings have been reported in the North Sea, including; winter 1994/1995 (21); winter 1995/1996 (16); and winter 1997/1998 (20). Reasons for the strandings are unknown, although multiple causes (e.g., unfavorable North Sea topography, ship strikes, global changes in water temperature and prey distribution, and pollution) have been suggested (Holsbeek *et al.* 1999).

Ship strikes are another source of human- induced mortality. In May 1994 a ship-struck sperm whale was observed south of Nova Scotia (Reeves and Whitehead 1997) and in May 2000 a merchant ship reported a strike in Block Canyon (NMFS, unpublished data). In spring, Block Canyon is a major pathway for sperm whales entering southern New England continental shelf waters in pursuit of migrating squid (CETAP 1982; Scott and Sadove 1997).

A potential human-caused source of mortality is from accumulation of stable pollutants (e.g., polychlorobiphenyls (PCBs), chlorinated pesticides (DDT, DDE, dieldrin, etc.), polycyclic aromatic hydrocarbons (PAHs), and heavy metals) in long lived, high -trophic level animals. Analysis of tissue samples obtained from 21 sperm whales that mass -stranded in the North Sea in 1994/1995 indicated that mercury, PCB, DDE, and PAH levels were low and similar to levels reported for other marine mammals (Holsbeek *et al.* 1999). Cadmium levels were high and double reported levels in North Pacific sperm whales. Although the 1994/1995 strandings were not attributable to contaminant burdens, Holsbeek *et al.* (1999) suggest that the stable pollutants might affect the health or behavior of North Atlantic sperm whales.

Using stranding and entanglement data, during 1999 2000 01-2003 2005, one sperm whale was confirmed struck by a ship, thus, there is an annual average of 0.2 sperm whales per year struck by ships. In addition, during 1999-2003, one sperm whale was aNo sperm whale stranding mortalities during this period were confirmed fishery interactions, thus, there is an annual average of 0.2 sperm whales taken in U.S. fisheries.

STATUS OF STOCK

The status of this stock relative to OSP in U.S. Atlantic EEZ is unknown, but the species is listed as endangered under the ESA. There are insufficient data to determine population trends. The current stock abundance estimate was based upon a small portion of the known stock range. Total U.S. fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR, and therefore can be considered to be insignificant and approaching a zero mortality and serious injury rate. This is a strategic stock because the species is listed as endangered under the ESA. A Draft Recovery Plan for sperm whales has been prepared and is available for review (NMFS 2006) .

REFERENCES

Amano M. and M. Yoshioka. 2003. Sperm whale diving behavior monitored using a suction-cup-attached TDR tag. Mar. Ecol. Prog. Ser., 258:291-295.

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

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

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

Best, P. B., P. A. S. Canham, and N. Macleod. 1984. Patterns of reproduction in sperm whales, *Physeter macrocephlus*. Rep. int Whal. Commn. (Special Issue) 8~~)~~:51-79.

Buckland, S. T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

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

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Christal, J., H. Whitehead, and E. Lettevall. 1998. Sperm whale social units: variation and change. Can. J. Zool., 76: 1431-1440.

Dufault, S., H. Whitehead, and M. Dillon. 1999. An examination of the current knowledge on the stock structure of sperm whales (*Physeter macrocephalus)* Worldwide. J. Cetacean Res. Manage. 1(1):1-10.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*:. G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Holsbeek, L., C. R. Joiris, V. Debacker, I. B. Ali, P. Roose, J-P. Nellissen, S. Gobert, J-M. Bouquegneau, and M. Bossicart. 1999. Heavy metals, organochlorines and polycyclic aromatic hydrocarbons in sperm whales stranded in the southern North Sea during the 1994/1995 winter. Mar. Pollu. Bull. 38: 4 304-313.

Hooker, S. K., R. W. Baird, and M. A. Showell. 1997. Cetacean Strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Paper SC/49/05 presented to the IWC Scientific Committee, September 1997. 11 pp.

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

Lucas, Z. N. and S. K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. *Can. Field Nat*.:114 (45-61).

Lyrholm, T. and U. Gyllensten. 1998. Global matrilineal population structure in sperm whales as indicated by mitochondrial DNA sequences. Proc. R. Soc. Lond. B 265:1679-1684.

Lyrholm, T., O. Leimar, B. Johanneson, and U. Gyllensten. 1999. Sex-biased dispersal in sperm whales: contrasting mitochondrial and nuclear genetic structure of global populations. Proc. R. Soc. Lond. B 266: 347-354.

Mitchell, E. 1975. Progress report on whale research, Canada. *Rep. int Whal. Commn*. 25:270-272.

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

Mullin, K. D. and G. L. Fulling. 2003. Abundance of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

~~Anonymous~~NMFS [National Marine Fisheries Service]. 1990. Cruise results, NOAA Ship CHAPMAN, Cruise No. 90-05. Marine Mammal Sighting Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. ~~Anonymous.~~ 1991. Northeast cetacean aerial survey and interplatform study. NOAA-NMFS-SEFSC and NEFSC. 4 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. ~~Anonymous.~~ 1993. Cruise results, NOAA Ship DELAWARE II, Cruise No. DEL 93-06, Marine Mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. ~~Anonymous.~~ 1994. Cruise results, NOAA Ship RELENTLESS, Cruise No. RS 94-02, Marine Mammal Survey/Warm Core Ring Study. 8 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 2006. Draft recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD. (Available at http://www.nmfs.noaa.gov/pr/recovery/plans.htm)

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int Whal. Commn. (Special Issue 16):27-50.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA/NMFS/NEFSC. Ref. Doc. 96-04; 37 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Palka, D. and Hammond, P.S. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58: 777-787.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03; 41 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026. (http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf)

Reeves, R. R. and H. Whitehead. 1997. Status of sperm whale, *Physeter macrocephalus*, in Canada. Can. Field Nat. 111:293-307.

Rice, D. W. 1989. Sperm whale. *Physeter macrocephalus* Linnaeus, 1758. Pp. 177-233 *in:* Handbook of marine animals. Vol. 4. S. H. Ridgway and R Harrison (eds). Academic Press, London.

Scott, T. M. and S. S. Sadove. 1997. Sperm whale, *Physeter macrocephalus*, sightings in the shallow shelf waters off Long Island, New York. Mar. Mammal Sci. 13:317-321.

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

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

Waring, G.T., T. Hamazaki, D. Sheehan, G. Wood, and S. Baker. 2001. Characterization of beaked whale (Ziphiidae) and sperm whale (*Physeter macrocephalus*) summer habitat in shelf-edge and deeper waters off the northeast U.S. Mar. Mammal Sci. 17(4):-703-717.

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

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

Waring, G. T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. NOAA-NMFS-NEFSC, Lab. Ref. Doc. No. 98-09, 21 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

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

Watkins, W. A., M. A. Daher, K. M. Fristrup, and T. J. Howar~~l~~d, and G. Notarbatolo di Sciara. 1993. Sperm whales tagged with transponders and tracked underwater by sonar. Mar. Mammal Sci. 9:55-67.

Watwood, S.L., P.J.O. Miller, M. Johnson, P.T. Madsen, and P.L. Tyack. 2006. Deep-diving foraging behaviour of sperm whales (Physeter macrocephalus). J. Anim. Ecol. 75:814-825.

Whitehead, H. ~~2003~~2002. Sperm whales social evolution in the ocean. The University of Chicago Press, Chicago, 431 pp.

Whitehead, H., S. Brennan, and D. Grover. 1991. Distribution and behavior of male sperm whales on the Scotian Shelf, Canada. Can. J. Zool. 70:912-918.

~~December 2005~~

~~January~~May 2007

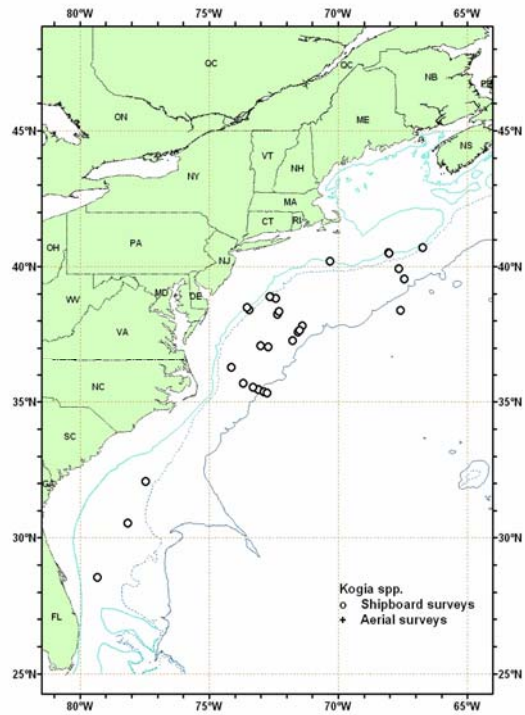
DWARF SPERM WHALE (*Kogia sima*): Western North Atlantic Stock

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). ~~There are no stranding records for the east Canadian coast (Willis and Baird 1998).~~ 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) ~~There is no information on stock differentiation for the Atlantic population.~~ 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 ~~Diagnostic morphological characters have also 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).~~

.



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 dwarf sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. Because

Figure 1. *Distribution of Kogia sp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in ~~1998 and~~ 2004. Isobaths are at 100 m, 1,000 m and*

Kogia sima and *Kogia breviceps* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia*. The best abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 animals (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because these two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 695 (CV = 0.49) *Globicephala* sp. was obtained from the sum of the estimate of 115 (CV=0.61) *Kogia* sp. from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 580 (CV=0.57) *Kogia* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).

~~An abundance of 115 (CV=0.61) for *Kogia* sp. was estimated from a line-transect survey conducted from July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N) (Fig. 1; Palka *et al.*, Unpublished Ms.) Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 580 (CV=0.57) for *Kogia* sp. was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed , 4,163 km of track line in waters south of Maryland (38°N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001; Thomas *et al.* 1998).~~

Recent surveys and abundance estimates

An abundance estimate of 358 (CV= 0.44) for *Kogia* sp. was ~~estimated~~ obtained from a ~~line~~ 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) (~~Figure~~ Table 1; Palka ~~unpublished Ms.~~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 (~~Figure 1;~~ Palka ~~u~~Unpublished ~~Ms.~~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 50x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and ~~there were~~accomplished a total of 473 cetacean sightings. Sightings were most frequent in waters ~~North~~ north of Cape Hatteras, North Carolina along the shelf break. Data were ~~analyzed to~~ corrected for visibility bias ~~(~~*g(0)*~~)~~ and group-size bias ~~employing~~ and analyzed using ~~line~~ line-transect distance analysis ~~and the direct duplicate estimator~~ (Palka 1995; Buckland *et al*~~.~~, 2001). The resulting abundance estimate for *Kogia* sp. between Florida and Maryland was 37 animals (CV=0.75).

~~The best 2004 abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because together these two surveys have the most complete coverage of the species' habitat. A separate estimate of dwarf sperm whale abundance cannot be provided due to the uncertainty of species identification at sea.~~

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~115~~	~~0.61~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~580~~	~~0.57~~
~~Jul-Sep 1998~~	~~Florida to Gulf of St. Lawrence (COMBINED)~~	~~695~~	~~0.49~~
Jun-Aug 2004	Maryland to Bay of Fundy	358	0.44
Jun-Aug 2004	Florida to Maryland	37	0.75
Jun-Aug 2004	Bay of Fundy to Florida (COMBINED)	395	0.40

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log- normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for *Kogia* sp. is 395 (CV=0.40). The minimum population estimate for *Kogia* sp. is 285 animals.

Current Population Trend

The available information is insufficient to evaluate population trends ~~in population size~~ for this species in the western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Kogia* sp. is 285. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic *Kogia* sp. is 2.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. ~~There has been no logbook report of fishery- related serious injury recorded off the east coast of Florida in the pelagic longline fishery in 2000 (Table 2) (Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~ Total annual estimated average fishery-related mortality and serious injury to the~~i~~se stocks during ~~1999-2003~~2001-2005 was zero for *Kogia* sp. ~~dwarf sperm whales~~, as there were no reports of mortality or serious injury to these species.~~dwarf sperm whales~~
~~(Yeung 2001; Garrison 2003; Garrison and Richards 2004).~~

Earlier Interactions

No *Kogia* sp. ~~dwarf sperm whale~~mortalities were observed in 1977-1991 foreign fishing activities.

Pelagic Longline

Between 1992 and 2005, 1 *Kogia* sp. was hooked, released alive and considered

seriously injured in 2000 (in the Florida East coast fishing area) (Yeung 2001).

~~Bycatch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in other fisheries.~~

~~There was one report of mortality or serious injury to a dwarf sperm whale attributable to the pelagic drift gillnet fishery. Estimated annual fishery related mortality and serious injury (CV in parentheses) was 0 dwarf sperm whales from 1991-1994, 1.0 in 1995 (CV=0), and 0 from 1996-2003.~~

Other Mortality

No dwarf sperm whales were reported to strand in Nova Scotia from 1990-2005 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). From 2001-2005, ~~33~~30 dwarf sperm whales were reported stranded along the U.S. Atlantic coast and 2 were reported stranded in Puerto Rico.~~between New Jersey Massachusetts and FloridaVirginia~~ (Table 2). ~~No dwarf sperm whales were reported to strand in Nova Scotia from 1990-2005 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). The total includes I1 animal stranded in North and South Carolina and 2 in Florida in 2001; 3 animals stranded in Florida and 2 in Puerto Rico in 2002; 4 animals stranded in North Carolina, and 2 each in South Carolina, Georgia, and Florida in 2003; 2 animals stranded in North Carolina, 1 in Georgia, and 4 in Florida in 2004; and 1 animal stranded in New Jersey, 4 in North Carolina, and 2 in Georgia in 2005.~~ In addition to the above strandings of ~~*Kogia*~~*Kogia sima*, there were ~~8~~ 11 strandings reported as *Kogia* sp. ~~as follows: 1 stranded in North Carolina in 2001; 1 stranded in North Carolina, one in Georgia and 2 in Florida in 2002; 1 stranded in Georgia and 3 in Florida in 2003; one stranded in Florida in 2004 and in 2005.~~ There were no documented strandings of dwarf sperm whales along the U.S. Atlantic coast during 2001-2005 which were classified as likely caused by fishery or human interactions.

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (K~~B~~b) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

STATE	**2001**			**2002**			**2003**			**2004**			**2005**			**TOTALS**		
	Ks	**Kb**	**Sp**	**Ks**	**Kb**	**Sp**	**Ks**	**Kb**	**Sp**	**Ks**	**Kb**	**Sp**	**Ks**	**Kb**	**Sp**	**Ks**	**Kb**	**Sp**
Massachusetts	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
New York	0	0	0	0	0	0	0	0	0	0	~~3~~0	0	0	0	0	0	~~3~~0	0
New Jersey	0	0	0	0	0	0	0	0	0	0	~~1~~0	0	1	0	0	1	~~1~~0	0
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Virginia	0	0	0	0	0	0	0	0	0	0	~~2~~0	0	0	0	0	0	~~2~~0	0
North Carolina	1	0	1	0	0	1	4	0	0	2	~~0~~5	0	4	~~0~~5	0	11	~~0~~10	2
South Carolina	1	0	0	0	0	0	2	0	0	~~0~~0	~~0~~8	0	0	~~0~~8	0	~~3~~3	~~0~~16	0
Georgia	0	0	0	0	0	1	2	0	1	~~1~~1	~~0~~10	0	2	~~0~~3	0	~~5~~5	~~0~~13	2
Florida	2	0	0	3	0	2	2	0	3	~~4~~3	~~0~~8	1	0	~~0~~3	1	~~11~~10	~~0~~11	7
Puerto Rico	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
TOTALS	4	0	1	5	0	4	10	0	4	~~7~~6	~~6~~31	1	7	~~1~~20	1	~~33~~32	~~7~~51	11

Historical stranding records (1883-1988) of dwarf sperm whales in the southeastern U.S. (Credle 1988), and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 17% of all *Kogia* strandings in the entire southeastern U.S. ~~this area~~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 8533 small cetaceans stranded from Maryland to Georgia between 3 July 2004 and 16 JanuarySeptember 20054. The species involved are generally found offshore and are not expected to strand along the coast. SeventeenFifteen pygmy sperm whales (Kogia breviceps) and one dwarf sperm whale (Kogia sima) were involved in this UME. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn et al. 2006), though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings". Two pygmy sperm whales were involved in a multispecies UME in North Caroline in January of 2005 (Hohn et al. 2006).

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

Rehabilitation challenges for *Kogia* sp. are numerous due to limited knowledge regarding even the basic biology of these species. Advances in recent rehabilitation success has potential implications for future release and tracking of animals at sea to potentially provide information on distribution, movements and habitat use of these species (Manire *et al.* 2004).

STATUS OF STOCK

The status of the *Kogia* sp. dwarf sperm whale relative to OSP in the western U.S. Atlantic EEZ is unknown. Thiseses species isare not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Total U.S. fishery-related mortality and serious injury for thiese stocks is less than 10% of the calculated PBR and therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. . Average annual fisheryhuman-related mortality and serious injury rate does not exceed the PBR, therefore *Kogia* sp. are not strategic stocks.
This is not a strategic stock.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Barros, N.B. and D.A. Duffield. 2003. Unraveling the mysteries of Pygmy and Dwarf sperm whales. Strandings Newsletter of the Southeast U.S. Marine Mammal Stranding Network. December 2003. U.S. Dep. Commer., NOAA Tech. Memo NMFS-SEFSC-521, 11 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149.

Barros, N. B., D. A. Duffield, P. H. Ostrom, D. K. Odell, and V. R. Cornish. 1998. Nearshore vs. offshore ecotype differentiation of *Kogia breviceps* and *K. simus* based on hemoglobin, morphometric and dietary analyses. World Marine Mammal Science Conference Abstracts. Monaco. 20-24 January.

Barros, N. B., D. K. Odell and G. W. Patton. 1990. Ingestion of plastic debris by stranded marine mammals from Florida. Page 746. *In:* R. S. Shomura and M.L. Godfrey (eds.) Proceedings of the Second International Conference on Marine Debris. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-154. . Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Caldwell, D. K. and M. C. Caldwell. 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville 1838): dwarf sperm whale *Kogia simus* Owen, 1866. pp. 235-260 *In:* S. H. Ridgway and R. Harrison (eds.)~~,~~ Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego. 442 pp.

Credle, V. R. 1988. Magnetite and magnetoreception in dwarf and pygmy sperm whales, *Kogia simus* and *Kogia breviceps*. MSc. Thesis. University of Miami. Coral Gables, FL.

Duffield, D.A., N.B. Barros, E.O. Espinoza, S. Ploen, F.M.D. Gulland, and J.E. Heyning. 2003. Identifying Pygmy and Dwarf Sperm Whales (Genus *Kogia*) using electrospray ionization mass spectrometry of myoglobin and hemoglobin. Mar. Mammal Sci.19(2):395-399.

~~Fairfield Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149~~

~~Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, FL.~~Handley, C.O. 1966. A synopsis of the genus *Kogia* (pygmy sperm whales) *in* Norris, K.S. (ed) Whales , dolphins, and porpoises. U. of CA Press, xv + 789 pp.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. pp. 179-189. *In*: G.W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald, and D. G. Robertson (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam. 287 pp.

Hohn, A.A., D.S. Rotstein, C.A. Harms, and B.L. Southall. 2006. Report on marine mammal unusual mortality event UMESE0501Sp: Multispecies mass stranding of pilot whales (*Globicephala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and dwarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-537, 222pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Manire, C.A., H.L. Rhinehart, N.B. Barros, L. Byrd, and P. Cunningham-Smith. 2004. An approach to the rehabilitation of *Kogia* sp. Aquatic Mamm. 30(2):257-270.

McAlpine, D.F. 2002. Pygmy and Dwarf Sperm whales. pp. 1007-1009. *In*: W. F. Perrin, B. Wursig, and J.G.M. Thewissen (eds.) Encyclopedia of Marine Mammals. Academic Press, San Diego, CA.

Mullin, K. D. and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjørge and G.P.Donovan (eds.) Biology of the *Phocoenids*~~.~~. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 16 I-x + 552 pp.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line-transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58: 777-787.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard, and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. ~~Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.~~

Wursig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. Texas A&M University Press, College Station, TX, 256 pp.

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. U.S. Dep. Commer., NOAA-TM-SEFSC-467, 42 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

~~January~~May 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale (*Kogia breviceps*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2002). Sightings of these animals in the western North Atlantic occur in oceanic waters (Mullin and Fulling 2003; SEFSC unpublished data), although there are no stranding records for the east Canadian coast (Willis and Baird 1998). Pygmy sperm whales and dwarf sperm whales (*K. sima*) are difficult to differentiate at sea (Caldwell and Caldwell 1989, Wursig *et al.* 2000), and sightings of either species are often categorized as *Kogia* sp. Diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Barros and Duffield 2003; Handley 1966), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species when such measurements are obtainable (Barros and Duffield 2003). Duffield *et al.* (2003) propose using the molecular weights of myoglobin and hemoglobin, as determined by blood or muscle tissues of stranded animals, as a quick and robust way to provide species confirmation.

Using hematological as well as stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. This may result in differential exposure to marine debris, collision with vessels and other anthropogenic activities between the two *Kogia* species.

The western North Atlantic *Kogia* sp. population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Total numbers of pygmy sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. Because *Kogia breviceps* and *Kogia sima* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia*. The best abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 animals (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because these two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 695 (CV = 0.49) *Globicephala* sp. was obtained from the sum of the estimate of 115 (CV=0.61) *Kogia* sp. from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that

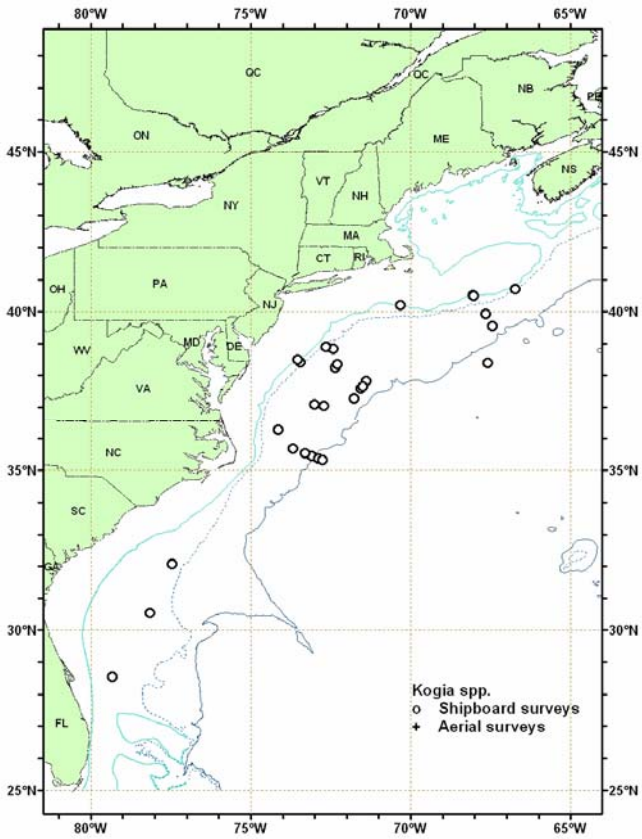


Figure 1. *Distribution of Kogia sp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in ~~1998 and~~ 2004. Isobaths are at 100 m, 1,000 m and 4,000 m.*

surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 580 (CV=0.57) *Kogia* sp., obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).

~~An abundance of 115 (CV=0.61) for *Kogia* sp. was estimated from a line-transect survey conducted from July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N) (Fig. 1; Palka *et al.* in review Unpublished. Ms). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 580 (CV=0.57) for *Kogia* sp. was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001; Thomas *et al.* 1998).~~

Recent surveys and abundance estimates

An abundance estimate of 358 (CV= 0.44) ~~for~~ *Kogia* sp. was ~~estimated~~ 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~~ Table 1; Palka ~~Unpublished Ms.~~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 (~~Figure 1;~~ Palka ~~Unpublished Ms.~~2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ≥ 50 m) between 27.5 ~~to~~and ~~–~~ 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and ~~there were~~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 ~~analyzed to~~ corrected for visibility bias ~~(~~*g(0)*~~)~~ and group-size bias ~~employing~~ and analyzed using line-transect distance analysis ~~and the direct duplicate estimator~~ (Palka 1995; Buckland *et al.*~~.~~, 2001). The resulting abundance estimate for *Kogia* sp. between Florida and Maryland was 37 animals (CV=0.75).

~~The best 2004 abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because together these two surveys have the most complete coverage of the species' habitat. A separate estimate of pygmy sperm whale abundance cannot be provided due to the uncertainty of species identification at sea.~~

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~115~~	~~0.61~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~580~~	~~0.57~~
~~Jul-Sep 1998~~	~~Florida to Gulf of St. Lawrence (COMBINED)~~	~~695~~	~~0.49~~
Jun-Aug 2004	Maryland to Bay of Fundy	358	0.44
Jun-Aug 2004	Florida to Maryland	37	0.75
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	395	0.40

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for *Kogia* sp. is 395 animals (CV=0.40). The minimum population estimate for *Kogia* sp. is 285 animals.

Current Population Trend

The available information is insufficient to evaluate population trends ~~in population size~~ for this species in the western North Atlantic.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Kogia* ~~is~~sp. is 285. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic *Kogia* sp. is 2.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. ~~There has been no logbook report of fishery-related serious injury recorded off the east coast of Florida in the pelagic longline fishery in 2000 (Table 2) (Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~ Total annual estimated average fishery-related mortality and serious injury to the~~is~~se stocks during ~~1999-2003~~ 2001-2005 was zero for *Kogia* sp., as there were no reports of mortality or serious to these species. ~~zero for dwarf sperm whales, as there were no reports of mortality or serious injury to dwarf sperm whales (Yeung 2001; Garrison 2003; Garrison and Richards 2004~~

Earlier Interactions

No *Kogia* sp. mortalities were ~~No sperm whale mortalities were~~ observed in 1977-1991 foreign fishing activities.

~~Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 0 sperm whales from 1991 .~~

Pelagic Longline

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

Other Mortality

No pygmy sperm whales were reported to strand in Nova Scotia from 1990-2005 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). From 2001-2005, ~~7~~51 pygmy sperm whales were reported stranded along the U.S. Atlantic coast (Table 2). ~~between Massachusetts and Virginia (Table 2). The total includes 3 animals stranded in New York in 2004, 1 animal stranded in New Jersey in 2004, 2 animals stranded in Virginia in 2004, and one animal stranded in Massachusetts in 2005. In addition to the above strandings of *Kogia breviceps*, there were 11 strandings reported as *Kogia* sp. as follows: 1 stranded in North Carolina in 2001; 1 stranded in North Carolina, one in Georgia and 2 in Florida in 2002; 1 stranded in Georgia and 3 in Florida in 2003; one stranded in Florida in 2004 and in 2005.~~

Table 2. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (~~KB~~Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

STATE	2001			2002			2003			2004			2005			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Massachusetts	0	0	0	0	0	0	0	0	0	0~~0~~	0~~0~~	0~~0~~	0~~0~~	1~~1~~	0~~0~~	0~~0~~	1~~1~~	0~~0~~
New York	0	0	0	0	0	0	0	0	0	0~~0~~	0~~3~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~3~~	0~~0~~

New Jersey	0	0	0	0	0	0	0	0	0	0~~0~~	0~~1~~	0~~0~~	1~~1~~	0~~0~~	0~~0~~	1~~1~~	0~~1~~	0~~0~~
Delaware	0	0	0	0	0	0	0	0	0	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Maryland	0	0	0	0	0	0	0	0	0	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Virginia	0	0	0	0	0	0	0	0	0	0~~0~~	0~~2~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~2~~	0~~0~~
North Carolina	1	0	1	0	0	1	4	0	0	2~~2~~	5~~0~~	0~~0~~	4~~4~~	5~~0~~	0~~0~~	11~~11~~	10~~0~~	2~~2~~
South Carolina	1	0	0	0	0	0	2	0	0	0~~0~~	8~~0~~	0~~0~~	0~~0~~	8~~0~~	0~~0~~	3~~3~~	16~~0~~	0~~0~~
Georgia	0	0	0	0	0	1	2	0	1	1~~1~~	10~~0~~	0~~0~~	2~~2~~	3~~0~~	0~~0~~	5~~5~~	13~~0~~	2~~2~~
Florida	2	0	0	3	0	2	2	0	3	3~~4~~	8~~0~~	1~~1~~	0~~0~~	3~~0~~	1~~1~~	10~~11~~	11~~0~~	7~~7~~
Puerto Rico	0	0	0	2	0	0	0	0	0	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	2~~2~~	0~~0~~	0~~0~~
TOTALS	4	0	1	5	0	4	10	0	4	6~~7~~	31~~6~~	1~~1~~	7~~7~~	20~~1~~	1~~1~~	32~~33~~	51~~7~~	11~~11~~

A Mid-Atlantic Offshore Small Cetacean UME, was declared when ~~85~~33 small cetaceans stranded from Maryland to Georgia between ~~3~~ July 2004 and ~~16 January~~September 200~~5~~4. The species involved are generally found offshore and are not expected to strand along the coast. ~~Seventeen~~Fifteen pygmy sperm whales (Kogia breviceps) and one dwarf sperm whale (Kogia sima) were involved in this UME. ~~Gross necropsies were conducted and samples were collected for pathological analyses (Hohn et al. 2006), though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings".~~

There were ~~3~~ 4 documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 1999- 2005 which were classified as ~~likely caused by~~involving fishery or human interactions - 1 in Florida in 1999, 1 in Puerto Rico in 2000, ~~and~~ 1 in North Carolina in 2001, and 1 in Massachusetts in 2005. In one of the strandings in 2002 of a pygmy sperm whale, red plastic debris was found in the stomach along with squid beaks.

~~this area.~~ Historical stranding records (1883-1988) of pygmy sperm whales in the southeastern U.S. (Credle 1988) and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 83% of all *Kogia* sp. strandings in this area. During the period 1990-October 1998, 21 pygmy sperm whale strandings occurred in the northeastern U.S. (Delaware, New Jersey, New York and Virginia), whereas 194 strandings were documented along the U.S. Atlantic coast between North Carolina and the Florida Keys in the same period. Remains of plastic bags and other marine debris have been retrieved from the stomachs of 13 stranded pygmy sperm whales in the southeastern U.S. (Barros *et al.* 1990, 1998), and at least on one occasion the ingestion of plastic debris is believed to have been the cause of death. During the period 1987-1994, 1 animal had possible propeller cuts on its flukes.

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

Rehabilitation challenges for *Kogia* sp. are numerous due to limited knowledge regarding even the basic biology of these species. Advances in recent rehabilitation success has potential implications for future release and tracking of animals at sea to potentially provide information on distribution, movements and habitat use of these species (Manire *et al.* 2004).

STATUS OF STOCK

The status of ~~the~~ *Kogia* sp. ~~sperm whale~~relative to OSP in the western U.S. Atlantic EEZ is unknown. The~~i~~se species ~~is~~are not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Total U.S. fishery-related mortality and serious injury for the~~i~~se stocks is less than 10% of the calculated PBR and therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual human~~fishery~~-related mortality and serious injury rate does not exceed the PBR, therefore *Kogia* sp. are~~This is~~ not ~~a~~ strategic stocks.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Barros, N.B. and D.A. Duffield. 2003. Unraveling the mysteries of Pygmy and Dwarf sperm whales. Strandings Newsletter of the Southeast U.S. Marine Mammal Stranding Network. December 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-521, 11 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149.

Barros, N. B., D. A. Duffield, P. H. Ostrom, D. K-. Odell, and V. R. Cornish. 1998. Nearshore vs. offshore ecotype differentiation of *Kogia breviceps* and *K. simus* based on hemoglobin, morphometric and dietary analyses. World Marine Mammal Science Conference Abstracts. Monaco. 20-24 January.

Barros, N. B., D. K. Odell, and G. W. Patton. 1990. Ingestion of plastic debris by stranded marine mammals from Florida. Page 746. *In:* R. S. Shomura and M.L. Godfrey (eds.). Proceedings of the Second International Conference on Marine Debris. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFSC-154. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Caldwell, D. K. and M. C. Caldwell. 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville 1838): dwarf sperm whale *Kogia simus* Owen, 1866. pp. 235-260 *In:* S. H. Ridgway and R. Harrison (eds.). Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego. 442 pp.

Credle, V. R. 1988. Magnetite and magnetoreception in dwarf and pygmy sperm whales, *Kogia simus* and *Kogia breviceps*. MSc. Thesis. University of Miami. Coral Gables, FL.

Duffield, D.A., N.B. Barros, E.O. Espinoza, S. Ploen, F.M.D. Gulland, and J.E. Heyning. 2003. Identifying Pygmy and Dwarf Sperm Whales (Genus *Kogia*) using electrospray ionization mass spectrometry of myoglobin and hemoglobin. Mar. Mamm. Sci.19(2):395-399.

~~Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149~~

~~Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, FL.~~Handley, C.O. 1966. A synopsis of the genus *Kogia* (pygmy sperm whales) *in* Norris, K.S. (ed) Whales , dolphins, and porpoises. U. of CA Press, xv + 789 pp.

Hohn, A.A., D.S. Rotstein, C.A. Harms, and B.L. Southall. 2006. Report on marine mammal unusual mortality event UMESE0501Sp: Multispecies mass stranding of pilot whales (*Globicephala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and dwarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-537, 222pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. pp. 179-189. *In*: G.W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald, and D. G. Robertson (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam. 287 pp.

Manire, C.A., H.L. Rhinehart, N.B. Barros, L. Byrd, and P. Cunningham-Smith. 2004. An approach to the rehabilitation of *Kogia* sp. Aquatic Mamm. 30(2):257-270.

McAlpine, D.F. 2002. Pygmy and Dwarf Sperm whales. pp. 1007-1009. *In*: W. F. Perrin, B. Wursig, and J.G.M. Thewissen (eds.) Encyclopedia of Marine Mammals. Academic Press, San Diego, CA.

Mullin, K. D. and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjørge and G.P.Donovan (eds.) Biology of the *Phocoenids*.. Rep. Int. Whal. Commn., Special Issue 16: I-x + 552 pp.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line-transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58: 777-787.

~~Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.~~

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.

Wursig, B., T.A. Jefferson, and D.J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. Texas A&M University Press, College Station, TX, 256 pp.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-SEFSC-467, 42 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

~~December 2005~~~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy killer whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994). Pygmy killer whales are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The paucity of sightings is probably due to a naturally low number of groups compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico occur in oceanic waters (Mullin *et al.* 1994; Mullin and Fulling~~,~~ 2004). Sightings of pygmy killer whales were documented in all seasons during aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The western North Atlantic ~~–~~population is provisionally being considered one stock for management purposes. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of 6 pygmy killer whales was sighted during a 1992 vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina, in waters >1500 m deep (Hansen *et al.* 1994), but this species was not sighted during subsequent surveys (~~Anon.~~NMFS 1999; ~~Anon.~~NMFS 2002; Mullin and Fulling 2003). Abundance was not estimated for pygmy killer whales from the 1992 vessel survey ~~–~~because the sighting was not made during line-transect sampling effort; therefore, the population size of pygmy killer whales is unknown.

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal level (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic stock of pygmy killer whales is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during ~~1999-2003~~2001-2005 was zero pygmy killer whales, as there were no reports of mortality or serious injury to pygmy killer whales (Yeung 2001; Garrison 2003; Garrison and Richards~~,~~ 2004; Fairfield-Walsh and Garrison 2006).

There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and Caldwell 1971).

Other Mortality

From ~~1999-2003~~2001-2005, ~~2~~ 3 pygmy killer whales were reported stranded between Maine and Puerto Rico

(Table 1). The total includes 1 animal stranded in South Carolina, ~~and~~ 1 in Georgia in 2003, and 1 animal stranded in Georgia in 2004, though there were no indications of human interactions for these stranded animals.

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

Table 1. Pygmy killer whale (Feresa attenuatta) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
South Carolina	0	0	1	0	0	1
Georgia	0	0	1	1	0	2
TOTALS	0	0	2	1	0	3

STATUS OF STOCK

The status of pygmy killer whales, relative to OSP, in the U.S. western North Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

REFERENCES

Barlow, J., S.-L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from: NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

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

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. NOAA Tech. Memo. NMFS-SEFSC-539, 56 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Hansen, L. J., K. D. Mullin, and C. L. Roden. 1994. Preliminary estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys, and of selected cetacean species in the U.S. Atlantic Exclusive Economic Zone from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-93/94-58. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson, and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. Pages 55-132. *In:* R. W. Davis and G. S. Fargion (editors), Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Jefferson, T. A., S. Leatherwood, and M. A. Weber. 1994. Marine mammals of the world. FAO, Rome, 320 pp.

Mullin, K. D. and G. L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull. 101:603-613.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. Mar. Mamm. Sci. 20(4):787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (editors), Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

National Marine Fisheries Service.~~MFS [National Marine Fisheries Service].~~ 1999. Cruise results. Summer Atlantic Ocean marine mammal survey. NOAA Ship *Oregon II* cruise 236 (99- 05), 4 August - 30 September 1999. Available from: SEFSC, 3209 Frederic Street, Pascagoula, MS, 39567.

National Marine Fisheries Service~~MFS [National Marine Fisheries Service]. .~~ 2002. Cruise results. Mid-Atlantic cetacean survey. NOAA Ship *Gordon Gunter* cruise GU-02-01, 6 February - 8 April 2002. Available from: SEFSC, 3209 Frederic Street, Pascagoula, MS 39567.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. ~~Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.~~

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

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

There are two main centers of bottlenose whale distribution in the western north Atlantic, one in the area called "The Gully" just north of Sable Island, Nova Scotia, and the other in Davis Strait off northern Labrador (Reeves *et al*. 1993). Studies at the entrance to the Gully from 1988-1995 identified 237 individuals and estimated the local population size at about 230 animals (95% C.I. 160-360) (Whitehead *et al*. 1997). Wimmer and Whitehead (2004) identified individuals moving between several Scotian Shelf canyons more than 100 km from the Gully. Whitehead and Wimmer (2005) estimated a population of 163 animals (95% confidence interval 119-214), with no statistical significant population trend. These individuals are believed to be year-round residents and all age and sex classes are present (Gowans and Whitehead 1998; Gowans *et al*. 2000; Hooker *et al.* 2002). Mitchell and Kozicki (1975) documented stranding records in the Bay of Fundy and as far south as Rhode Island. Lucas and Hooker (2000) documented three stranded individuals on Sable Island, Nova Scotia, Canada.

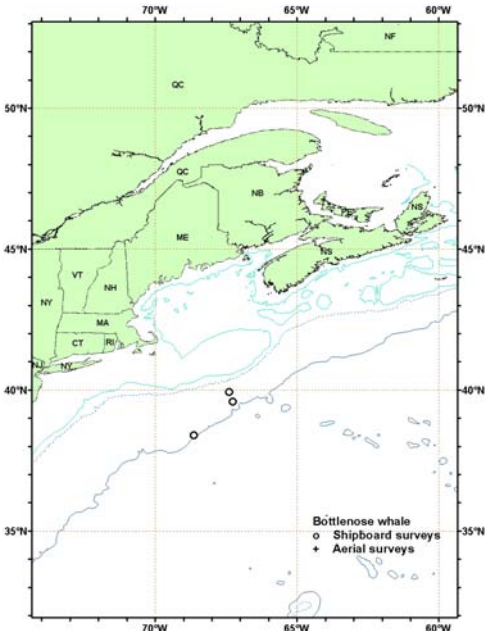


Figure 1: *NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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

POPULATION SIZE

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

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic northern bottlenose whale is unknown because the minimum population size cannot be determined.

ANNUAL HUMAN-CAUSED MORTALITY

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

Fishery Information

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

~~There have been no observed mortalities or serious injuries by NMFS Sea Samplers in the pelagic drift gillnet, pelagic longline, pelagic pair trawl, New England multispecies sink gillnet, Mid-Atlantic coastal sink gillnet, and North Atlantic bottom trawl fisheries.~~The only documented fishery interaction with northern bottlenose whales occurred in 2001 in the U.S. NED experimental pelagic longline fishery in Canadian waters. The animal was released alive, but considered a serious injury.

STATUS OF STOCK

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

REFERENCES

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Dalebout, M.L., Hooker, S.K. and I. Christensen. 2001. Genetic diversity and population structure among northern bottlenose whales, *Hyperoodon ampullatus*, in the western North Atlantic Ocean. Canadian Journal of Zoology. 79(3):478-484.

Dalebout, M.L., D.E. Ruzzante, H. Whitehead and N. Oien. 2006. Nuclear and mitochondrial markers reveal distinctiveness of a small population of bottlenose whales, *Hyperoodon ampullatus*, in the western North Atlantic. Molecular Ecology. 15: 3115-3129.

Gowans, S. and H. Whitehead. 1998. Social organization of northern bottlenose whales. The World Marine Mammal Science Conference, Monaco, January 1998 (Abstract).

Gowans, S., H. Whitehead, J. K. Arch, and S. K. Hooker. 2000. Population size and residency patterns of northern bottlenose whales (*Hyperoodon ampullatus*) using the Gully, Nova Scotia. J. Cetacean Res. Manage. 2(3):201-210.

Hooker, S.K., R.W. Baird~~, R.W~~, S. Al-Omari~~.~~, S. Gowans, ~~,~~and H. Whitehead. 2001. Behavioral reactions of northern bottlenose whales (*Hyperoodon ampullatus*) to biopsy darting and tag attachment procedures. Fishery Bulletin Vol. 99, no. 2, pp. 303-308.

Hooker, S.K., S.J. Iverson, P. Ostrom, and S.C. Smith. 2001. Diet of northern bottlenose whales inferred from fatty-acid and stable-isotope analyses of biopsy samples. Canadian Journal of Zoology. 79(8):1442-1454.

Hooker, S. K., H. Whitehead, S. Gowans and R. W. Baird. 2002. Fluctuations in distribution and patterns of individual range use of northern bottlenose whales. Mar. Ecol. Prog. Ser. 225:287-297.

~~Gowans, S. and H. Whitehead. 1998. Social organization of northern bottlenose whales. The World Marine Mammal Science Conference, Monaco, January 1998 (Abstract).~~

Lucas, Z. N. and S. K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Fld. Nat. 114(1):45-61.

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

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

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

NMFS [National Marine Fisheries Service] 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine Mammal Survey. NOAA NMFS NEFSC, Woods Hole Laboratory, Woods Hole, MA 5 pp.

NMFS [National Marine Fisheries Service] 1996. Cruise results, R/V ABEL-J, Cruise No. AJ-9601, Part III, Marine Mammal Survey. NOAA NMFS NEFSC, Woods Hole Laboratory, Woods Hole, MA 7 pp.

Reeves, R.R., E. Mitchell and H. Whitehead. 1993. Status of the northern bottlenose whale, *Hyperoodon ampullatus*. Can. Fld. Nat. 107:490-508.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Whitehead, H.~~,~~ S., Gowans, A. Faucher, and S.W. McCarrey. 1997. Population analysis of northern bottlenose whales in the Gully, Nova Scotia. Mar. Mamm. Sci. 13(2): 173-185.

Whitehead, H. and T. Wimmer. 2005. Heterogeneity and the mark-recapture assessment of the Scotian Shelf population of northern bottlenose whales (*Hyperoodon ampullatus*). Canadian Journal of Fisheries and Aquatic Sciences. 62(11): 2573-2585.

Wimmer, T. and H. Whitehead. 2004. Movements and distribution of northern bottlenose whales, *Hyperoodon ampullatus*, on the Scotian Slope and in adjacent waters. Canadian Journal of Zoology. 82(11): 1782-1794.

~~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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.~~

~~December 2005~~ April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The distribution of Cuvier's beaked whales is poorly known, and is based mainly on stranding records (Leatherwood *et al.* 1976). Strandings have been reported from Nova Scotia along the eastern U.S. coast south to Florida, around the Gulf of Mexico, and within the Caribbean (Leatherwood *et al.* 1976; CETAP 1982; Heyning 1989; Houston 1990; Mignucci-Giannoni *et al.* 1999; MacLeod *et al.* 2006). Stock structure in the North Atlantic is unknown.

Cuvier's beaked whale sightings have occurred principally along the continental shelf edge in the Mid-Atlantic region off the northeast U.S. coast (CETAP 1982; Waring *et al.* 1992; Waring *et al.* 2001; Hamazaki 2002; Palka 2006~~*et al.* Unpubl. Ms.~~). Most sightings were in late spring or summer.

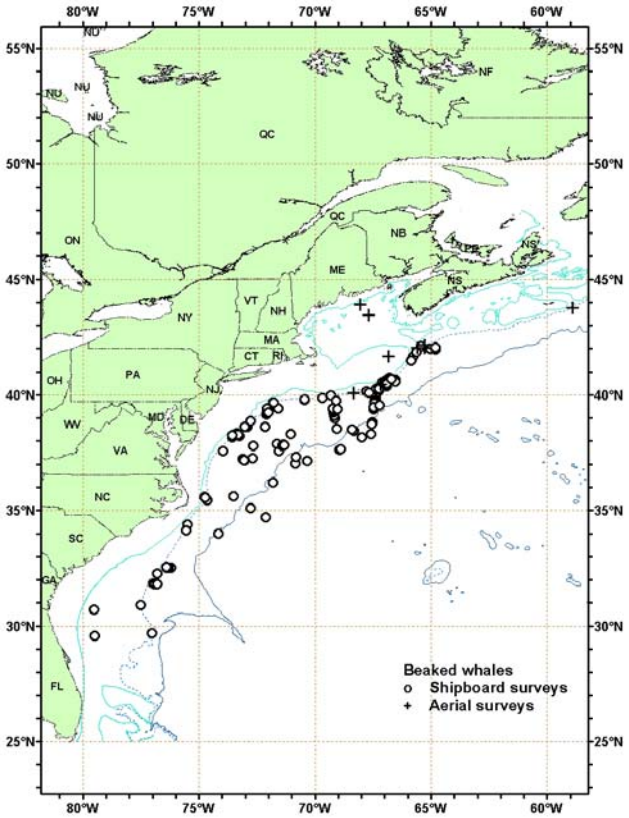


Figure 1. *Distribution of beaked whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer 1998, 1999, 2002, 2004 and 2006. Isobaths are 100 m. 1.000 m. and 4.000 m.*

POPULATION SIZE

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

However, several estimates of the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions are available~~of the habitat do exist~~ for select time periods (Barlow *et al.* 2006). Sightings ~~were~~ are almost exclusively in the continental shelf edge and continental slope areas (Figure 1). ~~—~~The best abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV =0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV =0.578), and from the southern U.S. Atlantic is 674 (CV =0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance of 120 undifferentiated beaked whales (CV=0.71) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 442 (CV=0.51) undifferentiated beaked whales was ~~estimated~~ obtained from an ~~—~~August 1990 shipboard ~~line~~ line-transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (NMFS 1990; Waring *et al.* 1992). An abundance estimate of 262 (CV=0.99) undifferentiated beaked whales was ~~estimated~~ obtained from a June and July 1991 shipboard ~~line~~ line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). ~~An a~~Abundance estimates of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales w~~as~~ere ~~estimated~~ obtained from ~~line~~ line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11~~, respectively~~aircraft (NMFS 1991). An abundance of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (NMFS 1994). An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey

conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 2006). An abundance estimate of 3,141 (CV=0.34) undifferentiated beaked whales was obtained from the sum of the estimate of 2,600 undifferentiated beaked whales (CV=0.40) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 541 (CV = 0.55) undifferentiated beaked whales, obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, ~~therefore~~ 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 822 (CV=0.81) undifferentiated beaked whales was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

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

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

~~An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka *et al.* Unpubl. Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 and 1,000 fathom isobaths, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid Atlantic from the coastline to the 50 f isobath, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1,000 f isobath. Data collection and analysis methods used were described in Palka (1996).~~

~~An abundance of 2,600 (CV=0.40) undifferentiated beaked whales was estimated from a line transect sighting survey conducted during 6 July 6 to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Figure 1; Palka *et al.* Unpubl. Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 541 (CV=0.55) undifferentiated beaked whales was estimated from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Figure 1; Mullin and Fulling 2003). This estimate is a recalculation of the same data reported in previous SARs. For more details, see Mullin and Fulling (2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993) where school size bias and ship attraction were accounted for.~~

~~The best 1998 abundance estimate for undifferentiated beaked whales is the sum of the estimates from the two U.S. Atlantic surveys, 3,141 (CV=0.34), where the estimate from the northern U.S. Atlantic is 2,600 (CV=0.40) and from the southern U.S. Atlantic is 541 (CV=0.55). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

An abundance of 2,211 (CV=0.58) for beaked whales was estimated from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38^0N) to the Bay of Fundy (45^0N) (~~Figure~~ Table 1; Palka ~~unpubl.~~2006). Shipboard data were collected using the two independent team ~~line~~ 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 ~~unpubl.~~2005).

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5 and 38ºN latitude) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye ~~binocluars~~binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and ~~there were~~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 ~~analyzed to~~ corrected for visibility bias *g(0)* and group-size bias ~~employing~~ and analyzed using ~~line~~ line-transect distance analysis ~~and the direct duplicate estimator~~ (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.)

~~An estimate of abundance for an August 2002 survey was 822 (CV=0.81) and 922 (CV=1.47 for August 2006. The summer of 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from the three aerial surveys, while the density estimates were year-specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~

~~The best 2004 abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513(CV =0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV =0.78), and from the southern U.S. Atlantic is 674 (CV =0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

Although the 1990-2006~~2004~~ surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-2004 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features.

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

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~2,600~~	~~0.40~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~541~~	~~0.55~~
~~Jul-Sep 1998~~	~~Florida to Gulf of St. Lawrence (COMBINED)~~	~~3,141~~	~~0.34~~
Aug 2002	S. Gulf of Maine to Maine	822	0.81
Jun-Aug 2004	Maryland to the Bay of Fundy	2,839	0.78
Jun-Aug 2004	Florida to Maryland	674	0.36

Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	3,513	0.63
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for undifferentiated beaked whales is 3,513 (CV =0.63). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,154. It is not possible to determine the minimum population estimate of only Cuvier's beaked whales.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3 m, length at sexual maturity is 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 (Mitchell 1975; Mead 1984; Houston 1990).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the undifferentiated complex of beaked whales is 2,154. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.~~5~~ 4 because the CV for the fishery mortality estimate exceeds 0.8~~this stock is of unknown status~~. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is ~~22~~17. It is not possible to determine the PBR for only Cuvier's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The ~~1999~~2001-~~2003~~ 2005 total average estimated annual mortality of beaked whales in fisheries in the U.S. Atlantic EEZ was 1.0 and is derived from ~~three~~ five components: 1) average annual fishery bycatch of one animal (Table 2~~1~~), ~~1~~2) ~~two~~ one stranded animal~~s were~~ entangled in fishing gear, ~~2~~3) two animals were ship struck, ~~and 3~~4) one stranded animal died from acoustic or blunt trauma, and 5) one animal with ingested debris - see other mortality text and ~~(~~Table 2~~)~~.

Fishery Information

~~Detailed fishery information is reported in Appendix III.~~

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

Total annual estimated average fishery related mortality or serious injury of this stock in 2001-2005 in the U.S. fisheries listed below was 1 beaked whale (CV=1.0). Detailed fishery information is reported in Appendix III.

Earlier Interactions

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

available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24) and 12 in 1993 (0.16). The 1994-1998 estimates by 'species' are:

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

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

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions were reported prior to 2003 or in 2004 or 2005. The estimated average combined mortality in 2001-2005 was 1 beaked whale (CV=1.0)(Table 2~~1~~).

Table 2~~1~~. Summary of the incidental mortality of Beaked Whales (*Ziphius cavirostris* and *Mesoplodon* sp.) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers , the estimated annual mortality and serious injury–, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[c]	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) [b,d]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 5.3[e], 0, 0	0, 0, 0, 0, 0	0, 0, 5.3, 0, 0	0, 0, 1.0, 0, 0	1(1.0)
TOTAL											1 (1.0)

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

[b] 2003 SI estimates were taken from Table 10 in Garrison and Richards (2004).

[c] Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

Other Mortality

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

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

previously been observed on beaked whales (Lucas and Hooker 2000).

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

During 2001-~~2003~~2005, ~~twenty~~thirty-four beaked whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 2).

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.

State	**2001**	**2002**	**2003**	**2004**	**2005**	**Total**
Maine	_	*M. mirus* (1)	*M. bidens* (1)[c]	_	_	2
Massachusetts	_	_	_	_	_	0
New Jersey	_	_	_	_	*Ziphius* (1)	1
Virginia	0	*M. Europaeus* (2)[b]	*M. mirus* (1)[d]	_	_	3
North Carolina	*M. europaeus* (1) Mesoplodon sp. (3)	Unid. (1)	*M. europeaus* (2); *Mesoplodon* sp. (1)	_ *M. densirostris (1)*	*M. europeaus* (2); *M. densirostris (1)*	_ 12
South Carolina	*M. europaeus* (2)	*Ziphius* (1)	*Ziphius* (2)	_	*M. densirostris (1)*	6
Georgia				*M. bidens* (1)	*Ziphius* (1)[f]	2
Florida	*M. europaeus* (4)[a]	--	*Ziphius* (1); *M. europaeus* (1)	_ *M. europeaus* (1);	_ *Mesoplodon sp. (1)*	7
Puerto Rico				*M. densirostris (1)*		1
Total	10	5	9	4	7	34[e]

[a] Acoustic or blunt trauma was the assigned cause of mortality for one animal stranded in Broward County in Sept.

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

[c] Boat strike was the likely cause of death

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

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

[f] Plastic debris found in the stomach.

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) reported strandings along the U.S. Atlantic coast.				
STATE	**2001**	**2002**	**2003**	**TOTAL**
Maine		*M. mirus* (1)	*M. bidens* (1)[c]	2
Massachusetts	—	—	—	—
Virginia	—	*M. europaeus* (2)[b]	*M. mirus* (1)[d]	3
North Carolina	*M. europaeus* (1) *Mesoplodon* spp. (3)	Unid. (1)	*M. europaeus* (2) *Mesoplodon* spp. (1)	8
South Carolina	*M. europaeus* (2)	*Ziphius* (1)	*Ziphius* (2)	5
Florida	*M. europaeus* (4)[a]	—	*Ziphius* (1) *M. europaeus* (1)	6
Total	10	5	9	24[e]

[a] Acoustic or blunt trauma was the assigned cause of mortality for one animal stranded in Broward County in Sept.
[b] Ship strike was the likely cause of death for one animal
[c] Boat strike was the likely cause of death
[d] Entanglement in fishing gear was the likely cause of death
[e] The cause of death for most of the stranded animals could not be determined.

STATUS OF STOCK

The status of Cuvier's beaked whale relative to OSP in the U.S. Atlantic EEZ is unknown. This species is not listed as threatened or endangered under the Endangered Species Act. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total U.S. fishery mortality and serious injury for this group is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities.

REFERENCES

Anon. 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001).NOAA unpublished report. 55pp.[Available at http://www.nmfs.noaa.gov/pro_tres/overview/Interim_Bahamas_Report.pdf].

Balcomb, K. C. III, and D. E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2:2-12.

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Barlow, J., M.C. Fergunson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). J. Cetacean Res. Manage. 7:263-270.

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

Buckland, S. T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-

CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Cox, T.M., T. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernadez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. ~~2004. Report of a workshop to understand the impacts of anthropogenic sound on beaked whales. 33 pp. In press.~~ J. Cetacean Res. Manage. 7:177-187.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392:29.

~~Evans, D.L. and G. R. England. 2001. Joint interim report - Bahamas Marine Mammal Stranding - event of 15-16 March 2000. U.S. Department of Commerce; Secretary of the Navy, vi + 59 pp. Available at: http://www.nmfs.noaa.gov/pr/acoustics/acoustics_reports.htm.~~

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Hamazaki, Toshihide. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). Mar. Mammal Sci. 18(4):920-939.

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

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *In*: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds.). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

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

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

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field- Nat. 114: 45-61.

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

Mead, J.G. 1989. Beaked whales of the genus *Mesoplodon*. Pages 349-430. *In:* S.H. Ridgeway and R. Harrison (eds.), Handbook of Marine Mammals, Vol. 4: River Dolphins and Toothed Whales. Academic Press, San Diego, CA, 442 pp.

MacLeod, C.D., W.F. Perrin, R. Pittman, J. Barlow, L. Balance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D.L. Palka, and G.T. Waring. 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7: 271-286.

Mignucci-Giannoni, A.-A., B. Pinto-Rodríguez, M. Velasco-Escudero, R.-A. Montoya-Ospina, N.-M. Jiménez, M.A. Rodríguez-López, E.-H. Williams, Jr., and D.-K. Odell. 1999. Cetacean strandings in Puerto Rico and the Virgin Islands. J. Cetacean Res. Manage. 1:191-198.

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

Mullin, K. D. and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull., *U.S.*101:603-613.

NMFS [National Marine Fisheries Service]. 1990. Cruise results, NOAA Ship CHAPMAN, Cruise No. 90-05. Marine Mammal Sighting Survey. 5pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1991. Northeast cetacean aerial survey and interplatform study. NOAA-NMFS-SEFSC and NEFSC. 4 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1994. Cruise results, NOAA Ship RELENTLESS, Cruise No. RS 94-02, Marine Mammal Survey/Warm Core Ring Study. 8pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001).NOAA unpublished report. 55pp. [Available at http://www.nmfs.noaa.gov/pro_tres/overview/Interim_Bahamas_Report.pdf].

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 16:27-50.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA/NMFS/NEFSC. Ref. Doc. 96-04; 37 pp. ~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

~~Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. NOAA NMFS NEFSC, Lab.Ref.Doc.No.06-03,52 pp. Available at: http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/.~~

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:~~-~~777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. NOAA NMFS NEFSC, Lab.Ref.Doc.No.06-03, 52 pp.

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the Northwest Atlantic. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 15:~~-~~133-147.

Simmonds, M.P. and L.F. Lopez-Jurado. 1991. Whales and the military. Nature 351:448.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

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

Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. NOAA-NMFS-NEFSC Lab. Ref. Doc. No. 98-09, 21 pp. ~~Available from: National Marine Fisheries Service, 166 Water St., Woods Hole, Massachusetts 02543-1026.~~

Waring, G.T., T. Hamazaki, D. Sheehan, G. Wood, and S. Baker. 2001. Characterization of beaked whale (Ziphiidae) and sperm whale (*Physeter macrocephalus*) summer habitat in shelf-edge and deeper waters off the northeast U.S. Mar. Mamm. Sci. 17(4):~~-~~703-717

~~December 2004~~~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Within the genus *Mesoplodon*, there are four species of beaked whales that reside in the northwest Atlantic. These include True's beaked whale, *Mesoplodon mirus*; Gervais' beaked whale, *M. europaeus*; Blainville's beaked whale, *M. densirostris*; and Sowerby's beaked whale, *M. bidens* (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.

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). Off the U.S. Atlantic coast, beaked whale (*Mesoplodon* spp.) sightings have occurred principally along the shelf-edge and deeper oceanic waters (CETAP, 1982; Waring *et al.* 1992; Tove 1995; Waring *et al.* 2001; Hamazaki 2002; Palka 2006~~*et al.* unpublished manuscript~~; Figure 1)). Most sightings were in late spring and summer, which corresponds to survey effort.

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). It is considered rare in Canadian waters (Houston 1990).

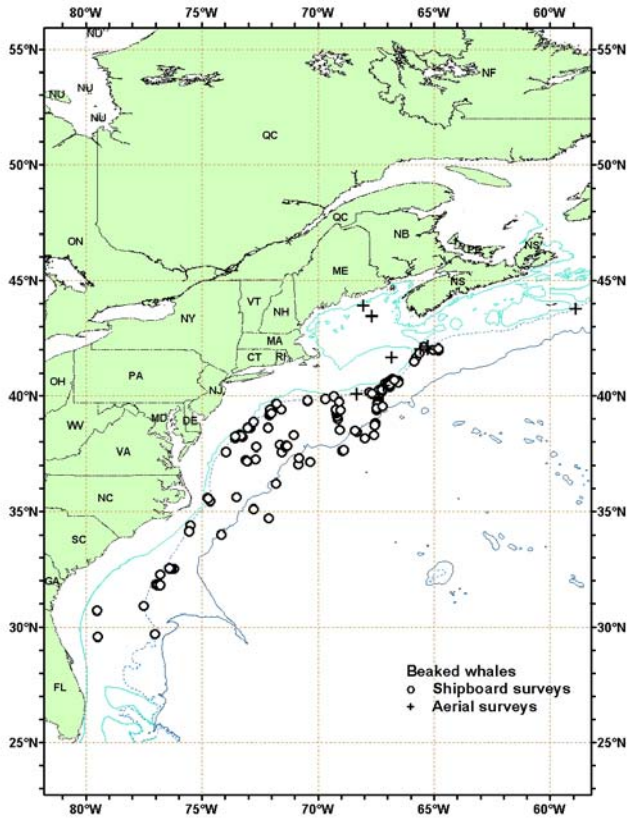


Figure 1: *NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

Gervais' beaked whales are believed to be principally oceanic, and strandings have been reported from Cape Cod Bay to Florida, into the Caribbean and the Gulf of Mexico (Leatherwood *et al.* 1976; Mead 1989; ~~;~~MacLeod *et al.* 2006; NMFS unpublished data). This is the most common species of *Mesoplodon* to strand along the U.S. Atlantic coast. The northernmost stranding was on Cape Cod.

Blainville's beaked whales have been reported from southwestern Nova Scotia to Florida, and are believed to be widely but sparsely distributed in tropical to warm-temperate waters (Leatherwood *et al.* 1976; Mead 1989, Nicolas *et al.* 1993 ;MacLeod *et al.* 2006). 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).

Sowerby's beaked whales have been reported from New England waters north to the ice pack, and individuals are seen along the Newfoundland coast in summer (Leatherwood *et al.* 1976; Mead 1989; MacLeod *et al.* 2006). Furthermore, a single stranding occurred off the Florida west coast (Mead 1989). This species is considered rare in Canadian waters (Lien *et al.* 1990).

POPULATION SIZE

The total number of *Mesoplodon* spp. beaked whales off the eastern U.S. and Canadian Atlantic coast is unknown. However, several estimates of~~-~~ the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) from selected regions ~~of the habitat do exist~~are available for select time periods (Barlow *et al.* 2006). Sightings ~~were~~ are almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV =0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV =0.578), and from the southern U.S. Atlantic is 674 (CV =0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 120 (CV=0.71) undifferentiated beaked whales was ~~estimated~~ obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 442 (CV=0.51) undifferentiated beaked whales was ~~estimated~~ obtained from an August 1990 shipboard ~~line~~ line-transect sighting survey, conducted principally along the Gulf Stream north wall between Cape Hatteras and Georges Bank (NMFS 1990; Waring *et al.* 1992). An abundance of 262 (CV=0.99) undifferentiated beaked whales was estimated from a June and July 1991 shipboard ~~line~~ line-transect sighting survey conducted primarily between the 200 and 2,000m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundance estimates of 370 (CV=0.65) and 612 (CV=0.73) undifferentiated beaked whales were ~~estimated~~ obtained from ~~line~~ line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11~~, respectively~~ aircraft (NMFS 1991). An abundance of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance of 99 (CV=0.64) undifferentiated beaked whales was estimated from an August 1994 shipboard line transect survey conducted within a Gulf Stream warm-core ring located in continental slope waters southeast of Georges Bank (NMFS 1994). An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka 2006). An abundance estimate of 3,141 (CV=0.34) undifferentiated beaked whales was obtained from the sum of the estimate of 2,600 undifferentiated beaked whales (CV=0.40) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 541 (CV = 0.55) undifferentiated beaked whales, obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, ~~therefore~~ 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 of 330 (CV=0.66) undifferentiated beaked whales was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (NMFS 1993). Data were collected by two alternating teams that searched with 25x150 binoculars and were analyzed using DISTANCE (Buckland *et al.* 1993). Estimates include school size bias, if applicable, but do not include corrections for *g(0)* or dive time. Variability was estimated using bootstrap resampling techniques.~~

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

~~An abundance of 1,519 (CV=0.69) undifferentiated beaked whales was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka *et al.* unpublished manuscript). Total track line length was 32,600km. The ships covered waters between the 50 and 1000 fathom isobaths, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom isobath, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom isobath. Data collection and analysis methods used were described in Palka (1995).~~

~~An abundance of 2,600 (CV=0.40) undifferentiated beaked whales was estimated from a line transect sighting survey conducted during July 6 to September 6, 1998 by a ship and plane that surveyed 15,900km of track line in waters north of Maryland (38ºN) (Figure 1; Palka *et al.* unpublished manuscript). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 541 (CV=0.55) for undifferentiated beaked whales was estimated from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163km of track line in waters south of Maryland (38ºN) (Figure 1; Mullin and Fulling 2003). This estimate is a recalculation of the same data reported in previous SARs. For more details see Mullin and Fulling (2003). Abundance estimates were made using the program~~

~~DISTANCE (Buckland *et al*. 1993) where school size bias and ship attraction were accounted for.~~

~~The best 1998 abundance estimate for undifferentiated beaked whales is the sum of the estimates from the two U.S. Atlantic surveys, 3,141 (CV=0.34), where the estimate from the northern U.S. Atlantic is 2,600 (CV=0.40) and from the southern U.S. Atlantic is 541 (CV=0.55). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

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

An abundance of 2,211 (CV=0.58) 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) (~~Figure~~ Table 1; Palka ~~unpublished~~2006). Shipboard data were collected using the two independent team ~~line~~ 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~~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 50x bigeye ~~binocluars~~binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and ~~there were~~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 ~~analyzed to~~ corrected~~t~~ for visibility bias (*g(0)*) and group-size bias ~~employing~~ and analyzed using ~~line~~ line-transect distance analysis ~~and the direct duplicate estimator~~ (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.)

~~An estimate of abundance for an August 2002 survey was 822 (CV=0.81) and 922 (CV=1.47 for August 2006. The summer of 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from the three aerial surveys, while the density estimates were year-specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~

~~The best 2004 abundance estimate for beaked whales is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 3,513 (CV =0.63), where the estimate from the northern U.S. Atlantic is 2,839 (CV =0.578), and from the southern U.S. Atlantic is 674 (CV =0.36). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

Although the 1990-2006~~2004~~ surveys did not sample exactly the same areas or encompass the entire beaked whale habitat, they did focus on segments of known or suspected high-use habitats off the northeastern U.S. coast. The collective 1990-2004 data suggest that, seasonally, at least several thousand beaked whales are occupying these waters, with highest levels of abundance in the Georges Bank region. Recent results suggest that beaked whale abundance may be highest in association with Gulf Stream and warm-core ring features.

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

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~2,600~~	~~0.40~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~541~~	~~0.55~~
~~Jul-Sep 1998~~	~~Gulf of St. Lawrence to Florida (COMBINED)~~	~~3,141~~	~~0.34~~
Aug 2002	Georges Bank to Maine coast~~S. Gulf of Maine to Maine~~	822	0.81
Jun-Aug 2004	Maryland to the Bay of Fundy	2,839	0.78
Jun-Aug 2004	Florida to Maryland	674	0.36
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	3,513	0.63
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	922	1.47

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for undifferentiated beaked whales is 3,513 (CV =0.63). The minimum population estimate for the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is 2,154. It is not possible to determine the minimum population estimate of only *Mesoplodon* beaked whales.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: length at birth is 2 to 3m, length at sexual maturity 6.1m for females, and 5.5m 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~~ 4 because ~~this stock is of unknown status~~the CV for the fishery mortality estimate exceeds 0.8. PBR for all species in the undifferentiated complex of beaked whales (*Ziphius* and *Mesoplodon* spp.) is ~~22~~17. It is not possible to determine the PBR for only *Mesoplodon* beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The ~~1999~~2001-~~2003~~ 2005 total average estimated annual mortality of beaked whales in fisheries in the U.S. Atlantic EEZ ~~was~~ is 1.0 and is derived from ~~three~~ five components: 1) average annual fishery bycatch of one animal (Table ~~1~~2), ~~1~~2) ~~two~~ one stranded animal ~~s were~~ entangled in fishing gear, ~~2~~3) two animals were ship struck, ~~and 3~~4) one stranded animal died from acoustic or blunt trauma, and 5) one animal with ingested debris - see other mortality text and ~~(~~Table 2~~)~~.

Fishery Information

Total fishery-related mortality and serious injury cannot be estimated separately for each beaked whale species because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that any beaked whale stock which occurred in the U.S. Atlantic EEZ might have been subject to the observed fishery-related mortality and serious injury.

~~Bycatch has been observed by NMFS sea samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in the pelagic longline, pelagic trawl, Northeast sink gillnet, Mid-Atlantic coastal gillnet, or North Atlantic bottom trawl fisheries by NMFS sea samplers. Total annual e~~Estimated annual average fishery-related mortality or serious injury of this stock in 2001-2005 in the U.S. fisheries listed below was 1 beaked whale (CV=1.0)(Table 1). 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) ~~have~~ has been used to determine species identifications for some of the bycaught animals. Estimates of bycatch mortality by species are available for the 1994-1998 period. Prior estimates are for undifferentiated beaked whales. The estimated annual fishery-related mortality (CV in parentheses) was 60 in 1989 (0.21), 76 in 1990 (0.26), 13 in 1991 (0.21), 9.7 in 1992 (0.24) and 12 in 1993 (0.16). The 1994-1998 estimates by 'species' are:

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

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

Pelagic Longline

One unidentified beaked whale was seriously injured in the U.S. Atlantic pelagic longline fishery in 2003. This interaction occurred in the Sargasso Sea fishing area. The estimated fishery-related combined mortality in 2003 was 5.3 beaked whales (CV=1.0). No serious injury or mortality interactions were reported prior to 2003 or in 2004 or 2005. The estimated average combined mortality in 2001-2005 was 1 beaked whale (CV=1.0)(Table 2).

Table ~~1~~2. Summary of the incidental mortality of Beaked Whales (*Ziphius cavirostris* and *Mesoplodon* sp.) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers , the estimated annual mortality and serious injury-, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[c]	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) [b,d]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 5.3[e], 0, 0	0, 0, 0, 0, 0	0, 0, 5.3, 0, 0	0, 0, 1.0, 0, 0	1(1.0)
TOTAL											1 (1.0)

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

Other Mortality

From 1992-2000, a total of 53 beaked whales stranded along the U.S. Atlantic coast between Florida and Massachusetts (NMFS unpublished data). This includes: 28 (includes one tentative identification) Gervais' beaked whales (one 1997 animal had plastics in esophagus and stomach, and Sargassum in esophagus; 2 animals that stranded in September 1998 in South Carolina showed signs of fishery interactions); 2 True's beaked whales; 5 Blainville's beaked whales; 1 Sowerby's beaked whale; 13 Cuvier's beaked whales (one 1996 animal had propeller marks, and one 2000 animal had a longline hook in the lower jaw) and 4 unidentified animals. One stranding of Sowerby's beaked whale was recorded on Sable Island between 1970-1998 (Lucas and Hooker 2000). The whale's body was marked by wounds made by the cookiecutter shark (*Isistius brasiliensis*), which has previously been observed on beaked whales (Lucas and Hooker 2000).

Also, several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with naval activities. During the mid- to late 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 and Lopez-Jurado 1991). Twelve Cuvier's beaked whales that live stranded and subsequently died in the Mediterranean Sea on 12-13 May 1996 was associated with low frequency acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (-5 Cuvier's and 1 Blainville's) died (Balcomb and Claridge 2001; ~~Anon~~NMFS 2001; ~~Evans and England 2001;~~ Cox *et al*.2006~~, in review~~). 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~~ in review~~).

During 2001-~~2003~~2005, ~~twenty-four~~thirty-four beaked whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 2).

Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.

State	2001	2002	2003	2004	2005	Total
Maine	_	*M. mirus* (1)	*M. bidens* (1)[c]	_	_	2
Massachusetts	_	_	_	_	_	0
New Jersey	_	_	_	_	*Ziphius* (1)	1
Virginia	0	*M. Europaeus* (2)[b]	*M. mirus* (1)[d]	_	_	3
North Carolina	*M. europaeus* (1) Mesoplodon sp. (3)	Unid. (1)	*M. europeaus* (2); *Mesoplodon* sp. (1)	_ *M. densirostris (1)*	*M. europeaus* (2); *M. densirostris (1)*	_ 12
South Carolina	*M. europaeus* (2)	*Ziphius* (1)	*Ziphius* (2)	_	*M. densirostris (1)*	6

Georgia				*M. bidens* (1)	*Ziphius* (1)[f]	2
Florida	*M. europaeus* (4)[a]	--	*Ziphius* (1); *M. europaeus* (1)	*M. europeaus* (1);	*Mesoplodon sp.* *(1)*	7
Puerto Rico				*M. densirostris* *(1)*		1
Total	10	5	9	4	7	34[e]

[a] Acoustic or blunt trauma was the assigned cause of mortality for one animal stranded in Broward County in Sept.

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

[c] Boat strike was the likely cause of death

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

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

[f] Plastic debris found in the stomach.

~~Table 2. Beaked whale (*Ziphius cavirostris* and *Mesoplodon* sp.) strandings along the U.S. Atlantic coast.~~

~~State~~	~~2001~~	~~2002~~	~~2003~~	~~Total~~
~~Maine~~	~~0~~	~~*M. mirus* (1)~~	~~*M. bidens* (1)[e]~~	~~2~~
~~Massachusetts~~	~~0~~	~~--~~	~~0~~	~~0~~
~~Virginia~~	~~0~~	~~*M. Europaeus* (2)[b]~~	~~*M. mirus* (1)[d]~~	~~3~~
~~North Carolina~~	~~*M. europaeus* (1)~~ ~~Mesoplodon sp. (3)~~	~~Unid. (1)~~	~~*M. europeaus* (2);~~ ~~*Mesoplodon* sp. (1)~~	~~9~~
~~South Carolina~~	~~*M. europaeus* (2)~~	~~*Ziphius* (1)~~	~~*Ziphius* (2)~~	~~5~~
~~Florida~~	~~*M. europaeus* (4)[a]~~	~~--~~	~~*Ziphius* (1);~~ ~~*M. europaeus* (1)~~	~~5~~
~~Total~~	~~10~~	~~5~~	~~9~~	~~24[e]~~

~~[a] Acoustic or blunt trauma was the assigned cause of mortality for one animal stranded in Broward County in Sept.~~
~~[b] Ship strike was the likely cause of death for one animal~~
~~[c] Boat strike was the likely cause of death~~
~~[d] Entanglement in fishing gear was the likely cause of death~~
~~[e] The cause of death for most of the stranded animals could not be determined.~~

STATUS OF STOCK

The status of *Mesoplodon* beaked whales relative to OSP in U.S. Atlantic EEZ is unknown. These species are not listed as threatened or endangered under the Endangered Species Act. Although a species specific PBR cannot be determined, the permanent closure of the pelagic drift gillnet fishery has eliminated the principal known source of incidental fishery mortality. The total U.S. fishery mortality and serious injury for this group is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities.

REFERENCES

~~Anon. 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001).NOAA unpublished report. 55pp. [Available at http://www.nmfs.noaa.gov/pro-tres/overview/Interim_Bahamas_Report.pdf].~~

Balcomb, K.C. III, and D.E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2:2-12.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Barlow, J., M.C. Fergunson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family *Ziphiidae*). J. Cetacean Res. Manage. 7:263-270.

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

Buckland, S.T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Cox, T.M., T. Ragen, A.J. Read, E. Vos, R.W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernadez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P.D. Jepson, D. Ketten, C.D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. ~~2004~~2006. ~~Report of a workshop to u~~Understanding the impacts of anthropogenic sound on beaked whales. ~~33 pp. Submitted to~~ J. Cetacean Res. Manage. 7:177-187.

~~Evans, D.L. and G.R. England. 2001. Joint interim report Bahamas Marine Mammal Stranding event of 15-16 March 2000. U.S. Department of Commerce; Secretary of the Navy, vi + 59 pp. Available at: http://www.nmfs.noaa.gov/pr/acoustics/acoustics_reports.htm.~~

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392:29.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Hamazaki, Toshihide. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). Mar. Mammal Sci. 18(4):920-939.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: Garner *et al.* (eds.). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Houston, J. 1990. Status of Blainville's beaked whale, *Mesoplodon densirostris*, in Canada. Can. Field Nat. 104(1): 117-120.

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

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

Lucas, Z.-N. and S.-K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field Nat.:114 (45-61).

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

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

MacLeod, C.D., W.F. Perrin, R. Pittman, J. Barlow, L. Balance, A. D'Amico, T. Gerrodette, G. Joyce, K.D. Mullin, D.L. Palka, and G.T. Waring. 2006. Known and inferred distributions of beaked whale species (Cetacea: Ziphiidae). J. Cetacean Res. Manage. 7:-271-286.

Mignucci-Giannoni, A.–A., B. Pinto-Rodríguez, M. Velasco-Escudero, R.–A. Montoya-Ospina, N.–M. Jiménez, M.A. Rodríguez-López, E.-H. Williams, Jr., and D.-K. Odell. 1999. Cetacean strandings in Puerto Rico and the Virgin Islands. J. Cetacean Res. Manage. 1:191-198.

Mullin, K.-D. and G.-L. Fulling. 2003. Abundance of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull., U.S.101:603-613.

Nawojchik, R. 1994. First record of *Mesoplodon densirostris* (*Cetacea: Ziphiidae*) from Rhode Island. Mar. Mamm.. Sci. 10: 477-480.

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

NMFS [National Marine Fisheries Service]. 1990. Cruise results, NOAA Ship CHAPMAN, Cruise No. 90-05. Marine Mammal Sighting Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1991. Northeast cetacean aerial survey and interplatform study. NOAA-NMFS- SEFSC and NEFSC. 4 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1994. Cruise results, NOAA ship RELENTLESS, Cruise No. RS 9402, Marine Mammal Survey/Warm Core Ring Study. 8 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 2001. Joint interim report on the Bahamas marine mammal stranding event of 15-16 March 2000 (December 2001). NOAA unpublished report. 55pp. [Available at http://www.nmfs.noaa.gov/pro_tres/overview/Interim_Bahamas_Report.pdf].

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500160.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 16:27-50.

~~Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.~~

~~Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. NOAA NMFS NEFSC, Lab.Ref.Doc.No.06-03, 52 pp. Available at: http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/.~~

Palka, D. and P.S Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58: 777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic navy operating areas. NOAA NMFS NEFSC, Lab.Ref.Doc.No.06-03, 52 pp.

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the Northwest Atlantic. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 1:~~-~~133-147.

Simmonds, M.P. and L.F. Lopez-Jurado. 1991. Whales and the military. Nature 351:448.

Tove, M. 1995. Live sighting of *Mesoplodon* CF. *M. Mirus*, True's Beaked Whale. Mar. Mamm. Sci. 11(1):~~-~~80-85.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

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

Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. NOAA NMFS NEFSC, Lab. Ref. Doc. No. 98-09, 21 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Waring, G.T., T. Hamazaki, D. Sheehan, G. Wood, and S. Baker. 2001. Characterization of beaked whale (Ziphiidae) and sperm whale (*Physeter macrocephalus*) summer habitat in shelf-edge and deeper waters off the northeast U.S. Mar. Mamm. Sci. 17(4):~~-~~703-7

~~December 2005~~~~January~~April 2007

MELON-HEADED WHALE (*Peponocephala electra*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The melon-headed whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994) and~~. Melon-headed whales~~ are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The paucity of sightings is probably due to a naturally low number of groups compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico occur in oceanic waters (Mullin *et al.* 1994; Mullin and Fulling~~,~~ 2004 _ Sightings of melon-headed whales in the northern Gulf of Mexico were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

~~The western North Atlantic population is provisionally being considered one stock for management purposes. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.~~

POPULATION SIZE

The numbers of melon-headed whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of melon- headed whales was sighted during both a 1999 (20 whales) and 2002 (80 whales) vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina in waters >2500 m deep (Figure 1; NMFS~~Anon.~~ , 1999; NMFS~~: Anon.~~, 2002). Abundances have not been estimated from the 1999 and 2002 vessel surveys in western North Atlantic ~~(NMFS 1999; NMFS 2002);~~ because the sighting was not made during line-transect sampling effort; therefore the population size of melon-headed whales is unknown. No melon-headed whales have been observed in any other surveys.

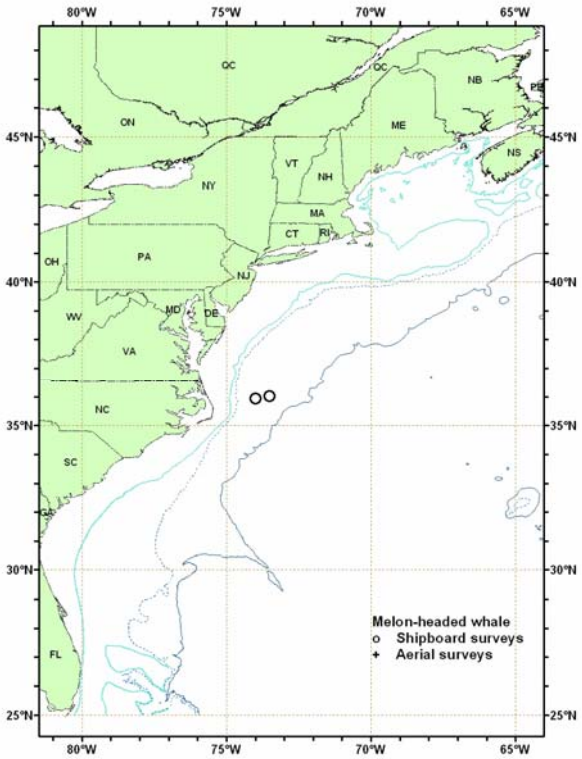


Figure 1. *Distribution of melon-headed whales from SEFSC vessel surveys during 1998-2002. All sightings are shown. Solid lines indicate the 100 m, 1,000 m, and 4,000 m isobaths.*

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal level (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic stock of melon-headed whales is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during ~~1999-2003~~2001-2005 was zero~~ melon-headed whales~~, as there were no reports of mortality or serious injury to melon-headed whales.~~ (Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~

Other Mortality

From ~~1999~~ 2001-~~2003~~2005, 1 melon-headed whale stranded in New Jersey and one in Georgia in 2004. Prior to this time, 1 melon-headed whale was reported stranded in Puerto Rico in 1999. ~~. There was one additional reported stranding of a melon-headed whale in the western North Atlantic between 1997 and 2002.~~ No evidence of human interaction was apparent for any of the ~~either~~ stranded animals.

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

STATUS OF STOCK

The status of melon-headed whales, relative to OSP, in the western North Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total U.S. fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

~~Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. NOAA Tech. Memo. NMFS-SEFSC 539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

Hansen, L. J., K. D. Mullin, T. A. Jefferson, and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. Pages 55-132. *In:* R. W. Davis and G. S. Fargion (editors), Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Jefferson, T. A., S. Leatherwood, and M. A. Weber. 1994. Marine mammals of the world. FAO, Rome, 320 pp.

Mullin, K.~~-~~D., T.~~-~~A. Jefferson, L.~~-~~J. Hansen, and W. Hoggard. 1994. First sightings of melon-headed whales (*Peponocephala electra*) in the Gulf of Mexico. Mar. Mam. Sci. 10(3): 342-348.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172. *In:* R. W. Davis, W. E. Evans, and B. Würsig (editors), Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. Mar. Mamm. Sci. 20(4):787-807.

National Marine Fisheries Service~~MFS [National Marine Fisheries Service]~~. 1999. Cruise results. Summer Atlantic Ocean marine mammal survey. NOAA Ship *Oregon II* cruise 236 (99- 05), 4 August - 30 September 1999. Available from SEFSC, 3209 Frederic Street, Pascagoula, MS 39567.

National Marine Fisheries Service~~MFS [National Marine Fisheries Service]~~. 2002. Cruise results. Mid-Atlantic cetacean survey. NOAA Ship *Gordon Gunter* cruise GU-02-01, 6 February - 8 April 2002. Available from SEFSC, 3209 Frederic Street, Pascagoula, MS 39567.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. ~~Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.~~

~~Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.~~

~~April 2006~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphins are distributed worldwide in tropical and temperate seas~~.~~, and in the Northwest Atlantic occur ~~They generally have an oceanic range, and occur along the Atlantic coast of North America~~ from Florida to eastern Newfoundland (Leatherwood *et al.* 1976; Baird and Stacey 1990). Off the northeast U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during ~~the~~ spring, summer, and autumn (CETAP 1982; Payne *et al.* 1984). In winter, the range ~~begins at~~is in the mid-Atlantic ~~bight~~ Bight and extends ~~further~~ outward into oceanic waters (Payne *et al.* 1984). In general, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne *et al.* 1984). During 1990, 1991 and 1993, spring/summer surveys conducted ~~in~~ along the continental shelf edge and in deeper oceanic waters ~~had sightings of~~sighted Risso's dolphins associated with strong bathymetric features, Gulf Stream warm-core rings, and the Gulf Stream north wall (Waring *et al.* 1992; Waring 1993). There is no information on stock ~~differentiation~~ structure of Risso's dolphin in the western North Atlantic~~.~~, or to determine if separate stocks exist in the Gulf of Mexico and Atlantic. In 2006, a rehabilitated adult male Risso's dolphin stranded and released in the Gulf of Mexico off Florida was tracked via satellite to waters off Delaware (Wells 2006).

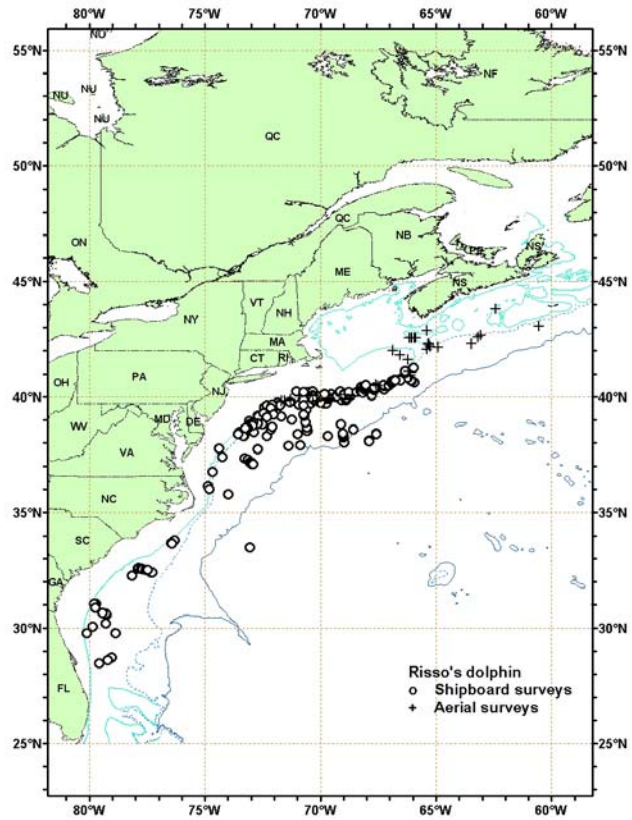


Figure 1. *Distribution of Risso's dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summesr of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100 m, 1,000 m, and 4,000 m depth contours.*

POPULATION SIZE

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

Earlier abundance estimates

An abundance estimate of 4,980 Risso's dolphins (CV=0.34) was ~~estimated~~ obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 11,017 (CV=0.58) Risso's dolphins was ~~estimated~~ obtained from a June and July 1991 shipboard ~~line~~ line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). ~~An abundance~~ Abundance estimates of 6,496 (CV=0.74) and 16,818 (CV=0.52) Risso's dolphins ~~was~~ were ~~estimated~~ obtained from ~~line~~ line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11~~, respectively~~ aircraft (NMFS 1991). An abundance estimate of 212 (CV=0.62) Risso's dolphins was obtained

from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). A 1995 abundance estimate of 5,587 (CV=1.16) Risso's dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence. An abundance estimate of 2~~9~~8,1~~10~~64 (CV=0.29) Risso's dolphins was obtained from the sum of the estimate of 18,631 (CV=0.35) Risso's dolphins from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of ~~10,479~~9,533 (CV=0.5~~1~~0) Risso's dolphins, estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

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

~~An abundance of 5,587 (CV=1.16) Risso's dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; Palka *et al.* Unpublished Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods used were described in Palka (1996).~~

~~An abundance of 18,631 (CV=0.35) Risso's dolphins was estimated from a line transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900km of track line in waters north of Maryland (38ºN) (Figure 1; Palka *et al.* Unpublished Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 10,479 (CV=0.51) Risso's dolphins was estimated from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 5,570 km of track line in waters south of Maryland (38ºN) (Figure 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993; Laake *et al.* 1993) where school size bias and ship attraction were accounted for.~~

~~The best 1998 abundance estimate for Risso's dolphins, 29,110 (CV=0.29), is the sum of the estimates from the two 1998 U.S. Atlantic surveys where the estimate from the northern U.S. Atlantic is 18,631 (CV=0.35) and from the southern U.S. Atlantic is 10,479 (CV=0.51). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

Recent surveys and abundance estimates

An abundance estimate of 69,311 (CV=0.76) Risso's dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 15,054 (CV=0.78) ~~for~~ Risso's dolphins was ~~estimated~~ obtained from a ~~line~~ line-transect sighting survey conducted during 12 June ~~-~~to 4 August 2004 by a ship and plane that surveyed 10,761km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (~~Figure~~ Table 1; Palka ~~Unpublished Ms.~~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 (~~Figure 1;~~ Palka ~~Unpublished Ms.~~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 50x bigeye binoculuars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf ~~s~~Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and ~~there were as~~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 analyzed to correct for visibility bias (*g(0)*) and group-size bias employing ~~line~~ line-transect distance analysis and the direct duplicate estimator (Palka, 1995; Buckland *et al.* 2001). The resulting abundance estimate for Risso's dolphins between Florida and Maryland was 5,426 (CV =0.54).

An abundance estimate of 14,408 (CV=0.38) Risso's dolphins was obtained from an aerial survey conducted in August 2006 which covered 10,676 km of trackline in the region from the 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 estimate of abundance for an aerial survey in August 2002 survey was 69,311 (CV=0.76) and 14,408 (CV=0.38) for August 2006. The summer of 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from the three aerial surveys, while the density estimates were year specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 aerial survey covered 6,180 km of trackline in the region from the 100m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~

~~The best best 2004 aabundance estimate for Risso's dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 20,479 (CV=0.59), where the estimate from the northern U.S. Atlantic is 15,053 (CV=0.78), and from the southern U.S. Atlantic is 5,426 (CV =0.54). This joint estimate is considered best because together these two surveys have the most complete coverage of the population's habitat.~~

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~18,631~~	~~0.35~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~10,479~~	~~0.51~~
Aug 2002~~Jul-Sep 1998~~	Georges Bank to ~~S. Gulf of~~ Maine coast~~to Maine~~Florida to Gulf of St. Lawrence ~~(COMBINED)~~	9,311~~29,110~~	0.76~~0.29~~
Jun-Aug 2004	Maryland to Bay of Fundy	15,053	0.78
Jun-Aug 2004	Florida to Maryland	5,426	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	20,479	0.59
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	14,408	0.38

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Risso's dolphins is 20,479 (CV=0.59), obtained from the 2004 surveys. The minimum population estimate for the western North Atlantic Risso's dolphin is 12,920.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 12,920. The maximum productivity rate is 0.04, the default value for cetaceans (Barlow *et al*.~~.~~ 1995). The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.~~48~~ 5 because the CV of the average mortality estimate is ~~between~~ less than 0.3 ~~and 0.6~~ (Wade and Angliss 1997). PBR for the western North Atlantic stock of Risso's dolphin is ~~124~~129.

ANNUAL HUMAN-CAUSED MORTALITY

Total annual estimated average fishery-related mortality or serious injury to this stock during ~~2000-2004~~ 2001-2005 was ~~52~~ 40 Risso's dolphins (CV=~~0.34~~0.28); Table 2).

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

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

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

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

In the pelagic pair trawl fishery, one mortality was observed in 1992. Estimated annual fishery-related mortality (CV in parentheses) attributable to the pelagic pair trawl fishery was 0.6 dolphins in 1991 (1.0), 4.3 in 1992 (0.76), 3.2 in 1993 (1.0), 0 in 1994 and 3.7 in 1995 (0.45).

Pelagic Longline

~~The 1993-1997 estimated take was based on a revised analysis of the observed incidental take and self-reported incidental take and effort data, and replaces previous estimates for the 1990-1993 and 1994-1995 periods (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999). Further, Yeung (1999b) revised the 1992-1997 fishery mortality estimates in Johnson *et al.* (1999) to include seriously injured animals. The~~Pelagic longline bycatch estimates of Risso's dolphins in 1998, 1999~~,~~, and 2000 ~~bycatch estimates~~ were obtained from Yeung (1999a), Yeung *et al.* (2000)~~,~~ and Yeung (2001), respectively. Bycatch estimates for 2001and 2002, 2003, 2004 and 2005 were obtained from Garrison (2003), Garrison and Richards (2003), Garrison (2005), and Fairfield-Walsh and Garrison (2006). Most of the estimated marine mammal bycatch was from ~~-~~U.S. Atlantic EEZ waters between South Carolina and Cape Cod. Excluding the Gulf of Mexico, from 1992 to 2000 one mortality was observed in both 1994 and 2000, and 0 in other years. The observed numbers of seriously-injured but released alive individuals from 1992 to ~~2000~~ 2005 were, respectively, 2, 0, 6, 4, 1, 0, 1, 1~~,~~, 1, 6, 4, 2, 2, and ~~1~~ 0 (Cramer 1994; Scott and Brown 1997; Johnson *et al.* 1999; Yeung 1999a; Yeung *et al.*~~.~~ 2000; Yeung 2001, Garrison 2003, Garrison and Richards 2003, Garrison 2005, and Fairfield-Walsh and Garrison 2006~~)~~) (Table 2). Estimated annual fishery-related mortality (CV in parentheses) was 17 animals in 1994 (1.0), 41 in 2000 (1.0), 24 in 2001(1.0), 20 in 2002 (0.86), and 0 in 2003 to 2005 ~~and 2004~~ (Table 2). Seriously injured and released alive animals were estimated to be 54 dolphins (0.7) in 1992, 0 in 1993, 120 (0.57) in 1994, 103 (0.68) in 1995, 99 (1.0) in 1996, 0 in 1997, 57 (1.0) in 1998, 22 (1.0) in 1999, 23 (1.0) in 2000, 45 (0.7) in 2001, 8 (1.0) in 2002, ~~and~~ 40 (0.63) in 2003 ~~and~~ 28(0.72) in 2004, and 3(1.0) in 2005 (Table 2). ~~-~~The annual average combined mortality and serious injury for ~~2000~~2001-~~2004~~ 2005 is ~~46~~34 Risso's dolphins (CV =0.~~37~~32; Table 2).

Northeast Sink Gillnet

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

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

Fishery	Years	~~Vessels[e]~~ Vessels[b]	Data Type [a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E) ~~b,d~~[c]	~~00-04~~01-05	~~116,~~ 98, 87, 63, ~~58~~60, 60	Obs. Data Logbook	~~.04,~~ .04, .05, .09, .09, .06	~~1,~~ 6, 4, 2, -2, 0	~~1,~~ 1, 0, 0, 0, 0	~~23,~~ 45, 8, 40, 28, 3	~~41,~~ 24, ~~20[e]~~20[d], 0, 0, 0	~~64,~~ 69, 28, 40, 28, 3	~~1,~~ .57, .67, .63, .72, 1	~~46 (0.37)~~34(0.32)
Pelagic Longline - NED-E area only ~~d~~[c]	01-03	9, 14, 11	Obs. Data Logbook	1, 1, 1	4, 3, 0	0, 0, 1	4, 3, 0	0, 0, 1	4, 3, 1	0, 0, 0	3

Northeast Sink Gillnet	~~00~~01-~~04~~05	1993=349 1998=301	Obs. Data Weighout Trip Logbook	~~.06,~~ .04, .02, .03, .06, .07	0,0,0, 0,0	~~1,~~ 0, 0, 0, 0, 1	0, 0, 0, 0, 0	~~15,~~ 0, 0, 0, ~~-~~0, 15	~~15,~~ 0, 0, 0, 0, 15	~~1.06,~~ 0, 0, 0, 0, 0.93	3 (~~1.06~~0.93)
TOTAL											~~52~~ 40 (0. ~~34~~.28)

[a] Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program. The Observer Program collects ~~-~~landings data (Weighout), and total landings are used as a measure of total effort for the coastal gillnet fishery.

~~[b] 2000 mortality estimates were taken from Table 10 in Yeung (2001).~~

[~~e~~b] Number of vessels in the fishery are based on vessels reporting effort to the pelagic longline logbook.

[~~d~~c] An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison 2003; Garrison and Richards 2004) The NED area was reopened in June 2004, so '04 and '05 bycatch analysis includes this area.

[~~e~~d] Note that the 2002 estimate of Risso's dolphin mortality is estimated from observed mortality rates in previous years (1998-2002) due to a gap in coverage during the 3rd quarter of 2002.

Other mortality

From ~~2000~~2001-~~2004~~2005, ~~thirty-nine~~65 Risso's dolphin strandings were recorded along the U.S. Atlantic coast (NMFS unpublished data). ~~–~~ In eastern Canada, one Risso's dolphin stranding was reported on Sable Island, Nova Scotia from 1970-1998 (Lucas and Hooker 2000).

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

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

Table 3. Risso's dolphin (*Grampus griseus*) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
Maine	0	0	0	2	0	**2**
New Hampshire	0	0	0	0	0	**0**
Massachusetts [a]	1	5	0	4	8	**18**
Rhode Island	0	0	0	1	1	**2**
Connecticut	0	0	0	0	0	**0**
New York	0	1	0	3	4	**8**
New Jersey	0	0	0	0	5	**5**
Delaware	0	0	0	1	1	**2**
Maryland	1	1	0	1	2	**5**
Virginia [b]	1	0	0	1	4	**6**
North Carolina	3	2	1	2	2	**10**
South Carolina	0	0	0	0	0	**0**
Georgia	0	0	0	0	0	**0**
Florida	1	1	1	3	0	**6**
EZ	0	0	0	1	0	**1**

TOTAL	**7**	**10**	**2**	**19**	**27**	**65**

a. 2001 animal had signs of human interaction, and one of the 2004 animals was mutilated, fluke cut off.
b. One of the 2005 animals was showed signs of human interaction.

~~**Risso's dolphin**~~	~~**2000**~~	~~**2001**~~	~~**2002**~~	~~**2003**~~	~~**2004**~~
~~Maine~~					~~2~~
~~New Hampshire~~					
~~Massachusetts~~		~~1[a]~~	~~5~~		~~4[b]~~
~~Rhode Island~~					~~1~~
~~Connecticut~~					
~~New York~~			~~1~~		~~3~~
~~New Jersey~~	~~1~~				
~~Delaware~~					~~1~~
~~Maryland~~		~~1~~	~~1~~		~~1~~
~~Virginia~~		~~1~~			~~1~~
~~North Carolina~~		~~3~~	~~2~~	~~1~~	~~2~~
~~South Carolina~~					
~~Georgia~~					
~~Florida~~		~~1~~	~~1~~	~~1~~	~~3~~
~~EZ~~					~~1~~
~~TOTAL~~	~~1~~	~~7~~	~~10~~	~~2~~	~~19~~

~~a Carcass showed signs of human interaction~~
~~b One animal was mutilated, fluke cut off~~

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

STATUS OF STOCK

The status of Risso's dolphins relative to OSP in the ~~-~~U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine ~~the~~ population trends for this species. The total U. S. fishery mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, can not be considered to be insignificant and approaching a zero mortality and serious injury rate. The ~~2000-2004~~2001-2005 average annual ~~fishery~~human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

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

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

Buckland, S.T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Cramer J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. NOAA Tech. Memo. NMFS-SEFSC-539, 56 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 52 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: Garner G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson. (eds). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Johnson, D.R., C.A. Brown, and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1992-1997. NOAA Tech. Memo. NMFS-SEFSC-418, 70 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Laake, J.L., S.T. Buckland, D.R. Anderson, and K.P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado. 72 pp.

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

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field Nat.~~:~~114~~-~~:(45-61).

Mullin, K.D. ~~And~~ and G.L. Fulling. 2003.~~.~~ Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

NMFS [National Marine Fisheries Service]. 1991. Northeast cetacean aerial survey and interplatform study. NOAA-NMFS-SEFSC and NEFSC, 4 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine ~~mammal~~ Mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Biology of the Phocoenids. Rep. int Whal. Commn~~.~~ (Special Issue) 16:27-50.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA-NMFS-NEFSC. Ref. Doc. 96-04; 37 pp. ~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.~~

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:~~-~~777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. European Cetacean Society Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03, 41 pp.

Payne, P.M., L.A. Selzer, and A.R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. 245 p. NOAA/NMFS Contract No. NA-81-FA-C-00023.

Scott, G.P. and C.A. Brown. 1997. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1994-1995. Miami Laboratory Contribution MIA-96/97-28

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry, and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull., U.S.~~.,~~ 88:347-360.

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

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

Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. NOAA-NMFS-NEFSC, Lab. Ref. Doc. No. 98-09, 21 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Wells, R.S. 2006. Follow-up monitoring as an integral component of cetacean rehabilitation programs. Keynote Address. Southeast Region Marine Mammal Stranding Network Biennial Conference. May 3-5, 2006. Panama City, FL.

~~Wells, R.S. 2007. Release and follow-up monitoring of Risso's dolphin "clyde": Record movements and dives. Sarasota Dolphin Research Program, Nicks 'n Notes, January 2007 p. 19.~~

Yeung, C. 1999a. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Yeung, C. 1999b. Revised Mortality Estimates of Marine Mammal Bycatch in 1992-1997 based on Serious Injury Guidelines. NOAA Tech. Memo. NMFS-SEFSC-429, 23 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Yeung, C., S. Epperly, and C.A. Brown. 2000. Preliminary revised estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet, 1992-1999. NMFS, Miami Lab. PRD Contribution Number 99/00-13. 58 pp.

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. NMFS, Southeast Fisheries Science Center, Miami, FL

~~April 2006~~ April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

Pilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeast U.S. coast in winter and early spring (CETAP 1982; Payne and Heinemann 1993; Abend and Smith 1999, Hamazaki 2002). In late spring, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters, and remain in these areas through late autumn (CETAP 1982; Payne and Heinemann 1993). Pilot whales tend to occupy areas of high relief or submerged banks. They are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring *et al.* 1992; NMFS unpublished data).

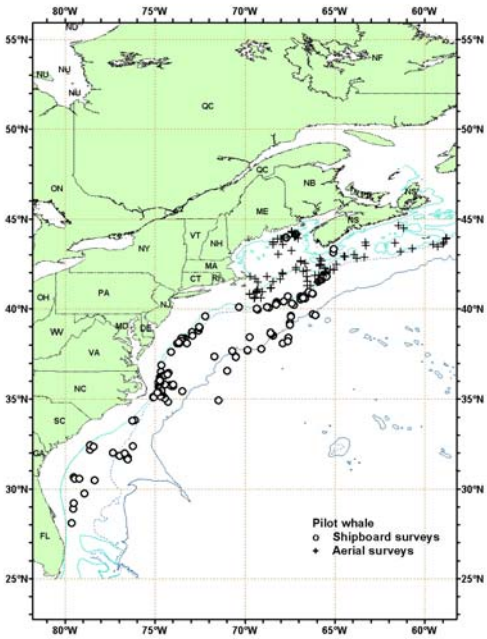


Figure 1. *Distribution of pilot whales sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are at the 100 m, 1,000 m, and 4,000 m depth contours.*

The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Sergeant 1962; Leatherwood *et al.* 1976; Abend 1993; Buckland *et al.* 1993a; Abend and Smith 1999). The stock structure of the North Atlantic population is uncertain (~~Anonymous~~ ICES 1993; Fullard *et al.* 2000). Recent morphometric (Bloch and Lastein 1993) and genetic (Siemann 1994; Fullard *et al.* 2000) studies have provided little support for stock structure across the Atlantic (Fullard *et al.* 2000). However, Fullard *et al.* (2000) have proposed a stock structure that is related to sea surface temperature: 1) a cold-water population west of the Labrador/North Atlantic current, and 2) a warm-water population that extends across the Atlantic in the Gulf Stream.

POPULATION SIZE

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

~~Two estimates were derived from catch data and population models that estimated the abundance of the entire stock. Seasonal estimates are available from selected regions in U.S. waters during spring, summer and autumn 1978-1982, August-1990, June-July 1991, August-September 1991, June-July 1993, July-September 1995, July-August 1998, August-2002, and June-August 2004, and August-2006. Because long-finned and short-finned pilot whales are difficult to identify at sea, seasonal abundance estimates were reported for *Globicephala* sp., both long-finned and~~

~~short-finned pilot whales. One estimate is available from the Gulf of St. Lawrence.~~

Earlier estimates

Mitchell (1974) used cumulative catch data from the 1951-1961 drive fishery off Newfoundland to estimate the initial population size (ca. 50,000 animals).

Mercer (1975) used population models to estimate a population in the same region of between 43,000 and 96,000 long-finned pilot whales, with a range of 50,000-60,000 ~~being considered the best estimate~~.

An abundance estimate of 11,120 (CV=0.29) *Globicephala* sp. was ~~estimated~~ obtained from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 3,636 (CV=0.36) *Globicephala* sp. was ~~estimated~~ obtained from a June and July 1991 shipboard ~~line~~ line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundances estimates of 3,368 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. were ~~estimated~~ derived from ~~line~~ line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircrafts~~, respectively~~ (NMFS 1991). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Further, due to changes in survey methodology, these data should not be used to make comparisons to more current estimates.~~

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

~~An abundance of 8,176 (CV=0.65) *Globicephala* sp. was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka *et al.* Unpublished Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 and 1,000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1,000 fathom isobath. Data collection and analysis methods used were described in Palka (1996).~~

~~Kingsley and Reeves (1998) obtained an abundance estimate of 1,600 long-finned pilot whales (CV=0.65) from a late August and early September aerial survey of cetaceans in the Gulf of St. Lawrence in 1995 and 1998 (Table 1). Based on an examination of long-finned pilot whale summer distribution patterns and information on stock structure, it was deemed appropriate to combine these estimates with NMFS 1995 summer survey data. The best~~A 1995 abundance estimate of 9,776 (CV=0.55) *Globicephala* sp. was generated ~~for~~ from~~*Globicephala* sp. was 9,776 (CV=0.55),~~ the sum of the ~~estimates~~ estimates of 8,176 (CV=0.65) *Globicephala* sp. from the U.S. July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence, and 1,600 (CV=0.65) *Globicephala* sp. from Canadian aerial surveys in late August and early September in the Gulf of St. Lawrence in 1995 and 1998 (Kingsley and Reeves 1998)~~, where the estimate from the U.S. survey was 8,176 (CV=0.65) and from the Canadian was 1,600 (CV=0.65)~~.

~~An abundance of 9,800 (CV=0.34) *Globicephala* sp. was estimated from a line transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Figure 1; Table 1; Palka et al. Unpublished Ms.).~~ An abundance estimate of 14,909 (CV = 0.26) *Globicephala* sp. was obtained from the sum of the estimate of 9,800 *Globicephala* sp. (CV=0.34) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 5,109 (CV = 0.41) *Globicephala* sp., ~~estimated~~obtained from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).~~Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 5,109 (CV = 0.41) *Globicephala* sp. was estimated from a shipboard line transect sighting~~

survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Figure 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993b; Laake *et al.* 1993) where school size bias and ship attraction were accounted for.

The best 1998 abundance estimate for *Globicephala* sp. is 14,909 (CV = 0.26), the sum of the estimates from the two U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 9,800 (CV=0.34) and from the southern U.S. Atlantic is 5,109 (CV =0.41). This estimate is a recalculation of the same data reported in previous SARs. This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates

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

An abundance estimate of 15,728 (CV=0.34) for *Globicephala* sp. was estimated obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (Figure Table 1; Palka Unpublished Ms.2006). Shipboard data were collected using the two independent team line 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..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 50x 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, resulting inand 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 analyzed to corrected for visibility bias *g(0)* and group-size bias employing and analyzed using line line-transect distance analysis and the direct duplicate estimator (Palka, 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 15,411 animals (CV =0.43).

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

An estimate of abundance for an aerial survey in August 2002 survey was 5,408 (CV=0.56) and 26,535 (CV=0.35) for August 2006. The summer 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from the three aerial surveys, while the density estimates were year specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

The best 2004 abundance estimate for *Globicephala* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 31,139 (CV =0.27), where the estimate from the northern U.S. Atlantic is 15,728 (CV =0.34), and

~~from the southern U.S. Atlantic is 15,411 (CV =0.43). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~9,800~~	~~0.34~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~5,109~~	~~0.41~~
~~Jul-Sep 1998~~	~~Florida to Gulf of St. Lawrence (COMBINED)~~	~~14,909~~	~~0.40~~
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to the Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	15,411	0.43
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	31,139	0.27
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity ~~include those~~obtained from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth is 177 cm; mean length at sexual maturity is 490 cm for males and 356 cm for females; age at sexual maturity is 12 years for males and 6 years for females; mean adult length is 557 cm for males and 448 cm for females; and maximum age was 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data ~~recently collected~~ from animals taken in the Faroe Islands drive fishery produced higher values for all parameters (Bloch *et al.* 1993; Desportes *et al.* 1993; Martin and Rothery 1993). These differences are likely related, at least in part, to larger sample sizes and ~~newer~~ different analytical techniques.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Globicephala* sp. is 24,866. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown

status relative to optimum sustainable population (OSP) is assumed to be 0.5 because ~~this stock is of unknown status~~ the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). ~~. Stock status will be determined when trawl fishery bycatch estimates are complete.~~ PBR for the western North Atlantic *Globicephala* sp. is 249. It is not possible to determine the PBR for only long-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III.

Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury. ~~Preliminary fishery mortality estimates have been generated for the years 2000-2004. The estimates will not be reported until scientific review is complete.~~

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Magnuson-Stevens Fisheries Conservation and Management Act (M-SFCMA). ~~Foreign fishing operations for squid ceased at the end of the 1986 fishing season and, for mackerel, at the end of the 1991 fishing season.~~

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

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

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995.

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

No pilot whales were taken in observed mid-Atlantic Coastal Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, 0 during 1999-2003. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7 in 1998 (1.10).

One pilot whale take was observed in the *Ilex* squid portion of the Southern New England/Mid-Atlantic Squid, Mackerel, Butterfish Trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales

in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in 1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

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

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

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

Pelagic Longline

Most of the estimated marine mammal bycatch is from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and ~~2004~~ 2005 ~~70~~ 109 pilot whales (including 2 identified as short-finned pilot whales) were released alive, including ~~38~~ 61 that were considered seriously injured (of which 1 was identified as a short-finned pilot whale), and ~~3~~ 4 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006)~~.~~ January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December bycatch occurred between the 20 and 50 fathom isobaths between Barnegat Bay and Cape Hatteras. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.0), 20 (CV = 1.0) in 2001, 2 (CV =1.0) in 2002, 0 in 2003-2004. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV= 0.51) in 1995, (includes 37 estimated short-finned pilot whales in 1995 (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV = 0.58), 51 in 2002 (CV = 0.48), 21 in 2003 (CV = 0.78), ~~and~~ 74 in 2004 (CV=0.42) and 212 (CV=0.21) in 2005. The average 'combined' annual mortality in ~~2000~~2001-200~~4~~5~~-~~was ~~70~~ 86 pilot whales (CV=0.~~37~~16) (Table 2).

Mid-Atlantic Bottom Trawl

~~—~~Two pilot whales were observed taken in the Mid-Atlantic bottom trawl in 2000 and four in 2005. ~~Preliminary The estimates will not be reported until scientific review is complete. The scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006.~~ The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: ~~16~~ 47 (CV=0.~~47~~32) in 2000, ~~13~~ 39 (CV=0.~~45~~31) in 2001, ~~8~~ 38(CV=0.~~44~~36) in 2002, ~~10~~ 31 (CV=0.~~46~~31) in 2003~~ and~~, ~~12~~ 35 (CV=0.~~51~~33) in 2004, and 31 (0.31) in 2005. The 2001-2005 average mortality attributed to the Mid-Atlantic bottom trawl was ~~11~~38 animals (CV=0.~~24~~15).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004 and four in 2005. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: ~~9~~ 18 (CV=0.~~54~~29) in 2000, ~~10~~ 30 (CV=0.~~53~~27) in 2001, ~~12~~ 22 (CV=0.~~45~~26) in 2002, ~~9~~ 20 (CV=0.~~50~~26) in 2003~~ and~~ , ~~8~~ 15 (CV=0.~~53~~29) in 2004, and 15 (0.30) in 2005. The 2001-2005 average mortality attributed to the northeast bottom trawl was ~~10~~19 animals (CV=0.12~~5~~).

~~The estimates will not be reported until scientific review is complete. The scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006.~~

GOM/GB Herring Mid-Water Trawl JV and TALFF

There were no marine mammal takes observed from the domestic mid-water trawl fishing trips between ~~2000~~2001and ~~2004~~2005.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF) (Table 2). The ~~2000~~2001-~~2004~~ 2005 average mortality attributed to the Atlantic herring mid-water trawl fishery was 11 animals (Table 2).

Northeast Mid-Water Trawl – Including Pair Trawl

~~The two most commonly targeted fish in this fishery are herring (94% of VTR records) and mackerel (0.4%). Thus, the observer coverage and bycatch estimates are only for these two sub-fisheries.~~ The observer coverage in this fishery was highest ~~during~~ after 2003~~ and 2004~~, though a few trips in earlier years were observed (Table 2). A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring in 2004. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 ~~all~~ observed mid-water trawl data, including paired and single, and Northeast and Mid-Atlantic mid-water trawls ~~, that targeted either herring or mackerel and were observed between 1999 and 2004~~ (Palka, ~~in prep~~pers. com.). The model that best fit these data was a ~~binomial~~ Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls ~~target species and bottom slope~~ as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were: ~~4.6 (0.74) in 2000, 11 (0.74) in 2001, 8.9 (0.74) in 200~~unknown in 2001-2002, ~~14~~ 1.9 (0.~~74~~56) in 2003, and ~~5.8~~1.4 (0.~~74~~58) in 2004, and 1.1(.68) (Table 2; Palka ~~in prep~~pers. comm.). The average annual estimated fishery-related mortality during ~~2002~~2001-~~2004~~ 2005 was ~~8.9~~1 (0.35).

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

The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). No pilot whales were observed bycaught in this fishery between 2001-2005, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 3.9 (0.46) in 2003, 8.1 (0.38) in 2004, and 7.5 (.76) in 2005 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2001-2005 was 7 (0.34).

CANADA

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

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

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

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

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

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom ~~Trawl[e]~~Trawl[d]	~~00~~01-~~04~~05	~~tbd~~unk	Obs. Data Dealer	~~.01,~~ .01, .01, .01, .03, .03	0, 0, 0, 0, 0	~~2,~~ 0, 0, 0, 0, 4	0, 0, 0, 0, 0	39, 38, 31, 35, ~~tbd~~31	39, 38, 31, 35, 31~~tbd~~	.31, .36, .31, .33, .31~~, tbd~~	38(.15) ~~tbd~~
Northeast Bottom ~~Trawl[e]~~ Trawl[d]	~~00~~01-~~04~~05	~~tbd~~unk	Obs. Data Dealer Data VTR Data	~~.01,~~ .01, .03, .04, .05, .12	0, 0, 0, 0, 0	~~0,~~ 0, 0, 0, 2, 4	0, 0, 0, 0, 0	21, 22, 20, 15, 15~~tbd~~	21, 22, 20, 15, 15~~tbd~~	.27, .26, .26, .29, .30~~tbd~~	19(.12) ~~tbd~~
GOM/GB Herring Mid-Water Trawl JV and ~~TALFF[f]~~ TALFF[e]	2001	~~10[g]~~ 10[f]	Obs. Data	~~1[h]~~ 1[g]	0	11	0	11	11	NA	11 (NA)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[j]	01-05	23, 20, 23, 25, 31	Obs. Data Dealer Data VTR Data	0, .003, .018, .064, .084	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk, unk, 3.9, 8.1, 7.5	unk, unk, 3.9, 8.1, 7.5	unk, unk, .46, .38, .76	7 (.34)
Northeast Mid-Water Trawl - Including Pair Trawl ~~(Herring and Mackerel only)[e]~~	~~00~~01-~~04~~05	~~TBD~~24, 27, 28, 22, 25	Obs. Data Dealer Data VTR Data	~~.005,~~ .001, 0, .031, ~~.14~~126, .199	0, 0, 0, 0, 0	~~0,~~ 0, 0, 0, 1, 0	0, 0, 0, 0, 0	unk, unk, 1.9, 1.4, 1.1~~4.6, 11, 8.9, 14, 5.8~~	unk, unk, 1.9, 1.4, 1.1~~4.6, 11, 8.9, 14, 5.8~~	unk, unk, .56, .58, .68~~.74, .74, .74, .74, .74~~	~~8.9~~1 (.35)
Pelagic Longline (excluding NED-E)[i,h,j]	~~00~~01-~~04~~05	~~116,~~ 98, 87, 63, ~~58~~60, 60	Obs. Data Logbook	~~.04,~~ .04, .05, .09, .09, .06	~~4,~~ 4, 4, 2, 6, 9	~~1,~~ 1, 0, 0, 0, 0	~~109,~~ 50, 52, 21, 74, 212	~~24,~~ 20, 2, 0, 0, 0	~~133,~~ 70, 54, 21, 74, 212	~~.88,~~ .50, .46, .77, .42, .21	~~70~~86 (.~~37~~16)
Pelagic Longline - NED-E area only[i,h]	01-03	9, 14, 11	Obs. Data Logbook	1, 1, 1	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0
2005 Pelagic Longline experimental fishery[i]	05	6	Obs. Data	1	1	0	1	0	1	na	1(na)

TOTAL		~~tbd~~163(..09)

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).

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

~~d Preliminary estimates of mortality attributed to the Northeast bottom and Mid-Atlantic fisheries have been generated for the years 2000-2004 but scientific review of the analysis is not complete. Therefore, mortality estimates are not reported in the bycatch table. Scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006. e~~d. A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast ~~bottom~~ trawl fisheries during 2000-~~2004~~2005. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-~~2004~~2005. In addition, the fisheries listed in Table 2 reflect ~~new~~ definitions defined by the ~~proposed~~ List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The Illex, Loligo and Mackerel fisheries are now part of the 'Mid-Atlantic bottom trawl fishery'.

~~f~~e. NA=No joint venture or TALFF fishing effort for Atlantic herring.

~~g~~f. Three foreign vessels and seven American vessels.

~~h~~g. During ~~-~~joint venture fishing operations, nets that are transferred from the domestic vessel to the foreign vessels for processing are observed on board the foreign vessel. There may be nets fished by domestic vessels that do not get transferred to a foreign vessel for processing and therefore would not be observed. During TALFF fishing operations all nets fished by the foreign vessel are observed.

~~i 1999-2000 mortality estimates were taken from Table 10 in Yeung 2001 (NOAA Technical Memorandum NMFS-SEFSC-467).~~

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

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

j. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2001-2005. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From ~~2000~~2001-~~2004~~2005, ~~42~~ 76 short-finned pilot whales (*Globicephala macrorhynchus*), ~~120~~ 139 long-finned pilot whales (*Globicephala melas*), and ~~4~~ 9 pilot whales not specified to the species level (*Globicephala* sp.) ~~have been~~were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) ~~when recorded,~~ (Table 3). This includes several mass strandings as follows: 11 long-finned pilot whales mass stranded in Nantucket, MA in 2000~~ and~~, 57 in 2002 in Dennis, MA, and 18 in Brewster, MA in 2005; ~~and~~ 28 short-finned pilot whales stranded in Content Passage, ~~-~~Monroe County, FL (ocean side) on April 18, 2003, and 31 short-finned pilot whales stranded on the Outer Banks of North Carolina on January 15-16 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et at*. 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently, animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980).The fate of the animals is footnoted in Table 3, when recorded.

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

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

A UME mass stranding of thirty-three short-finned pilot whales, including five pregnant females, near Cape Hatteras, NC occurred from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses, though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings" (Hohn et al. 2006).

~~An Unusual Mortality Event (UME) occurred along the coast of Virginia from May to July 2004, when 66 small cetaceans stranded mostly along the outer (eastern) coast of Virginia's barrier islands. Species included: 52 bottlenose dolphins (stock undetermined to date), 4 harbor porpoise (*Phocoena phocoena*), 4 common dolphins (*Delphinus delphis*), 4 Atlantic white-sided dolphins (*Lagenorhynchus acutus*), 1 Risso's dolphin (*Grampus griseus*), and 1 pilot whale (*Globicephala* sp.). Additional strandings occurring from August through December were found to be at similar rates to previous years, and were not included in this UME. Human interactions were implicated in 17 of the strandings (1 common and 16 bottlenose dolphins), other causes were implicated in 14 strandings (1 Atlantic white-sided dolphin, 2 harbor porpoises and 11 bottlenose dolphins), and the no cause could be determined for the remaining strandings, including the pilot whale. Five bottlenose dolphins and 1 common dolphin were entangled in pound nets when they stranded, 1 bottlenose dolphins was entangled in pot gear, and 3 bottlenose dolphins were entangled in unidentified netting or lines, and 2 bottlenose dolphins were found with cinder blocks tied to their flukes (one on Cedar Island in June, and one on the Chincoteague National Wildlife refuge in July), and a third had a frayed line tied to its flukes and was found in Wallops Island in July 2004. A final report on this UME is pending.~~

~~Another UME was declared when 36 small cetaceans stranded from Maryland to Georgia between 3 July and 2 December 2004. The species involved, which are generally found offshore and are not expected to strand along the coast, include: 15 pygmy sperm whales (*Kogia breviceps*), 1 dwarf sperm whale (*Kogia sima*), 8 offshore bottlenose dolphins (*Tursiops truncatus*), 3 short-beaked common dolphins (*Delphinus delphis*), 3 Risso's dolphins (*Grampus griseus*), 1 Clymene dolphin (*Stenella clymene*), 1 pantropical spotted dolphin (*Stenella attenuata*), 1 short-finned pilot whale (*Globicephala macrorhynchus*), 1 unidentified pilot whale (*Globicephala* sp.), 1 Sowerby's beaked whale (*Mesoplodon bidens*), and 1 unidentified small cetacean that was pushed off the beach alive. Preliminary necropsy results indicate that several bottlenose dolphins and the Clymene dolphin that stranded in NC exhibited inflammation in the spinal chord and brain, though necropsy analyses are still underway and no final determination on this UME has been made.~~

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

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

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2001			2002			2003			2004			2005			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	3[b]	0	0	7[c]	0	0	2	0	0	3	0	0	2	0	0	17
Maine	1	5[d]	0	0	2	0	0	1	0	0	4	0	0	2	0	1	14	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Massachusetts	0	3	0	0	65[e]	0	0	5	0	0	1	0	0	22[o]	0	0	96	0
Rhode Island	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	1	0	0	0	0	0	0	0	0	3	0	0	1	0	0	5	0
New Jersey	0	0	0	0	0	0	0	6[f]	0	0	0	0	0	0	2	0	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0
Virginia	0	0	0	0	0	0	0	3	0	0	0	1[g]	0	4	0	0	7	1
North Carolina	1	0	1	0	0	0	2	0	1	1[h]	1	1[h]	35[m,n]	1	2	39	2	5
South Carolina	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1[i]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	29[j,k]	0	0	4	0	0	0	0	0	33	0	0
Puerto Rico	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
EEZ	0	0	0	0	0	0	0	1[l]	0	0	0	0	0	0	1	0	1	1
TOTALS - U.S., Puerto Rico, & EEZ	5	9	1	0	68	0	31	18	1	5	10	2	35	34	5	76	139	9

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Three mass live stranded animals at Judique, Inverness County on July 19, 2001 - all returned to sea.
c. Includes 4 mass strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported.
d. Includes one long finned pilot whale stranded with possible propeller marks in Maine in September 2001.
e. Includes mass stranding of 57 long-finned pilot whales in Dennis, MA in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later ; ~30 animals euthanized, and ~11 animals died during the strandings.
f. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
g. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
h. One short-finned pilot whale (September '04) and one pilot whale (November '04) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.
i. Only moderate confidence on species identification as long-finned pilot whale.
j. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on April 19, 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on August 10, 2003.
k. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
l. One long-finned pilot whale floating dead on Georges Bank offshore.
m. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales on 15-16 January, 2005, including 5 pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.

n. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.

o. Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December, 2005.

p. Sign of human interaction (a line on the flukes) observed in both animals, and one animal was a pregnant female.

~~Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) *and Globicephala* sp. (Sp) strandings along the Atlantic coast, 2000-2004. Strandings which were not reported to species have been reported as *Globicephala* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.~~

~~STATE~~	~~2000~~			~~2001~~			~~2002~~			~~2003~~			~~2004~~			~~TOTALS~~		
	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~	~~SF~~	~~LF~~	~~Sp~~
~~Nova Scotia[a]~~	~~0~~	~~0~~	~~16[a,b]~~	~~0~~	~~0~~	~~3[a,c]~~	~~0~~	~~0~~	~~7[a,d]~~	~~0~~	~~0~~	~~2[a]~~	~~0~~	~~0~~	~~3[a]~~	~~0~~	~~0~~	~~31[a]~~
~~Maine~~	~~0~~	~~0~~	~~0~~	~~1~~	~~5[e]~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~4~~	~~0~~	~~1~~	~~12~~	~~0~~
~~New Hampshire~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Massachusetts~~	~~0~~	~~11~~	~~2~~	~~0~~	~~3~~	~~0~~	~~0~~	~~65[f]~~	~~0~~	~~0~~	~~5~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~87~~	~~0~~
~~Rhode Island~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1~~	~~3~~	~~0~~
~~Connecticut~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~New York~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~5~~	~~0~~
~~New Jersey~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~6[g]~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~6~~	~~0~~
~~Delaware~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Maryland~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Virginia~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~3~~	~~0~~	~~0~~	~~0~~	~~1[h]~~	~~0~~	~~3~~	~~1~~
~~North Carolina~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1[i]~~	~~0~~	~~0~~	~~0~~	~~2~~	~~0~~	~~1[i]~~	~~1[j]~~	~~1[j]~~	~~1[j]~~	~~4~~	~~1~~	~~3~~
~~South Carolina~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1[k]~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1[k]~~	~~0~~
~~Georgia~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~
~~Florida~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~29[l,m]~~	~~0~~	~~0~~	~~4~~	~~0~~	~~0~~	~~33~~	~~0~~	~~0~~
~~Puerto Rico~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~
~~EEZ~~	~~0~~	~~1[n]~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1[o]~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~2~~	~~0~~
~~TOTALS – U.S., Puerto Rico, & EEZ~~	~~1~~	~~15~~	~~0~~	~~5~~	~~9~~	~~1~~	~~0~~	~~68~~	~~0~~	~~31~~	~~18~~	~~1~~	~~5~~	~~10~~	~~2~~	~~42~~	~~120~~	~~4~~

[a] ~~Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.). All Nova Scotia pilot whale strandings reported as pilot whales, so included as *Globicephala* sp.~~

[b] ~~Includes 14 mass live strandings at Judique, Inverness County on August 6, 2000 – 11 returned to sea. Reported as pilot whales, so included as *Globicephala* sp.~~

[c] ~~Three mass live stranded animals at Judique, Inverness County on July 19, 2001 – all returned to sea. Reported as pilot whales, so included as *Globicephala* sp.~~

[d] ~~Includes 4 mass live strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported. Reported as pilot whales, so included as *Globicephala* sp.~~

[e] ~~Includes one long finned pilot whale stranded with possible propeller marks in Maine in September 2001.~~

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

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

[h] ~~One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species(decomposed and decapitated), so included as *Globicephala* sp.~~

[i] ~~Reported as pilot whale, so included as *Globicephala* sp.~~

[j] ~~One short-finned pilot whale (September '04) and one pilot whale (November '04) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.~~

[k] ~~Only moderate confidence on species identification as long-finned pilot whale.~~

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

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

[n] ~~One long-finned pilot whale floating dead in Great South Channel offshore.~~

[o] ~~One long-finned pilot whale floating dead on Georges Bank offshore.~~

~~Between 2000-2004, human and/or fishery interactions were documented as follows: one long-finned pilot whale stranded with possible propeller marks in Maine in September 2001, two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.~~

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

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

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. Atlantic EEZ is unknown~~, but stock abundance may have been affected by reduction in foreign fishing, curtailment of the Newfoundland drive fishery for pilot whales in 1971, and increased abundance of herring, mackerel and squid stocks~~. There are insufficient data to determine ~~the~~ population trends for this species. The species is not listed under the Endangered Species Act. The total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. ~~The status~~

~~of this stock cannot be determined until the trawl bycatch mortality analysis is complete (Table 2).~~This is not a strategic stock because the 2001-2005 estimated average annual human-related mortality does not exceed PBR. However, the continuing inability to distinguish between species of pilot whales raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

REFERENCES CITED

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

Abend, A. and T.D. Smith. 1999. Review of the distribution of the long-finned pilot whale (*Globicephala melas*) in the North Atlantic and Mediterranean. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-NE-117, 22 pp.

~~Anonymous 1993. Report of the study group on long-finned pilot whales. ICES C.M. 1993/N:5 29 pp.~~

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Benjamins, S., J. Lawson., and G. Stenson. (in press). Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. J. Cetacean Res. Manage.

Bloch, D. and L. Lastein. 1993. Morphometric segregation of long-finned pilot whales in eastern and western North Atlantic. Ophelia 38: 55-68.

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

Buckland, S.T., D.R. Anderson, K.P. Burnham, and S.L. Laake. 1993b. Distance sampling: estimating abundance of biological populations. Chapman and Hall, New York, NY, 446 pp.

Buckland, S.T., D. Bloch, K.L. Cattanach, Th. Gunnlaugsson, K. Hoydal, S. Lens, and J. Sigurjónsson. 1993a. Distribution and abundance of long-finned pilot whales in the North Atlantic, estimated from NASS-87 and NASS-89 data. Rep. int Whal. Commn~~.~~ (Special Issue) 14:~~-~~33-49.

Buckland, S. T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Dam, M. and D. Bloch. 2000. Screening of mercury and persistent organochlorine pollutants in long-finned pilot whale (*Globicephala melas*) in the Faroe Islands. Mar. Pollut. Bull. 40:~~-~~1090-1099.

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

~~Fairfield, C.P., G.T. Waring, and M.H. Sano. 1993. Pilot whales incidentally taken during the distant water fleet Atlantic mackerel fishery in the mid-Atlantic Bight, 1984-88. Rep. int Whal. Commn. Special Issue 14: 107-116.~~Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. NOAA Tech. Memo. NMFS-SEFSC-539, 56 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Fehring, W.K. and R.S. Wells. 1976. A series of strandings by a single herd of pilot whales on the west coast of Florida. J. Mamm. 57(1):~~-~~191-194.

Fullard, K. J., G. Early, M.P. Heide-Jørgensen, D. Bloch, A. Rosing-Asvid, and W. Amos. 2000. Population structure of long-finned pilot whales in the North Atlantic: a correlation with sea surface temperature? Molecular Ecol. 9:~~-~~949-958.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 52 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

Hamazaki, Toshihide. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). Mar. Mammal Sci. 18(4):920-939.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G. W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDopnald, and D. G. Robertson. (eds). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Hohn, A.A, D.S.Rotstein, C.A. Harms, and B.L. Southall. 2006. Report on Marine Mammal Unusual Mortality Event UMESE0501Sp: Multipecies mass stranding of pilot whales (*Globicehala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and drarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. NOAA Tech. Memo. NMFS-SEFSC-537, 222 p.

Hooker, S. K., R. W. Baird, and M. A. Showell. 1997. Cetacean Strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Paper SC/49/05 presented to the IWC Scientific Committee, September 1997. 11 pp.

ICES 1993. Report of the study group on long-finned pilot whales. ICES C.M. 1993/N:5 29 pp.

Irvine, A. B., M.D. Scott, R.S. Wells, and J.G. Mead. 1979. Stranding of the pilot whale, *Globicephala macrorhynchus*, in Florida and South Carolina. Fish. Bull., U.S. 77 (2):-511-513.

Johnson, D. R., C.A. Brown, and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1992-1997. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-418. 70 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

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

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:-1529-1550.

Laake, J. L., S. T. Buckland, D. R. Anderson, and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Ft. Collins, CO. 72 pp.

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

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES CM 1997/Q:8. 10 pp.

Lucas, Z. N. and S. K. Hooker. 1997. Cetacean strandings on Sable Island, Nova Scotia, 1990-1996. Paper SC/49/06 presented to the IWC Scientific Committee, September 1997. 10 pp.

Lucas, Z. N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat. 114:-45-61.

Marine Mammal Commission. 2006. US Marine Mammal Commission Annual Report to Congress, 2004. Marine Mammal Commission, Bethesda MD. vi+163pp. Available at: htt://www.nefsc.noaa.gov/nefsc/publication/ 70 pp.

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

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

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

Muir, D.C.G., R. Wagermann, N.P. Grift, R.J. Norstrom, M. Simon, and J. Lien. 1988. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland. Canada. Arch. Environ. Contam. Toxicol. 17: 613-629.

Mullin, K. D. and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

Nawojchik, R., D.J. St. Aubin, and A. Johnson. 2003. Movements and dive behavior of two stranded, rehabilitated long-finned pilot whales (*Globicephala melas*) in the northwest Atlantic. Mar. Mamm. Sci. 19(1):232-239.

Nielsen, J.B., F. Nielsen, P-J. Jørgensen, and P. Grandjean. 2000. Toxic metals and selenium in blood from pilot whales (*Globicephala melas*) and sperm whales (*Physeter catodon*). Mar. Pollut. Bull. 40:348-351.

NMFS [National Marine Fisheries Service] 1991. Northeast cetacean aerial survey and interplatform study. NOAA-NMFS-SEFSC and NEFSC. 4 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993a. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993b. Status of fishery resources off the northeastern United States for 1993. U. S. Dep. Commer., NOAA Tech. Memo NMFS-F/NEC-101, 140 pp.

Odell, D. K., E. D. Asper, J. Baucom, and L. H. Cornell. 1980. A recurrent mass stranding of the false killer whale, *Pseudorca crassidens*, in Florida. Fish. Bull., U.S. 78(1): 171-177.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int Whal. Commn~~.~~ (Special Issue) 16:~~-~~27-50.

~~Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA-NMFS-NEFSC. Ref. Doc. 96-04; 37 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.~~

Palka, D. and Hammond, P.S. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:~~-~~777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03, 41 pp.

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

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn~~.~~(~~-~~Special Issue) 15:~~-~~133-147.

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

Siemann, L. 1994. Mitochondrial DNA sequence variation in North Atlantic long-finned pilot whales, *Globicephala melas.* Ph.D. Thesis, Massachusetts Institute of Technology/ Woods Hole Oceanographic Institution.

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

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

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

Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. NOAA-NMFS-NEFSC Lab. Ref. Doc. No. 98-09, 21pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry, and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull., U.S. 88(2): 347-360.

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

Waring, G.T., E. Josephson, C.P. Fairfield, and K. Maze-Foley. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201, xxx pp.

Weisbrod, A.V., D. Shea, M.J. Moore, and J.J. Stegeman. 2000. Bioaccumulation patterns of polychlorinated biphenyls and chlorinated pesticides in northwest Atlantic pilot whales. Environ. Toxicol. Chem. 19:667-677.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). There are two species of pilot whales in the western North Atlantic - the Atlantic or long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate ~~to the species level~~ at sea; therefore, much~~some~~ of the descriptive material below refers to *Globicephala* sp. and is identified as such. ~~The species boundary is considered to be in the New Jersey to Cape Hatteras area (Leatherwood and Reeves 1983). . Sightings north of this area are likely *G. melas*.~~

~~The short-finned pilot whale is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). The northern extent of the range of this species within the U.S. Atlantic Exclusive Economic Zone (EEZ) is generally thought to be Cape Hatteras, North Carolina (Leatherwood and Reeves 1983).~~ Sightings of these animals in the U.S. Atlantic EEZ occur in oceanic waters (Mullin and Fulling 2003) and along the continental shelf and continental slope in the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2003). ~~There is no i~~Information on stock differentiation for the Atlantic population based on morphological, genetic and/or behavioral data is in progress. Pending these results, the western North Atlantic *Globicephala* sp. population(s) are provisionally being considered a separate stock from the northern Gulf of Mexico stock(s). ~~.~~

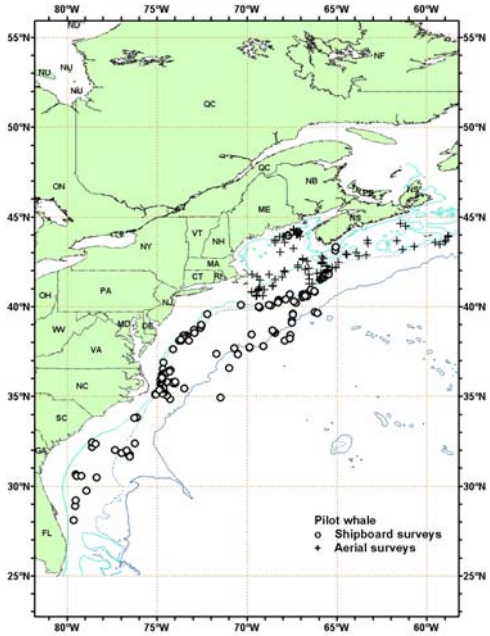


Figure 1. *Distribution of pilot whale sightings from NEFSC and SEFSC vessel and aerial summer surveys during 1998, 1999, 2002, 2004 and 2006. Isobaths are at the 100 m, 1,000 m, and 4,000 m depth contours.*

POPULATION SIZE

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

Mitchell (1974) used cumulative catch data from the 1951-1961 drive fishery off Newfoundland to estimate the initial population size (ca. 50,000 animals).

~~—~~Mercer (1975) used population models to estimate a population in the same region of between 43,000 and 96,000 long-finned pilot whales, with a range of 50,000-60,000 ~~being considered the best estimate~~.

~~—~~An abundance estimate of 11,120 (CV=0.29) *Globicephala* sp. was ~~estimated~~ obtained from an aerial survey program conducted from 1978 to 1982 in continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 3,636 (CV=0.36) *Globicephala* sp. was ~~estimated~~ obtained from a June and July 1991 shipboard ~~line~~ line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). Abundances estimates of 3,368 (CV=0.28) and 5,377 (CV=0.53) *Globicephala* sp. were ~~estimated~~ derived from ~~line~~ line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11 aircrafts~~,~~

~~respectively~~ (NMFS 1991). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Further, due to changes in survey methodology, these data should not be used to make comparisons to more current estimates.~~

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

~~An abundance of 8,176 (CV=0.65) *Globicephala* sp. was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka *et al.* Unpublished Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 and 1,000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1,000 fathom isobath. Data collection and analysis methods used were described in Palka (1996).~~

~~Kingsley and Reeves (1998) obtained an abundance estimate of 1,600 long-finned pilot whales (CV=0.65) from a late August and early September aerial survey of cetaceans in the Gulf of St. Lawrence in 1995 and 1998 (Table 1). Based on an examination of long-finned pilot whale summer distribution patterns and information on stock structure, it was deemed appropriate to combine these estimates with NMFS 1995 summer survey data. The best~~A 1995 abundance estimate of 9,776 (CV=0.55) *Globicephala* sp. was generated ~~for~~ from~~*Globicephala* sp. was 9,776 (CV=0.55),~~ the sum of the ~~estimates~~ estimates of 8,176 (CV=0.65) *Globicephala* sp. from the U.S. July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence, and 1,600 (CV=0.65) *Globicephala* sp. from Canadian aerial surveys in late August and early September in the Gulf of St. Lawrence in 1995 and 1998 (Kingsley and Reeves 1998)~~, where the estimate from the U.S. survey was 8,176 (CV=0.65) and from the Canadian was 1,600 (CV=0.65)~~.

~~An abundance of 9,800 (CV=0.34) *Globicephala* sp. was estimated from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Figure 1; Table 1; Palka et al. Unpublished Ms.).~~ An abundance estimate of 14,909 (CV = 0.26) *Globicephala* sp. was obtained from the sum of the estimate of 9,800 *Globicephala* sp. (CV=0.34) from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 5,109 (CV = 0.41) *Globicephala* sp., estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003).~~Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 5,109 (CV = 0.41) *Globicephala* sp. was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Figure 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993b; Laake *et al.* 1993) where school size bias and ship attraction were accounted for.~~

~~The best 1998 abundance estimate for *Globicephala* sp. is 14,909 (CV = 0.26), the sum of the estimates from the two U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 9,800 (CV=0.34) and from the southern U.S. Atlantic is 5,109 (CV =0.41). This estimate is a recalculation of the same data reported in previous SARs. This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~ As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable and should not be used for PBR determinations. Further, due to changes in survey methodology, the earlier data should not be used to make comparisons with more current estimates.

Recent surveys and abundance estimates

An abundance estimate of 5,408 (CV=0.56) *Globicephala* sp. was obtained from an aerial survey conducted in

July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1; Palka 2006). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 15,728 (CV=0.34) ~~for~~ *Globicephala* sp. was ~~estimated~~ obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38ºN) to the Bay of Fundy (45ºN) (~~Figure~~ Table 1; Palka ~~Unpublished Ms.~~2006). Shipboard data were collected using the two independent team ~~line~~ 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..~~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 50x 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, ~~resulting in~~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 ~~analyzed to~~ corrected for visibility bias *g(0)* and group-size bias ~~employing~~ and analyzed using ~~line~~ line-transect distance analysis ~~and the direct duplicate estimator~~ (Palka, 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 15,411 animals (CV =0.43).

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

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

Month/Year	Area	N_{best}	CV
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~9,800~~	~~0.34~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~5,109~~	~~0.41~~
~~Jul-Sep 1998~~	~~Florida to Gulf of St. Lawrence (COMBINED)~~	~~14,909~~	~~0.26~~
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	15,411	0.43
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	31,139	0.27
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity obtained from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth is 177 cm; mean length at sexual maturity is 490 cm for males and 356 cm for females; age at sexual maturity is 12 years for males and 6 years for females; mean adult length is 557 cm for males and 448 cm for females; and maximum age was 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data from animals taken in the Faroe Islands drive fishery produced higher values for all parameters (Bloch *et al.* 1993; Desportes *et al.* 1993; Martin and Rothery 1993). These differences are likely related, at least in part, to larger sample sizes and different analytical techniques.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Globicephala* sp. i~~I~~s 24,866. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997).~~this stock is of unknown status~~. ~~Stock status will be determined when trawl fishery bycatch estimates are complete.~~ PBR for the western North Atlantic *Globicephala* sp. is 249. It is not possible to determine the PBR for only short-finned pilot whales.

ANNUAL HUMAN-CAUSED MORTALITY

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the two species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury. ~~Preliminary fishery mortality estimates have been generated for the years 2001~~0-~~2005~~4. ~~The estimates will not be reported until scientific review is complete. The scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006.~~

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA). ~~Foreign fishing operations for squid ceased at the end of the 1986 fishing season and, for mackerel, at the end of the 1991 fishing season.~~

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities (Waring *et al.* 1990; Waring 1995). A total of 391 pilot whales (90%) was taken in the mackerel fishery, and 41

(9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. Due to temporal fishing restrictions, the bycatch occurred during winter/spring (December to May) in continental shelf and continental shelf edge waters (Fairfield *et al.* 1993; Waring 1995); however, the majority of the takes occurred in late spring along the 100m isobath. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

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

Five pilot whale (*Globicephala* sp.) mortalities were reported in the self-reported fisheries information for the Atlantic tuna pair trawl in 1993. In 1994 and 1995 observers reported 1 and 12 mortalities, respectively. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery in 1994 was 2.0 (CV=0.49) and 22 (CV=0.33) in 1995.

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

No pilot whales were taken in observed mid-Atlantic Coastal Gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, 0 during 1999-2003. Observed effort was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7 in 1998 (1.10).

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

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

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

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

Pelagic Longline

Most of the estimated marine mammal bycatch is from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Yeung 2001; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and ~~2004~~2005, ~~68~~ 109 pilot whales ~~(including 2 identified as short-finned pilot whales)~~ were released alive, including ~~38~~ 61 that were considered seriously injured ~~(of which 1 was identified as a short-finned pilot whale),~~ and 4~~3~~ mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006). January-March bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras. Bycatch was recorded in this area during April-June, and takes also occurred north of Hydrographer Canyon off the continental shelf in water over 1,000 fathoms during April-June. During the July-September period, takes occurred on the continental shelf edge east of Cape Charles, Virginia, and on Block Canyon slope in over 1,000 fathoms of water. October-December bycatch occurred between the 20 and 50 fathom isobaths between Barnegat Bay and Cape Hatteras. The estimated fishery-related mortality to

pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.0), 20 (CV = 1.0) in 2001, 2 (CV =1.0) in 2002, 0 in 2003-2005~~4~~. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV= 0.51) in 1995, (includes 37 estimated short-finned pilot whales in 1995 (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV = 0.58), 51 in 2002 (CV = 0.48), 21 in 2003 (CV = 0.78), ~~and~~ 74 in 2004 (CV=0.42), and 212 in 2005 (CV=0.21)~~.~~. The average 'combined' annual mortality in ~~2000-2004~~2001-2005 was ~~70~~ 86 pilot whales (CV=0.~~37~~16) (Table 2).

Mid-Atlantic Bottom Trawl

~~—~~Two pilot whales were observed taken in the Mid-Atlantic bottom trawl in 2000 and four in 2005. ~~Preliminary The estimates will not be reported until scientific review is complete. The scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006.~~ The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38(CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, and 31 (0.31) in 2005. The 2001-2005 average mortality attributed to the Mid-Atlantic bottom trawl was 38 animals (CV=0.15).
~~The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 16 (CV=0.47) in 2000, 13 (CV=0.45) in 2001, 8 (CV=0.44) in 2002, 10 (CV=.46) in 2003 and 12 (CV=0.51) in 2004. 12 22~~

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004 and four in 2005. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, and 15 (0.30) in 2005. The 2001-2005 average mortality attributed to the northeast bottom trawl was 19 animals (CV=0.12).
~~: 9 (CV=0.54) in 2000, 10 (CV=0.53) in 2001, 12 (CV=0.45) in 2002, 9 (CV=0.50) in 2003 and 8 (CV=0.53) in 2004. 105~~

GOM/GB Herring Mid-Water Trawl JV and TALFF

There were no marine mammal takes observed from the domestic mid-water trawl fishing trips between ~~2000-2004.~~2001-2005.

A U.S. joint venture (JV) mid-water (pelagic) trawl fishery was conducted on Georges Bank from August to December 2001. Eight pilot whales were incidentally captured in a single mid-water trawl during JV fishing operations. Three pilot whales were incidentally captured in a single mid-water trawl during foreign fishing operations (TALFF) (Table 2). The ~~2000-2004~~2001-2005 average mortality attributed to the Atlantic herring mid-water trawl fishery was ~~11~~ 11 animals (Table 2).

Northeast Mid-Water Trawl – Including Pair Trawl

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

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

The observer coverage in this fishery was highest after 2003, though a few trips in other years were observed (Table 2). No pilot whales were observed bycaught in this fishery between 2001-2005, though because of data pooling, estimates were still generated. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-

water trawls (Palka, pers. com.). The model that best fit these data was a Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were unknown in 2001-2002, 3.9 (0.46) in 2003, 8.1 (0.38) in 2004, and 7.5 (.76) in 2005 (Table 2; Palka pers. com.). The average annual estimated fishery-related mortality during 2001-2005 was 7 (0.34).

~~**Northeast Mid-Water Trawl – Including Pair Trawl**~~

~~The two most commonly targeted fish in this fishery are herring (94% of VTR records) and mackerel (0.4%). Thus, the observer coverage and bycatch estimates are only for these two sub-fisheries. The observer coverage in this fishery was highest during 2003 and 2004, though a few trips in earlier years were observed (Table 2). A pilot whale was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) in a haul that was targeting (and primarily caught) herring. Due to small sample sizes, the bycatch rate model used all observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls, thattrawls, which targeted either herring or mackerel and were observed between 1999 and 2004 (Palka, in prep). The model that best fit these data was a binomial logistic regression model that included target species and bottom slope as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were: 4.6 (0.74) in 2000, 11 (0.74) in 2001, 8.9 (0.74) in 2002, 14 (0.74) in 2003, and 5.8 (0.74) in 2004, and ?? (0.??) in 2005 (Table 2; Palka in prep.). The average annual estimated fishery-related mortality during 2002-2004 was 8.9 (0.35).~~

CANADA

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

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

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

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

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

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[d]	0~~0~~1-0~~4~~5	unk	Obs. Data Dealer	~~.01,~~ .01, .01, .01, .03, .03	0, 0, 0, 0, 0	~~2,~~ 0, 0, 0, 0, 4	0, 0, 0, 0, 0	39, 38, 31, 35, 31~~,~~ ~~unk~~	39, 38, 31, 35, 31~~,~~ ~~unk~~	.31, .36, .31, .33, .31~~,~~ ~~unk~~	38(.15)~~1~~ ~~4~~

Northeast Bottom Trawl[d]	0~~0~~1-0~~4~~5[d]	unk	Obs. Data Dealer Data VTR Data	~~.01,~~ .01, .03, .04, .05, .12	0, 0, 0, 0, 0	0, 0, 0, 0, 2, 4	0, 0, 0, 0, 0	21, 22, 20, 15, 15~~,~~ ~~unk~~	21, 22, 20, 15, 15~~,~~ ~~unk~~	.27, .26, .26, .29, .30~~,~~ ~~unk~~	19(.12)~~1~~ ~~05~~
GOM/GB Herring Mid-Water Trawl JV and TALFF[e]	2001	10[f]	Obs. Data	1[g]	0	11	0	11	11	NA	11 (NA)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[j]	01-05	23, 20, 23, 25, 31	Obs. Data Dealer Data VTR Data	0, .003, .018, .064, .084	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	unk, unk, 3.9, 8.1, 7.5	unk, unk, 3.9, 8.1, 7.5	unk, unk, .46, .38, .76	7 (.34)
Northeast Mid-Water Trawl - Including Pair Trawl[e]	01-05	24, 27, 28, 22, 25	Obs. Data Dealer Data VTR Data	.001, 0, .031, .126, .199	0, 0, 0, 0, 0	0, 0, 0, 1, 0	0, 0, 0, 0, 0	~~unk,~~ unk, unk, 1.9, 1.4, 1.1	~~unk,~~ unk, unk, 1.9, 1.4, 1.1	~~unk,~~ unk, unk, .56, .58, .68	1 (.35)
Pelagic Longline (excluding NED-E)[h]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	4, 4, 2, 6, 9	1, 0, 0, 0, 0	50, 52, 21, 74, 212	20, 2, 0, 0, 0	70, 54, 21, 74, 212	.50, .46, .77, .42, .21	86 (.16)
Pelagic Longline - NED-E area only[h]	01-03	9, 14, 11	Obs. Data Logbook	1, 1, 1	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0	0
2005 Pelagic Longline experimental fishery[i]	05	6	Obs. Data	1	1	0	1	0	1	na	1(na)
TOTAL											163(..09)

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).

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

d. A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast trawl fisheries during 2000-2005. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2005. ~~Observed takes in bottom trawl during 2005 are under review, so a four-year mean for the period 2001-2004 is reported.~~ ~~**Bottom trawl 2000-2004 estimates were not published in the 2006 SAR so are reported here to document the revised mortality estimates. Observed takes in bottom trawl during 2005 are under review.**~~ In addition, the fisheries listed in Table 2 reflect definitions defined by the 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 fishery'.

e. NA=No joint venture or TALFF fishing effort for Atlantic herring.

f. Three foreign vessels and seven American vessels.

g. During joint venture fishing operations, nets that are transferred from the domestic vessel to the foreign vessels for processing are observed on board the foreign vessel. There may be nets fished by domestic vessels that do not get transferred to a foreign vessel for processing and therefore would not be observed. During TALFF fishing operations all nets fished by the foreign vessel are observed.

h. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001-December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and

for ONLY the NED in the second row. No mortalities or serious injuries were observed for pilot whales in the NED-E, though 1 pilot whale was caught alive and released without injury (Garrison, 2003; Garrison and Richards, 2004).

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

j. The data used to predict bycatch rates to estimate annual mortality were pooled over the years 2001-2005. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along the eastern U.S. seaboard since 1980 (NMFS 1993b, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From ~~2000-2004~~2001-2005, ~~42~~ 76 short-finned pilot whales (*Globicephala macrorhynchus*), ~~120~~ 139 long-finned pilot whales (*Globicephala melas*), and ~~4~~ 9 pilot whales not specified to the species level (*Globicephala* sp.) ~~have been~~were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) ~~when recorded,~~ (Table 3). This includes several mass strandings as follows: 11 long-finned pilot whales mass stranded in Nantucket, MA in 2000 and 57 in 2002 in Dennis, MA; ~~and~~ 28 short-finned pilot whales stranded in Content Passage, Monroe County, FL (ocean side) on April 18, 2003~~.~~; and 18 pilot whales (including one pregnant female) were part of a multi-species mass stranding in Barnstable County, MA on 10 December, 2005. Two juvenile animals that live stranded in Chatham, Massachusetts in 1999 were rehabilitated, satellite tagged and released (Nawojchik *et at*. 2003). Both animals were released off eastern Long Island, New York and tracked for four months in the Gulf of Maine. Four of 6 animals from one live stranding event in Massachusetts in 2000 were rehabilitated and released. However, certain studies have shown that frequently~~,~~ animals that are returned to the water swim away and strand someplace else (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980). The fate of the animals is footnoted in Table 3, when recorded.

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

A Mid-Atlantic Offshore Small Cetacean UME, was declared when ~~85~~33 small cetaceans stranded from Maryland to Georgia between ~~3~~ July ~~2004~~ and ~~16 January 2005~~September 2004. The species involved are generally found offshore and are not expected to strand along the coast. ~~Thirty-three~~One short-finned pilot whale~~s~~ (*Globicephala macrorhynchus*) ~~and 1 unidentified pilot whale (*Globicephala* sp.) were~~was involved in this UME. ~~This included~~ ~~a~~A mass stranding of thirty-~~one~~three short-finned pilot whales, including five pregnant females, near Cape Hatteras, NC from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn et al. 2006), though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings".

Table 3. Pilot whale (*Globicephala macrorhynchus* (SF), *Globicephala melas* (LF) and *Globicephala* sp. (Sp) strandings along the Atlantic coast, 2001-2005. Strandings which were not reported to species have been reported as Globicephala sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded pilot whales to species, reports to specific species should be viewed with caution.

STATE	2001			2002			2003			2004			2005			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	3[b]	0	0	7[c]	0	0	2	0	0	3	0	0	2	0	0	17
Maine	1	5[d]	0	0	2	0	0	1	0	0	4	0	0	2	0	1	14	0
New Hampshire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Massachusetts	0	3	0	0	65[e]	0	0	5	0	0	1	0	0	22[o]	0	0	96	0
Rhode Island	1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	3	0
Connecticut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New York	0	1	0	0	0	0	0	0	0	0	3	0	0	1	0	0	5	0
New Jersey	0	0	0	0	0	0	0	6[f]	0	0	0	0	0	0	2	0	6	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4	0
Virginia	0	0	0	0	0	0	0	3	0	0	0	1[g]	0	4[p]	0	0	7	1
North Carolina	1	0	1	0	0	0	2	0	1	1[h]	1	1[h]	35[m,n]	1	2	39	2	5
South Carolina	1	0	0	0	0	0	0	1[i]	0	0	0	0	0	0	0	1	1[i]	0
Georgia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida	0	0	0	0	0	0	29[j,k]	0	0	4	0	0	0	0	0	33	0	0
Puerto Rico	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
EEZ	0	0	0	0	0	0	0	1[l]	0	0	0	0	0	0	1	0	1	1
TOTALS - U.S., Puerto Rico, & EEZ	5	9	1	0	68	0	31	18	1	5	10	2	35	34	5	76	139	9

a. Data supplied by Tonya Wimmer, Nova Scotia Marine Animal Response Society (pers. comm.).
b. Three mass live stranded animals at Judique, Inverness County on July 19, 2001 - all returned to sea.
c. Includes 4 mass strandings at Point Tupper, Inverness County on January 11, 2002 - fate unreported.
d. Includes one long finned pilot whale stranded with possible propeller marks in Maine in September 2001.
e. Includes mass stranding of 57 long-finned pilot whales in Dennis, MA in July 2002 – majority of pod refloated and released, but rebeached 1-2 days later; ~30 animals euthanized, and ~11 animals died during the strandings.
f. Two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes.
g. One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated).
h. One short-finned pilot whale (September 2004) and one pilot whale (November 2004) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in North Carolina in February, not related to any UME.
i. Only moderate confidence on species identification as long-finned pilot whale.
j. Includes mass live stranding of 28 short-finned pilot whales in Content Passage, Monroe County, FL (Ocean side) on April 19, 2003 - 12 animals died or were euthanized at the scene, 9 were returned to sea, 7 were taken into rehabilitation of which 2 subsequently died and 5 were released to sea on August 10, 2003.
k. Signs of human interaction reported on 1 stranded short-finned pilot whale (not part of the live mass stranding), which stranded in May 2003 in Florida.
l. One long-finned pilot whale floating dead on Georges Bank offshore.
m. Includes Unusual Mortality Event mass stranding of 33 short-finned pilot whales in Dare, NC on 15-16 January, 2005, including five pregnant females. Six animals had fishery interaction marks, which were healed and not the cause of death.
n. Signs of fishery interaction observed on a short-finned pilot whale stranded in May in NC.
o. Includes 18 pilot whales which were part of a multi-species mass stranding in Barnstable County, MA on 10 December, 2005. This includes one pregnant female.
p. Sign of human interaction (a line on the flukes) observed in both animals, and one animal was a pregnant female.

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

only moderate. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

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

Between ~~2000-2004~~2001-2005, human and/or fishery interactions were documented as follows: one long-finned pilot whale stranded with possible propeller marks in Maine in September 2001, two long-finned pilot whales stranded dead separately in April 2003 off New Jersey with rope tied around the flukes, and signs of human interaction were reported (but no specifics recorded in database) on 1~~ stranded~~ -short-finned pilot whale~~ (not part of the live mass stranding),~~ which stranded in May 2003 in Florida. During a UME in Dare, NC in January 2005, six of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) which were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in NC had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. Two long-finned pilot whales stranded in Virginia in April 2005, one with a line on its flukes and another with human interactions noted but specifics not given.

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

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

STATUS OF STOCK

The status of short-finned pilot whales relative to OSP in the U.S. Atlantic EEZ is unknown~~, but stock abundance may have been affected by reduction in foreign fishing, curtailment of the Newfoundland drive fishery for pilot whales in 1971, and increased abundance of herring, mackerel, and squid stocks~~. There are insufficient data to determine ~~the~~ population trends for this species. The species is not listed under the Endangered Species Act. The total fishery-related mortality and serious injury for *Globicephala* sp. ~~this stock~~ is not less than 10% of the calculated PBR, and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because the 2001-2005 estimated average annual human related mortality does not exceed PBR. However, the continuing inability to distinguish between species of pilot whales raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

~~***The status of this stock cannot be determined until the trawl bycatch mortality analysis is complete (Table 2).***~~

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Benjamins, S., J. Lawson., and G. Stenson. (in press). Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. J. Cetacean Res. Manage.

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

14:117-135.

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

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

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

Dam, M. and D. Bloch. 2000. Screening of mercury and persistent organochlorine pollutants in long-finned pilot whale (*Globicephala melas*) in the Faroe Islands. Marine Pollution Bulletin 40:1090-1099.

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

Fairfield, C.P., G.T. Waring and M.H. Sano. 1993. Pilot whales incidentally taken during the distant water fleet Atlantic mackerel fishery in the mid-Atlantic Bight, 1984-88. pp. 107-116. *In:* G.P. Donovan, C.H. Lockyer and A. R. Martin (eds.) Biology of Northern Hemisphere Pilot Whales. Rep. int. Whal. Commn (Special Issue) 14: i-x + 479 pp.

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149

Fehring, W.K. and R.S. Wells. 1976. A series of strandings by a single herd of pilot whales on the west coast of Florida. J. Mamm. 57(1):191-194.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Hansen, L.J., K.D. Mullin, T.A. Jefferson, and G.P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. pp. 179-189. *In*: G.W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald, and D. G. Robertson (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam. 287 pp.

Hooker, S. K., R. W. Baird, and M. A. ShowelI. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Paper SC/49/05 presented to the IWC Scientific Committee, September 1997. 11 pp.

Hohn, A.A., D.S. Rotstein, C.A. Harms, and B.L. Southall. 2006. Report on marine mammal unusual mortality event UMESE0501Sp: Multispecies mass stranding of pilot whales (*Globicephala macrorhynchus*), minke whale (*Balaenoptera acutorostrata*), and dwarf sperm whales (*Kogia sima*) in North Carolina on 15-16 January 2005. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-537, 222pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Irvine, A.B., M.D. Scott, R.S. Wells, and J.G. Mead. 1979. Stranding of the pilot whale, *Globicephala macrorhynchus*, in Florida and South Carolina. Fish. Bull., U.S. 77 (2):511-513.

Johnson, D.R., C.A. Brown, and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1992-1997. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-418. 70 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.

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

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial survey of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:1529-1550.

Laake, J.L., S.T. Buckland, D.R. Anderson, and K.P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado

Cooperative Fish and Wildlife Research Unit, Colorado State University, Ft. Collins, CO. 72 pp.

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

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES CM 1997/Q:8. 10pp.

Lucas, Z.N. and S.K. Hooker. 1997. Cetacean strandings on Sable Island, Nova Scotia, 1990-1996. Paper SC/49/06 presented to the IWC Scientific Committee, September 1997. 10 pp.

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field Nat. 114:45-61.

Marine Mammal Commission. 2006. US Marine Mammal Commission Annual Report to Congress, 2004. Marine Mammal Commission, Bethesda MD. Vi+163pp. Available at: htt://www.nefsc.noaa.gov/nefsc/publication/ 70 pp

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

Mercer, M.C. 1975. Modified Leslie-DeLury population models of the long-finned pilot whale (*Globicephala melaena*) and annual production of the short-finned squid (*Illex illecebrosus*) based upon their interactions at Newfoundland. J. Fish. Res. Bd. Can. 32(7):1145-1154.

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

Muir, D.C.G., R. Wagermann, N.P. Grift, R.J. Norstrom, M. Simon and J. Lien. 1998. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland. Canada Arch. Environ. Contam. Toxicol. 17:613-629.

Mullin, K. D. and G.L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172. *In:* R. W. Davis, W. E. Evans, and B. Würsig (ed~~itor~~s.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Nawojchik, R., D. J. St. Aubin, and A. Johnson. 2003. Movements and dive behavior of two stranded, rehabilitated long-finned pilot whales (*Globicephala melas*) in the northwest Atlantic. Mar. Mamm. Sci. 19(1):232-239.

Nielsen, J. B., F. Nielsen, P-J. Jρrgensen and P. Grandjean. 2000. Toxic metals and selenium in blood from pilot whales (*Globicephala melas*) and sperm whales (*Physeter catodon*). Mar. Pollut. Bull. 40:348-35.

NMFS [National Marine Fisheries Service] 1991. Northeast cetacean aerial survey and interplatform study. NOAA-NMFS-SEFSC and NEFSC. 4 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993a. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

NMFS [National Marine Fisheries Service]. 1993b. Status of fishery resources off the northeastern United States for 1993. U. S. Dep. Commer., NOAA Tech. Mem. NMFS-F/NEC-101, 140 pp.

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500160.

Odell, D. K., E. D. Asper, J. Baucom, and L. H. Cornell. 1980. A recurrent mass stranding of the false killer whale, *Pseudorca crassidens*, in Florida. Fish. Bull., U.S. 78(1):171-177.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjρrge and G.P. Donovan (eds.) Biology of the Phocoenids.. Rep. Int. Whal. Commn Special Issue 16 i-x + 552 pp.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. U.S. Dep. Commer., NOAA/NMFS/NEFSC. Ref. Doc. 96-04; 37 pp.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03, 41 pp.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int. Whal. Commn (Special Issue) 15:133-147.

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

Taruski, A.G., C.E. Olney, and H.E. Winn. 1975. Chlorinated hydrocarbons in cetaceans. J. Fish. Res. Bd. Can. 32(11):2205-2209.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

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

Waring, G. T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. U.S. Dep. Commer., NOAA NMFS NEFSC, Lab. Ref. Doc. No. 98-09, 21pp.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry, and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull., U.S. 88(2):347-360.

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

Weisbrod, A.V., D. Shea, M.J. Moore, and J.J. Stegeman. 2000. Bioaccumulation patterns of polychlorinated biphenyls and chlorinated pesticides in northwest Atlantic pilot whales. Environ. Toxicol. Chem. 19:667-677.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, National Marine Fisheries Service, Miami, FL, 43 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100m depth contour. The species inhabits waters from central West Greenland to North Carolina (about 35˚N) and perhaps as far east as 43˚W (Evans 1987; Hamazaki 2002). Distribution of sightings, strandings and incidental takes suggest the possible existence of three stocks units: Gulf of Maine, Gulf of St. Lawrence and Labrador Sea stocks (Palka *et al.* 1997). Evidence for a separation between the population in the southern Gulf of Maine and the Gulf of St. Lawrence population comes from a virtual absence of summer sightings along the Atlantic side of Nova Scotia. This was reported in Gaskin (1992), is evident in Smithsonian stranding records, and was obvious during abundance surveys conducted in the summers of 1995 and 1999 which covered waters from Virginia to the Gulf of St. Lawrence. White-sided dolphins were seen frequently in Gulf of Maine waters and in waters at the mouth of the Gulf of St. Lawrence, but only a few sightings were recorded between these two regions.

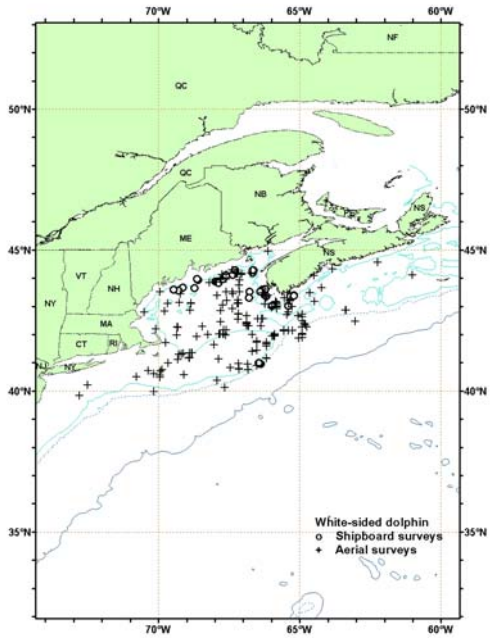


Figure 1. *Distribution of white-sided dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

The Gulf of Maine population of white-sided dolphins is most common in continental shelf waters from Hudson Canyon (approximately 39˚N) on to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sightings data indicate seasonal shifts in distribution (Northridge *et al.* 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia and North Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities. The Virginia and North Carolina observations appear to represent the southern extent of the species' range.

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

POPULATION SIZE

The total number of white-sided dolphins along the eastern U.S. and Canadian Atlantic coast is unknown, although eight~~five~~ estimates from select regions are available from: 1) spring, summer and autumn 1978-1982; 2) July-September 1991-1992; 3) June-July 1993; 4) July-September 1995;~~ and~~ 5) July-August 1999; 6) August 2002; 7) June-July 2004; and 8) August 2006~~ (Figure 1; Table 1)~~. The best available current abundance estimate for white-sided dolphins in the western North Atlantic stock is 63,368~~131,970~~ (CV=0.27~~30~~), an average of the surveys conducted in August within the last 8 years (2002 and 2006). An average is used to account for the~~ as estimated from the August 2002 line-transect survey because this survey is recent and provided an estimate when the largest portion of the population was within the study area. The~~ large inter-annual variability of the~~se~~ abundance estimates for this species. This variability may be associated with the water temperature and prey patterns.

Earlier abundance estimates

An abundance estimate of 28,600 white-sided dolphins (CV=0.21) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 20,400 (CV=0.63) white-sided dolphins was obtained from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Palka *et al.* 1997). An abundance estimate of 729 (CV=0.47) white-sided dolphins was obtained from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel, to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance estimate of 27,200 (CV=0.43) white-sided dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered 32,600 km in waters from Virginia to the mouth of the Gulf of St. Lawrence. Kingsley and Reeves (1998) estimated that there were 11,740 (CV=0.47) white-sided dolphins in the Gulf of St. Lawrence during 1995 and 560 (CV=0.89) white-sided dolphins in the northern Gulf of St. Lawrence during 1996. It is assumed these estimates apply to the Gulf of St. Lawrence stock. During the 1995 survey, 8,427 km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993 km of track lines were flown in an area of 94,665 km^2 during July and August. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

~~An abundance of 28,600 white-sided dolphins (CV=0.21) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982).~~

~~An abundance of 20,400 (CV=0.63) white-sided dolphins was estimated from two shipboard line transect surveys conducted during July to September 1991 and 1992 in the northern Gulf of Maine-lower Bay of Fundy region (Palka *et al.* 1997). This population size is a weighted average of the 1991 and 1992 estimates, where each annual estimate was weighted by the inverse of its variance.~~

~~An abundance of 729 (CV=0.47) white-sided dolphins was estimated from a June and July 1993 shipboard line transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (NMFS 1993).~~

~~An abundance of 27,200 (CV=0.43) white-sided dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka, Unpublished Ms.). Total track line length was 32,600km. The ships covered waters between the 50 and 1000 fathom contours, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the mid-Atlantic from the coastline to the 50 fathom line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom line. Data collection and analysis methods used were described in Palka (1996).~~

An abundance estimate of 51,640 (CV=0.38) white-sided dolphins was ~~estimated~~ obtained from a 28 July to 31 August 1999 line-transect sighting survey conducted from a ship and an airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence ~~(Table 1; Figure 1; D. Palka, Unpublished Ms.)~~. Total track line length was 8,212 km. ~~Using methods similar to that used in the above 1995 survey, s~~Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) ~~that~~ which accounts for school size bias and for *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)* (Palka 2000). The 1999 estimate is larger than the 1995 estimate due to, at least in part, the fact that the 1999 survey covered the upper Bay of Fundy and the northern edge of Georges Bank for the first time and white-sided dolphins were seen in both areas.

An abundance estimate 109,141~~31,974~~ (CV=0.30) white-sided dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1~~; Palka 2006~~). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 2,330~~3,290~~ (CV=0.80~~3~~) white-sided dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed. (Table 1~~; Palka 2006.~~). Shipboard data were collected using the two independent

team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Palka 2005).

An abundance estimate of 17,594~~26,110~~ (CV=0.30~~1~~) white-sided dophins was generated from an aerial survey conducted in August 2006 which surveyed 10,676 km of trackline in the region from the 2000m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.)

The average abundance estimate of white-sided dolphins from surveys conducted in August during the last 8 years (2002 and 2004) is 63,368 (CV=0.27). An average was used to incorporate the large inter-annual variability and thus provide an average number of white-sided dolphins that could be within the Gulf of Maine-western Scotian shelf region.

~~An estimate of abundance for the August 2002 survey was 131,974 (CV=0.30), 3,290 (CV=0.83) for June-July 2004, and 26,110 (CV=0.31) for August 2006. The summer 2002, 2004 and 2006 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.~~

~~Kingsley and Reeves (1998) estimated that there were 11,740 (CV=0.47) white-sided dolphins in the Gulf of St. Lawrence during 1995 and 560 (CV=0.89) white-sided dolphins in the northern Gulf of St. Lawrence during 1996 (Table 1). It is assumed these estimates apply to the Gulf of St. Lawrence stock. During the 1995 survey, 8,427km of track lines were flown in an area of 221,949km^2 during August and September. During the 1996 survey, 3,993km of track lines were flown in an area of 94,665km^2 during July and August. Data were analyzed using Quenouille's jackknife bias reduction procedure on line transect methods that model the left-truncated sighting curve. These estimates were uncorrected for visibility biases, such as *g(0)*.~~

~~The best available current abundance estimate for white-sided dolphins in the Gulf of Maine stock is 131,97051,640 (CV=0.308) as estimated from the July to August 20021999 line transect survey because this survey is recent and provided anthe estimate when the largest portion of the population was within the study area.most complete coverage of the known habitat. The large inter-annual variability of these abundance estimates may be associated with the water temperature and prey patterns.~~

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

Month/Year	Area	N_{best}	CV
	~~Gulf of Maine stock~~		
Jul-Aug 1999	Georges Bank to mouth of Gulf of St. Lawrence	51,640	0.38
Aug 2002	S. Gulf of Maine to Maine	109,141	0.30
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	2,330	0.80
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	17,594	0.30
	~~Gulf of St. Lawrence stock~~		

~~July-Aug 1996~~	~~Northern Gulf of St. Lawrence~~	~~560~~	~~0.89~~

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 ~~Gulf of Maine~~western North Atlantic stock of white-sided dolphins is 63,368~~51,640~~ (CV=0.27~~38~~). The minimum population estimate for these white-sided dolphins is 50,883~~37,904~~.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity include: calving interval is 2-3 years; lactation period is 18 months; gestation period is 10-12 months and births occur from May to early August, mainly in June and July; length at birth is 110cm; length at sexual maturity is 230-240 cm for males, and 201-222 cm for females; age at sexual maturity is 8-9 years for males and 6-8 years for females; mean adult length is 250 cm for males and 224 cm for females (Evans 1987); and maximum reported age for males is 22 years and for females, 27 years (Sergeant *et al.* 1980).

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 50,883~~37,904~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997).~~this stock is of unknown status~~. PBR for the ~~Gulf of Maine stock of the~~ western North Atlantic stock of white-sided dolphin is 509~~379~~.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III~~. Recently, within U.S. waters, white-sided dolphins have been observed caught in the Northeast sink gillnet, Northeast bottom trawl, Northeast mid-water trawl, mid-Atlantic bottom trawl, mid-Atlantic mid-water trawl, and the Gulf of Maine/Georges Bank herring trawl TALFF fisheries (Table 2). Preliminary fishery mortality estimates have been generated for the years 2000-2004. The estimates will not be reported until scientific review is complete.~~

Earlier Interactions

~~In the past, incidental takes of white-sided dolphins have been recorded in the Atlantic foreign mackerel and pelagic drift gillnet, and mid-Atlantic gillnet fisheries. Fisheries information is reported in Appendix III.~~

NMFS observers in the Atlantic foreign mackerel fishery reported 44 takes of Atlantic white-sided dolphins incidental to fishing activities in the continental shelf and continental slope waters between March 1977 and December 1991 (Waring *et al.* 1990; NMFS unpublished data). Of these animals, 96% were taken in the Atlantic mackerel fishery. This total includes 9 documented takes by U.S. vessels involved in joint-venture fishing operations in which U.S. captains transfer their catches to foreign processing vessels. No incidental takes of white-sided dolphins were observed in the Atlantic mackerel JV fishery when it was observed in 1998.

During 1991 to ~~1998~~2005, two white-sided dolphins were observed taken in the Atlantic pelagic drift gillnet fishery, both in 1993. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 4.4 (.71) in 1989, 6.8 (.71) in 1990, 0.9 (.71) in 1991, 0.8 (.71) in 1992, 2.7 (0.17) in 1993 and 0 ~~in~~ from 1994 to

~~1998~~2005. There was no fishery during 1997.

The mid-Atlantic gillnet fishery occurs year round from New York to North Carolina and has been observed since 1993. One white-sided dolphin was observed taken in this fishery during 1997. None were observed taken in other years. The estimated annual mortality (CV in parentheses) attributed to this fishery was 0 for 1993 to 1996, 45 (0.82) for 1997, 0 for 1998 to 2001, unknown in 2002 and 0 in 2003-2005. ~~During 2002, the overall observer coverage was lower than usual, 1% over the entire coast, where 65% of those trips were off of Virginia and most of the rest of the area was not sampled at all. Thus, the low coverage was mostly concentrated in one time and area. In conclusion, a bycatch estimate from the unsurveyed areas cannot be confidently estimated.~~

~~No incidental takes of white-sided dolphin were observed in the Atlantic mackerel JV fishery when it was observed in 1998.~~

U.S.

Northeast Sink Gillnet

This fishery occurs year round from in the Gulf of Maine, Georges Bank and in southern New England waters. Between 1990 and ~~2004~~ 2005 there were ~~49~~ 54 white-sided dolphin mortalities observed in the Northeast sink gillnet fishery. Most were taken in waters south of Cape Ann during April to December. In recent years, the majority of the takes have been east and south of Cape Cod. During 2002, one of the takes was off Maine in the fall Mid-coast Closure Area in a pingered net. Estimated annual fishery-related mortalities (CV in parentheses) were 49 (0.46) in 1991, 154 (0.35) in 1992, 205 (0.31) in 1993, 240 (0.51) in 1994, 80 (1.16) in 1995, 114 (0.61) in 1996 (Bisack 1997a), 140 (0.61) in 1997, 34 (0.92) in 1998, 69 (0.70) in 1999, 26 (1.00) in 2000, 26 (1.00) in 2001, 30 (0.74) in 2002, 31 (0.93) in 2003, ~~and~~ 7 (0.98) in 2004, and 59 (0.49)in 2005. Average annual estimated fishery-related mortality during ~~2000~~2001-~~2004~~ 2005 was ~~24~~ 31 white-sided dolphins per year (0.~~43~~35) (Table 2).

Northeast Bottom Trawl

~~The fishery is active in New England waters in all seasons. One moderately decomposed dolphin was brought up during a monkfish trawl in April 2001 east of Cape Cod. This moderately decomposed animal could not have been killed during this haul because the haul duration was only 4.6 hours. Thirty-two Seventy-nine~~Forty-three mortalities were documented between 1991 and ~~2004~~ 2005 in the Northeast bottom trawl fishery; 1 during 1992, 0 in 1993, 2 ~~during~~ in 1994, 0 in 1995-2001, 1 in 2002, 12 in 2003, ~~and~~ 16 in 2004, and ~~47~~12 in 2005~~.~~ Estimated annual fishery-related mortalities (CV in parentheses) were 110 (0.97) in 1992, 0 in 1993, 182 (0.71) in 1994, 0 in 1995-1999, 137 (0.34) in 2000, 161 (0.34) in 2001, 70 (0.32) in 2002, 216 (0.27) in 2003, 200 (0.30) in 2004, and 213 (0.28) in 2005. ~~Estimated annual fishery-related mortalities (CV in parentheses) were~~ ~~The 1 white-sided dolphin taken in 1992 was in a haul that was composed of 43% cod, 20% silver hake and 17% pollock. One of the 1994 takes was in a haul that was composed of 42% white hake, 19% pollock and 16% monkfish. The other 1994 take was in a haul that kept seven species of which none were dominant. In 2002, there was one take reported through the Marine Mammal Authorization Program (MMAP) that was taken in a North Atlantic bottom trawl haul. Preliminary~~ The 2001-2005 average mortality attributed to the northeast bottom trawl was 192 animals (CV=0.13)(Table 2).

~~estimates of mortality attributed to the Northeast bottom and mid-Atlantic fisheries have been generated for the years 2000-2004. The estimates will not be reported until scientific review is complete.~~

Northeast Atlantic (Gulf of Maine/Georges Bank) JV and TALFF Herring Fishery

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

Northeast Mid-water Trawl Fishery (Including Pair Trawl)

~~The two most commonly targeted fish in this fishery are herring (94% of VTR records) and mackerel (0.4%). Thus, the observer coverage and bycatch estimates are only for these two sub-fisheries.~~ The observer coverage in this fishery was highest ~~during~~ after 2003~~ and 2004~~, though a few trips in earlier years were observed (Table 2). A white-sided dolphin was observed taken in the single trawl fishery on the northern edge of Georges Bank (off of Massachusetts) during July 2003 in a haul that was targeting (and primarily caught) herring and 3 white-sided dolphins were taken in 2005 in paired trawls targeting herring. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 ~~all~~ observed mid-water trawl data~~, including~~ from paired and single~~, and N~~northeast and mid-Atlantic mid-water trawls~~, that targeted either herring or mackerel and were observed between~~

~~1999 and 2004~~ (Palka, pers. com.~~in prep~~). The model that best fit these data was a Poisson ~~binomial~~ logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls~~target species and bottom slope~~ as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were ~~4.3 (0.74) in 1999, 4.5 (0.74) in 2000, 8.9 (0.74) in 2001, 14 (0.44) in~~ unknown in 2001-2002, ~~2.0~~24 (0.~~74~~56) in 2003, ~~and 0.5~~19 (0.58) in 2004, and 15(.68) in 2005 (Table 2; Palka ~~in prep~~pers. com.). The average annual estimated fishery-related mortality during ~~2002~~2001-~~2004~~ 2005 was ~~6.0~~19 (0.~~33~~35).

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

~~The two most commonly targeted fish in this fishery are herring (54% of VTR records) and mackerel (26%). Thus, the observer coverage and bycatch estimates are only for these two sub-fisheries.~~ The observer coverage in this fishery was highest ~~during 2000,~~after 2003~~ and 2004~~, though a few trips in other years were observed (Table 2). A white-sided dolphin was observed taken in the pair trawl fishery near Hudson Canyon (off New Jersey) during February 2004 in a haul that was targeting mackerel (and landed nothing). In 2005, 5 white-sided dolphins were taken in paired trawls targeting mackerel. Due to small sample sizes, the bycatch rate model used the 2003 to September 2006 ~~all~~ observed mid-water trawl data, including paired and single, and Northeast and mid-Atlantic mid-water trawls~~, that targeted either herring or mackerel and were observed between 1999 and 2004~~ (Palka, in prep). The model that best fit these data was a ~~binomial~~ Poisson logistic regression model that included latitude, bottom depth, and whether a kite panel was used on pair-trawl hauls ~~target species and bottom slope~~ as significant explanatory variables, and soak duration as the unit of effort. Estimated annual fishery-related mortalities (CV in parentheses) were ~~0 (0.55) in 1999, 0 (0.55) in 2000, 0 (0.55) in 2001, 9.4 (0.55) in~~unknown in 2001-~~-~~2002, ~~73~~ 51 (0.~~55~~46) in 2003, ~~and 31~~ 105 (0.~~55~~38) in 2004, and 97(.76) in 2005 (Table 2; Palka ~~in prep~~pers. com.). The average annual estimated fishery-related mortality during ~~2000~~2001-~~2004~~ 2005 was ~~23~~ 84 (0.~~39~~34).

Mid-Atlantic Bottom Trawl Fishery

One white-sided dolphin incidental take was observed in 1997~~ where the~~, resulting in a~~estimated~~ mortality estimate ~~was~~ of 161 (CV=1.58) animals. No takes were observed from 1998 through 2004, and one take was observed in 2005. Recently observer coverage for this fishery was around 1%, except for 2004 where it was 3% (Table 2). ~~Preliminary~~ Estimated annual fishery-related mortalities (CV in parentheses) were 27 (0.17) in 2000, 27 (0.19) in 2001, 25 (0.17) in 2002, 31 (0.25) in 2003, 26 (0.20) in 2004, and 38 (0.29) in 2005.~~estimates of mortality attributed to the Northeast bottom and mid-Atlantic fisheries have been generated for the years 2000-2004.~~ . The 2001-2005 average mortality attributed to the mid-Atlantic bottom trawl was 29 animals (CV=0.11)~~The estimates will not be reported until scientific review is complete.~~

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	~~00~~01-~~04~~05	1993=349 1998=301	Obs. Data Weighout Trip Logbook	~~.06,~~ .04, .02, .03, .06, .07	~~1[e],~~ 1[e], 1[e], 1[e], 1[e], 5	~~26[e],~~ 26[e], 30[e], 31[e], 7[e], 59[e]	~~1.00,~~ 1.00, .74, .93, .98, .49[e]	~~24~~ 31 (0.~~43~~35)
Northeast Bottom ~~Trawl[d]~~Trawl[c]	~~00~~01-~~04[c]~~05~~4~~	~~tbd~~unk	Obs. Data Weighout	~~.01,~~ .01, .03, .04, .05, .12	~~0,~~ 0, 1, 12, 16, 47	~~102,~~ 161, 170, 216, ~~unk~~200,213 ~~tbd[e]~~	~~.20,~~ .34, .32, .27, .30, ~~unk.~~28 ~~tbd[e]~~	~~130 (0.09~~136~~92~~ (0.1~~0~~3) ~~tbd[e]~~
GOM/GB Herring Trawl-TALFF	2001	2[f]	Obs. Data	1.00[f]	2	2	0	2 (0)

Northeast Mid-water Trawl - Including Pair Trawl ~~(Herring and Mackerel only)~~[d]	~~00~~01-~~04~~05	24, 27, 28, 22, 25~~tbd~~	Obs. Data Weighout Trip Logbook	.001, 0, .031, .126, .199~~.005, .001, 0, .03, .14~~	~~0,~~0,0,1,0,3	~~4.5, 8.9, 14, 2.0, 0.5~~unk, unk, 24, 19, 15	~~.74, .74, .44, .74, .50~~unk, unk, .56, .58, .68	~~6.0~~ 19 (0.~~33~~35)
Mid-Atlantic Mid-water Trawl - Including Pair Trawl ~~(Herring and Mackerel only)~~ [d~~c~~]	~~00~~01-~~04~~05	~~tbd~~23, 20, 23, 25, 31	Obs. Data Weighout Trip Logbook	0, .003, .018, .064, .084~~.08, 0, .008, .04, .12~~	~~0,~~0,0,0,1,5	~~0, 0, 9.4, 73, 31~~unk, unk, 51, 105, 97	~~.55, .55, .55, .55, .55~~unk, unk, .46, .38, .76	~~23~~ 84 (0.34~~9~~)
Mid-Atlantic Bottom ~~Trawl[d]~~Trawl[c]	~~00~~01-~~04~~05	unk	Obs. Data Weighout Trip Logbook	~~.01,~~ .01, .01, .01, .03, .03	~~0,~~ 0, 0, 0, 0, 1	~~27,~~ 27, 25, 31, 26, ~~unk~~38~~tbd[e]~~	~~.25,~~ .19, .17, .25, .20, ~~unk~~29~~bd[e]~~	29 (.11) [e] ~~tbd[e]~~
Total								~~tbd~~357~~7~~(0.11)

a Observer data (Obs. Data), used to measure bycatch rates, are collected within the Northeast Observer Program. NEFSC collects landings data (Weighout) that are used as a measure of total effort in the Northeast gillnet fishery. Mandatory Vessel Trip Report (VTR) (Trip Logbook) data are used to determine the spatial distribution of fishing effort in the sink gillnet fishery and in the two mid-water trawl fisheries. In addition, the Trip Logbooks are the primary source of the measure of total effort (soak duration) in the two mid-water trawl fisheries.

b Observer coverages for the Northeast sink gillnet are ratios based on metric tons of fish landed. Observer coverages of the trawl fisheries are ratios based on trips.

~~c Preliminary estimates of mortality attributed to the Northeast bottom and mid-Atlantic fisheries have been generated for the years 2000-2004 but scientific review of the analysis is not complete. Therefore, mortality estimates are not reported in the bycatch table.~~

~~d~~c A new method was used to develop preliminary estimates of mortality for the mid-Atlantic and Northeast ~~bottom~~ trawl fisheries during 2000-~~2004~~2005. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-~~2004~~2005. ~~Observed takes in trawl during 2005 are under review, so a four-year mean for the period 2001-2004 is reported.~~ ~~**The bottom trawl 2000-2004 estimates were not published in the 2006 SAR so are reported here to document the revised trawl mortality estimates. Observed takes in bottom trawl during 2005 are under review.**~~ In addition, the fisheries listed in Table 2 reflect new definitions defined by the proposed List of Fisheries for 2005 (FR Vol. 69, No. 231, 2004). The 'North Atlantic bottom trawl' fishery is now referred to as the 'Northeast bottom trawl. The Illex, Loligo and Mackerel fisheries are now part of the mid-Atlantic and Northeast bottom trawl fisheries.

~~e~~d After 1998, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within the stratum where white-sided dolphins were observed taken. During the years 1997, 1999, 2001, 2002, and 2004, respectively, there were 2, 1, 1, 1, and 1 observed white-sided dolphins taken on pingered trips. No takes were observed on pinger trips during 1995, 1996, 1998~~ and~~ ,2000, and 2005.

~~f~~e There were two foreign vessels that harvested Atlantic herring in the U.S. fishery under a TALFF quota. During TALFF fishing operations all nets fished by the foreign vessel are observed.

CANADA

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

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

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

Herring Weirs

During the last several years, one white-sided dolphin was released alive and unharmed from a herring weir in

the Bay of Fundy- (A. Westgate, pers. comm.). Due to the formation of a cooperative program between Canadian fishermen and biologists, it is expected that most dolphins and whales will be able to be released alive. Fishery information is available in Appendix III.

Other Mortality

U.S.

Mass strandings involving up to a hundred or more animals at one time are common for this species. From 1968 to 1995, 349 Atlantic white-sided dolphins were known to have stranded on the New England coast (Hain and Waring 1994; Smithsonian stranding records 1996). The causes of these strandings are not known. Because such strandings have been known since antiquity, it could be presumed that recent strandings are a normal condition (Gaskin 1992). It is unknown whether human causes, such as fishery interactions and pollution, have increased the number of strandings. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because 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.

White-sided dolphin stranding records from 1997 that are in the NMFS/NE Regional Office strandings and entanglement database have been reviewed and updated. The most recent five years are reported in Table 3. Cause of death was investigated and it was determined that the documented human interactions were as follows: 1 animal possibly killed by a boat collision off Maine during 2001; 2 animals with indications of fishery interactions found in March 2002 in Massachusetts; and 1 animal with indications of fishery interactions found in May 2002 in Virginia, 1 animal with indications of fishery interactions was found in Massachusetts during 2004, and one animal during 2004 was found with twine blocking its esophagus (thus, this is a human interaction, but not necessarily a fishery interaction). In 2005 5 animals had signs of human interaction but in no case was the human interaction able to be determined to be the cause of death. (Table 3).

Mass strandings in Massachusetts occur frequently (Table 3). There were 80 animals in a mass stranding near Wellfleet, Massachusetts, during the week of 29 January to 3 February 1998. Of these, 2 were released alive. Of the 4 found in Massachusetts during the November 1998 mass stranding, 1 was released alive. Fifty-three animals stranded in Wellfleet, Massachusetts during 19-24 March 1999. During 1999, of the 70 strandings, 38 were found alive, and 3 of these animals were released alive. During 2000, 5 were found alive (3 in April and 2 in August), and the 2 in August were released alive. During 2002, there were mass strandings in March and August, of which a few were released alive. During 2003 in Massachusetts 36 white-sided dolphins were involved in mass strandings in January, April and November, of which 25 were found alive. There were no mass strandings in 2004. In 2005 there were mass strandings in February, April, May and January. A total of 26 white-sided dolphins were involved in mass strandings, of which 11 were successfully released.

CANADA

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

Whales and dolphins stranded between 1997 and ~~2004~~ 2005 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows (Table 3): 0 white-sided dolphins stranded in 1997 to 2000, 3 in September 2001 (released alive), 5 in November 2002 (4 were released alive), 0 in 2003, ~~and~~ 19-24 in 2004 (15-20 in October (some (unspecified) were released alive) and 4 in

November were released alive), and 0 in 2005.

Table 3. White-sided dolphin (*Lagenorhynchus acutus*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2001-2005.

Area	Year					**Total**
	2001	2002	2003	2004	2005	
Maine[b]	2	4	2	10	3	21
New Hampshire	-	-	-	-	1	1
Massachusetts[a,b]	16	53	59	34	60	222
Rhode Island	-	2	-	-	2	4
Connecticut	-	-	1	-	-	1
New York	-	1	2	1	-	4
New Jersey	-	1	1	1	6	9
Delaware	-	-	-	-	-	0
Maryland	-	-	-	-	1	1
Virginia[b]	-	1	-	4	3	8
North Carolina	-	-	1	2	3	6
TOTAL US	18	62	66	52	79	277
Nova Scotia	3	6	-	2	-	8
GRAND TOTAL	21	68	66	54	79	285

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

[b] Strandings that appear to involve a human interaction are: 1 animal from Maine in 2001 that was a possible boat collision; 1 animal from Virginia in May 2002 had signs of fishery interaction; 2 animals from Massachusetts in March 2002 had signs of fishery interactions; 1 animal from Massachusetts in 2004 was a fishery interaction; and 1 other animal from Massachusetts in 2004 was found with twine obstructing its esophagus. In 2005 5 animals had signs of human interaction but in no case was the human interaction able to be determined to be the cause of death.

~~Table 3. Summary of number of stranded white-sided dolphins during January 1, 2000 to December 31, 2004, by year and area within U.S. and Canada.~~

~~Area~~	~~Year~~					~~Total~~
	~~2000~~	~~2001~~	~~2002~~	~~2003~~	~~2004~~	
~~Maine[b]~~		~~2~~	~~4~~	~~2~~	~~10~~	~~18~~
~~New Hampshire~~						
~~Massachusetts[a,b]~~	~~24~~	~~16~~	~~53~~	~~59~~	~~34~~	~~186~~
~~Rhode Island~~			~~2~~			~~2~~
~~Connecticut~~				~~1~~		~~1~~
~~New York~~			~~1~~	~~2~~	~~1~~	~~4~~
~~New Jersey~~			~~1~~	~~1~~	~~1~~	~~3~~
~~Delaware~~						

~~Maryland~~						
~~Virginia[b]~~			~~1~~		~~4~~	~~5~~
~~North Carolina~~				~~1~~	~~2~~	~~3~~
~~TOTAL US~~	~~24~~	~~18~~	~~62~~	~~66~~	~~52~~	~~222~~
~~Nova Scotia~~	~~0~~	~~3~~	~~6~~	~~0~~	~~2~~	~~11~~
~~GRAND TOTAL~~	~~24~~	~~21~~	~~68~~	~~66~~	~~54~~	~~233~~

~~[a] Records of mass strandings in Massachusetts are: March 1999 - 53 animals; April 2000 - 5 animals; August 2000 - 11 animals; April 2001 - 6 animals; March 2002 - 31 animals, of which 7 were released alive; August 2002 - 3 animals, of which 1 was released alive; January 2003 - 4 animals; April 2003 - 28 animals; November 2003 - 4 animals.~~

~~[b] Strandings that appear to involve a human interaction are: 1 animal from Maine in 2001 that was a possible boat collision; 1 animal from Virginia in May 2002 had signs of fishery interaction; 2 animals from Massachusetts in March 2002 had signs of fishery interactions; 1 animal from Massachusetts in 2004 was a fishery interaction; and 1 other animal from Massachusetts in 2004 was found with twine obstructing its esophagus~~

STATUS OF STOCK

The status of white-sided dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is a non-strategic stock because the 2001-2005 estimated average annual human related mortality does not exceed PBR.

~~The status of this stock cannot be determined until the trawl bycatch mortality analysis is complete (Table 2).~~

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S.Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bisack, K.D. 1997a. Harbor porpoise bycatch estimates in the New England multispecies sink gillnet fishery: 1994 and 1995. Rep. int Whal. Comm 47:-705-14.

Bisack, K.D. 1997b. Marine mammal bycatch estimates and their sampling distributions in the U.S. New England sink gillnet, pair trawl, Atlantic pelagic drift gillnet and North Atlantic bottom trawl fisheries - 1994 to 1996. NOAA, NMFS, NEFSC. Woods Hole, MA. Working paper SC/49/SM35 submitted to the IWC Scientific Committee meeting in Bournemouth, UK, Aug/Sept 1997.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

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

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

Hain, J. H. W. and G. T. Waring. 1994. Status of and human effects upon marine mammals. Pages. 9-20 *In:* R. W.

Langton , J. B. Pearce, and J.A. Gibson (eds). Selected living resources, habitat conditions, and human perturbations of the Gulf of Maine: Environmental and ecological considerations for fishery managements. NOAA Tech. Mem. NMFS-NE-106. ~~[Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543].~~

Hamazaki, Toshihide. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). Mar. Mammal Sci. 18(4):920-939.

Hooker, S.K., R.W. Baird, and M.A. Showell. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission meeting in Bournemouth, UK.

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

Kenney, R.D., P.M. Payne, D.W. Heinemann, and H.E. Winn. 1996. Shifts in Northeast shelf cetacean distributions relative to trends in Gulf of Maine/Georges Bank finfish abundance. Pp. 169-196 *in:* K. Sherman, N.A. Jaworski and T. Smada (eds.). The northeast shelf ecosystem: assessment, sustainability, and management. Blackwell Science, Cambridge, MA 02142, USA.

Kingsley, M.C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:1529-1550.

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Fld. Nat. 114(1):~~-~~46-61.

National Marine Fisheries Service [NMFS]. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine Mammal Survey. 5 pp. [Available from: NMFS, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.]

Northridge, S., M. Tasker, A. Webb, K. Camphuysen, and M. Leopold. 1997. White-beaked *Lagenorhynchus albirostris* and Atlantic white-sided dolphin *L. acutus* distributions in northwest European and U.S. North Atlantic waters. Rep. int. Whal. Commn. 47:797-805.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NOAA/NMFS/NEFSC Ref. Doc. 00-07. 29 pp. ~~[Available from: NMFS, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.]~~

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA/NMFS/NEFSC Ref. Doc. 96-04. 37 pp. [Available from: NMFS, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.]

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjρrge and G.P. Donovan (eds.) Biology of the Phocoenids. Rep. int Whal. Commn. (Special Issue) 16.

Palka, D., A. Read, and C. Potter. 1997. Summary of knowledge of white-sided dolphins (*Lagenorhynchus acutus*) from the U.S. and Canadian North Atlantic waters. Rep. int Whal. Commn. 47:~~-~~729-34.

Payne, M. and D.W. Heinemann. 1990. A distributional assessment of cetaceans in the shelf and shelf edge waters of the northeastern United States based on aerial and shipboard surveys, 1978-1988. Report to NMFS. 108p. [Available from National Marine Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.]

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn. Special Issue 15: 133-147.

Reeves, R. R., C. Smeenk, R. L. Brownell, Jr., and C. C. Kinze. 1999. Atlantic white-sided dolphin *Lagenorhynchus acutus* (Gray, 1828). Pp. 31-56 *In* S. H. Ridgway and Sir R. Harrison (eds.) Handbook of Marine Mammals. Volume 6: The Second Book of Dolphins and the Porpoises. Academic Press, Boston.

Sergeant, D.E., D.J. St. Aubin, and J.R. Geraci. 1980. Life history and northwest Atlantic status of the Atlantic white-sided dolphin, *Lagenorhynchus acutus*. Cetology 37:~~-~~1-12.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull., U.S. 88(2):~~–~~347-360.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

White-beaked dolphins are the more northerly of the two species of *Lagenorhynchus* in the northwest Atlantic (Leatherwood *et al.* 1976). The species is found in waters from southern New England to southern Greenland and Davis Straits (Leatherwood *et al.*1976; CETAP 1982), across the Atlantic to the Barents Sea and south to at least Portugal (Reeves *et al.* 1999). Differences in skull features indicate that there are at least two separate stocks, one in the eastern and one in the western North Atlantic (Mikkelsen and Lund 1994). No genetic analyses have been conducted to corroborate this stock structure.

In waters off the northeastern U.S. coast, white-beaked dolphin sightings are concentrated in the western Gulf of Maine and around Cape Cod (CETAP 1982). The limited distribution of this species in U.S. waters has been attributed to opportunistic feeding (CETAP 1982). Prior to the 1970's, white-sided dolphins (*L. acutus*) in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins were found on the continental shelf. During the 1970's, there was an apparent switch in habitat use between these two species. This shift may have been a result of the increase in sand lance in the continental shelf waters (Katona *et al.*1993; Kenney *et al.*1996).

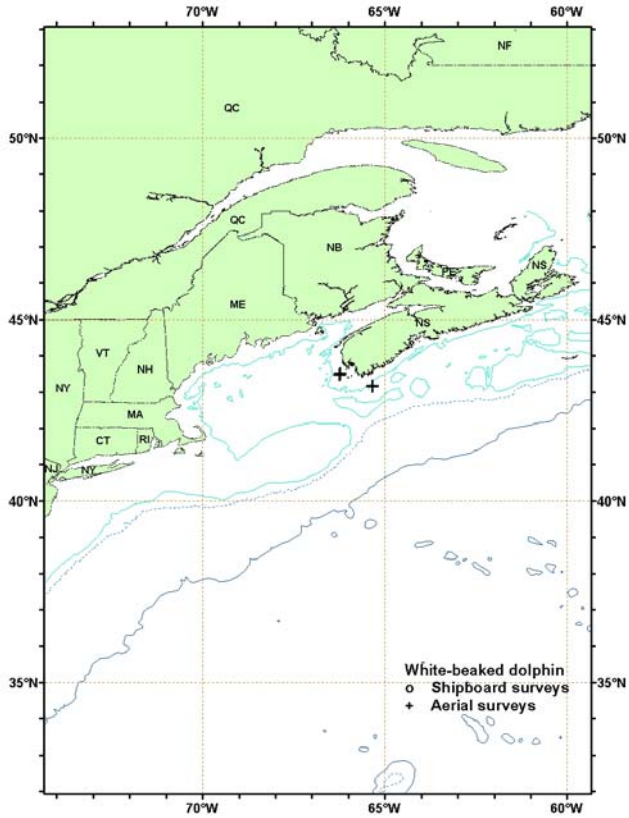


Figure 1. *Distribution of white-beaked dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

In late March 2001, one group of 18 animals was seen about 60 nautical miles east of Provincetown, MA during a NMFS aerial marine mammal survey (NMFS unpublished data). In addition, during spring 2001 and 2002, white-beaked dolphins stranded on beaches in New York and Massachusetts (see Other Mortality section below).

POPULATION SIZE

The total number of white-beaked dolphins in U.S. and Canadian waters is unknown, although one old abundance estimate is available for part of the known habitat in U.S. waters, ~~and~~ two other estimates are available from Canadian waters, and one estimate is available from August 2006 from waters in the Gulf of Maine and Scotian shelf (Table 1). The best and only recent abundance estimate for the western North Atlantic white-beaked dolphin is 2,003 (CV=0.94), an estimate derived aerial survey data collected in August 2006.~~There are no recent abundance estimates for this species in waters between the Gulf of Maine and the Newfoundland/Labrador region~~ . It is assumed this estimate is negatively biased because the survey only covered part of the species' habitat.

Earlier abundance estimates

A population size of 573 white-beaked dolphins (CV=0.69) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina

and Nova Scotia (~~Table 1;~~ CETAP 1982). The estimate is based on spring data because the greatest proportion of the population off the northeast U.S. coast appeared in the study area during this season, according to the CETAP data. This estimate does not include a correction for dive-time, or to g*(0)*, the probability of detecting an animal group on the track line. This estimate may not reflect the current true population size because of its high degree of uncertainty (e.g., large CV), ~~its old age, and it was estimated just after cessation of extensive foreign fishing operations in the region~~and its dated nature.

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

A population size of 3,486 white-beaked dolphins (95% confidence interval (CI)=2,001-4,971) was estimated from a ship-based survey of a small segment of the Labrador Shelf in August 1982 (~~Table 1;~~ Alling and Whitehead 1987). A CV was not given, but assuming a symmetric CI, it would be 0.22. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

An estimate of abundance from an August 2006 survey was 2,003 white-beaked dolphins (CV=0.94). Three aerial line transect abundance surveys were conducted in the summers of 2002, 2004 and 2006 on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000 m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed. No white-beaked dolphins were observed in the 2002 and 2004 abundance surveys.

~~The best and only recent abundance estimate for the western North Atlantic white-beaked dolphin is 2003 (CV=0.94), an estimate derived aerial survey data collected in August 2006.There are no recent abundance estimates for this species in waters between the Gulf of Maine and the Newfoundland/Labrador region. It is assumed this estimate is negatively biased because the survey only covered part of the species' habitat.~~

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

Month/Year	Area	N_{best}	CV
~~spring 1978-82~~	~~Cape Hatteras, NC to Nova Scotia~~	~~573~~	~~0.69~~
~~1980's~~	~~E. Newfoundland and SE Labrador~~	~~5,500~~	~~None reported~~
~~August 1982~~	~~Labrador shelf~~	~~3,486~~	~~0.22~~
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,003	0.94

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-

normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for the western North Atlantic stock of white-beaked dolphins is 2,003 (CV=0.94). The minimum population estimate for these white-beaked dolphins is 1,023~~Present data are insufficient to calculate a minimum population estimate in U.S. Exclusive Economic Zone (EEZ) waters~~.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (Wade and Angliss 1997). The minimum population size of white-beaked dolphins is 1,023~~unknown~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic white-beaked dolphin is 10~~unknown~~.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

White-beaked dolphins have been ~~taken~~ incidentally captured in cod traps and in the Canadian groundfish gillnet fisheries off Newfoundland and Labrador and in the Gulf of St. Lawrence (Alling and Whitehead 1987; Read 1994; Hai *et al.*1996~~);~~). ~~however~~However, the total number of animals taken is not known. Of three bycaught white-beaked dolphins reported off Newfoundland during 1987-1988, 1 died in a groundfish gill-net, 1 in a herring gill-net, and 1 in a cod trap (Reeves *et al.*1999).

There are no documented reports of fishery-related mortality or serious injury to this stock in the U.S. EEZ. A white-beaked dolphin was ~~picked up~~captured by a Northeast bottom trawl in March 2003. However, since the animal was moderately decomposed and the trawl duration was short, the animal could not have died in this trawl.

Fishery Information

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

Other Mortality

White-beaked dolphins were hunted for food by residents in Newfoundland and Labrador (Alling and Whitehead 1987). These authors, based on interview data, estimated that 366 white-beaked dolphins were taken each year. The same authors reported that 25-50% of the killed dolphins were lost. Hunting that now occurs in Canadian waters is believed to be opportunistic and in remote regions of Labrador where enforcement of regulations is minimal (Lien *et al.*2001).

White-beaked dolphins regularly become caught in ice off the coast of Newfoundland during years of heavy pack ice. A total of 21 ice entrapments involving approximately 350 animals were reported in Newfoundland from 1979 to 1990; known mortality as a result of entrapment was about 55% (Lien *et al.*2001).

Mass strandings of white-beaked dolphins are less common than for white-sided dolphins. White-beaked dolphins more commonly strand as individuals or in small groups (Reeves *et al.*1999). In Newfoundland, 5 strandings of white-beaked dolphins occurred between 1979 and 1990 ~~involved~~ involving groups of 2 to 7 animals. On three occasions live dolphins came ashore, including groups of 3 and 4 (Reeves *et al.*1999).

White-beaked dolphin stranding records from 1997 onward that are ~~in~~ part of the US NE Regional Office/NMFS strandings and entanglement database include ~~five~~ six records that clearly identify the species to be the white-beaked dolphin (Table 2). Three of these strandings were collected from Cape Cod, Massachusetts beaches, where 1 animal stranded during May 1997, and 2 animals stranded during March 2001. A white-beaked dolphin also stranded in New York in February 2002. No white-beaked dolphins stranded during 2003. One white-

beaked dolphin stranded in Maine during May 2004 and another stranded in Maine in June of 2005. It was not possible to determine the cause of death for any of the~~se~~ stranded animals.

Whales and dolphins stranded between 1997 and ~~2004~~ 2005 on the coast of Nova Scotia as recorded by the Marine Animal Response Society (MARS) and the Nova Scotia Stranding Network are as follows: 1 white-beaked dolphin stranded in May 1997, 0 documented strandings in 1998 to 2001, 2 in 2002 (1 in July (released alive) and 1 in August), and 0 in 2003~~ and~~, 2004 and 2005 (Table 2).

Table 2. Summary of number of stranded white-beaked dolphins during January 1, 2001 to December 31, 2005, by year and area within U.S. and Canada.

Area	Year					**Total**
	2001	2002	2003	2004	2005	
Maine	-	-	-	1	1	2
Massachusetts	2	-	-	-	-	2
New York	-	1	-	-	-	1
TOTAL US	**2**	**1**	**0**	**1**	**1**	**5**
Nova Scotia[a]	-	2	-	-	-	-
GRAND TOTAL	**2**	**3**	**0**	**1**	**1**	**7**

a. One animal that stranded in July 2002 was released alive.

~~Table 2. Summary of number of stranded white-beaked dolphins during January 1, 2000 to December 31, 2004, by year and area within U.S. and Canada.~~

~~**Area**~~	~~**Year**~~					~~**Total**~~
	~~2000~~	~~2001~~	~~2002~~	~~2003~~	~~2004~~	
~~Maine~~					~~1~~	~~1~~
~~Massachusetts~~		~~2~~				~~2~~
~~New York~~			~~1~~			~~1~~
~~**TOTAL US**~~	~~**0**~~	~~**2**~~	~~**1**~~	~~**0**~~	~~**1**~~	~~**4**~~
~~Nova Scotia[a]~~	~~0~~	~~0~~	~~2~~	~~0~~	~~0~~	~~2~~
~~**GRAND TOTAL**~~	~~**0**~~	~~**2**~~	~~**3**~~	~~**0**~~	~~**1**~~	~~**6**~~

~~a. One animal that stranded in July 2002 was released alive.~~

STATUS OF STOCK

The status of white-beaked dolphins, relative to OSP, in U.S. Atlantic coast waters is unknown. ~~They are~~The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine population trends for this species. The total documented U.S. fishery-related mortality and serious injury for this stock (0) is less than 10% of the calculated PBR (10.0) and, therefore, is considered to be insignificant and approaching zero mortality and serious injury rate. This is a non-strategic stock because the 2001-2005 estimated average annual human related mortality does not exceed PBR.

~~The status of Because there are insufficient data to calculate PBR it is not possible to determine if stock is strategic and if the U.S. fishery-related mortality and serious injury for this stock is insignificant and approaching zero mortality and serious injury rate. However, because this stock has a marginal occurrence in U.S. waters and there are no documented takes in U.S. waters, this stock has been designated as not strategic.~~

REFERENCES CITED

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

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S.Dept. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report #AA551-CT8-48 to the Bureau of Land Management, Washington, DC, 538 pp.

Hai, D.J., J. Lien, D. Nelson, and K. Curren. 1996. A contribution to the biology of the white-sided dolphin, *Lagenorhynchus albirostris*, in waters off Newfoundland. Can. Fld. Nat. 110(1): 278-287.

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

Kenney, R.D., P.M. Payne, D.W. Heineman, and H.E. Winn. 1996. Shifts in Northeast shelf cetacean distributions relative to trends in Gulf of Maine/Georges Bank finfish abundance. Pp. 169-196. *In:* K. Sherman, N.A. Jaworski and T. Smada (eds.) The Northeast Shelf Ecosystem: Assessment, Sustainability, and Management. Blackwell Science, Cambridge, MA 02142, USA.

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

Lien, J., D. Nelson, and D.J. Hai. 2001. Status of the White-beaked Dolphin, *Lagenorhynchus albirostris*, in Canada. Can. Fld. Nat. 115(1): 118-126.

~~Mikkelsen, A.M.H. and A. Lund. 1994. Intraspecific variation in the dolphins *Lagenorhnchus albirostris* and *L. acutus* (Mammalia: Cetacea) in metrical and non-metrical skull characters, with remarks on occurrence. J. Zool., Lond. 234:289-299.~~

Mikkelsen, A.M.H. and A. Lund. 1994. Intraspecific variation in the dolphins *Lagenorhynchus albirostris* and *L. acutus* (Mammalia: Cetacea) in metrical and non-metrical skull characters, with remarks on occurrence. J. Zool., Lond. 234:289-299.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int. Whal. Commn~~.~~ (Special Issue) 15:~~-~~133-147.

Reeves, R.R., C. Smeenk, C.C. Kinze, R. L. Brownell Jr., and J. Lien. 1999. White-beaked dolphin (*Lagenorhynchus albirostris* (Gray 1846). Pp. 1-30. *In*: S.H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol 6. Academic Press, San Diego, CA.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found world-wide in temperate, tropical, and subtropical seas. In the North Atlantic, common dolphins occur over the continental shelf along the 200-2000 m isobaths and over prominent underwater topography from 50º N to 40º S latitude (Evans 1994). The species is less common south of Cape Hatteras, although schools have been reported as far south as eastern Florida (Gaskin 1992). ~~NMFS is currently funding genetic and skull morphometric studies, which will provide information on common dolphin stock structure in the western North Atlantic. Preliminary work had documented a high variance in skull morphometric measurements, suggesting the existence of more than a single stock.~~ In waters off the northeastern USA coast common dolphins are distributed along the continental slope (100 to 2,000 m~~eters~~) 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 ~~(Palka *et al.* Unpublished Ms.; Figure 1)~~. Selzer and Payne (1988) reported very large aggregations (greater than 3,000 animals) on Georges Bank in autumn. Common dolphins are occasionally found in the Gulf of Maine (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs during summer and autumn when water temperatures exceed 11ºC (Sergeant *et al.* 1970; Gowans and Whitehead 1995).

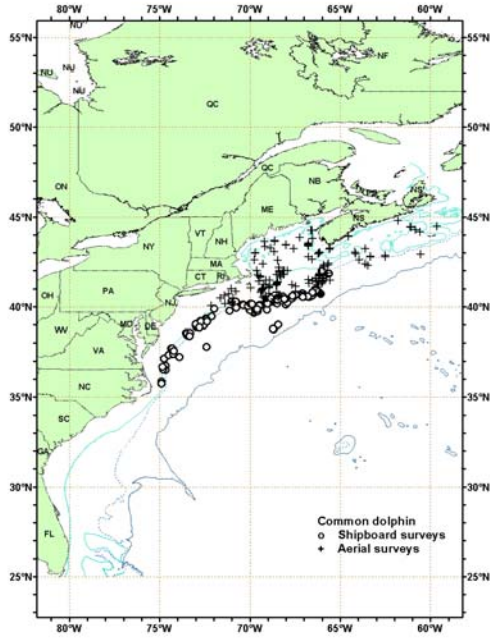


Figure 1. *Distribution of common dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004 and 2006. Isobaths are the 100m, 1000m and 4000m depth contours.*

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 then a single population in the western North Atlantic, supporting the proposed one stock model. However, when ~~Westgate (2005) compared~~ 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. ~~Westgate (2005)~~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).

There is also a peak in parturition during July and August with an average birth day of July 28th. Gestation lasts about 11.5 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 years) than males (11 years) 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).

POPULATION SIZE

~~Total~~ The total number~~s~~ of common dolphins off the U.S. or Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions ~~of the habitat do exist~~for selected time periods. ~~Sightings were~~

almost exclusively in the continental shelf edge and continental slope areas (Figure 1). The best abundance estimate for common dolphins is 120,743 animals (CV = 0.23). This is the sum of the estimates from two 2004 U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 90,547 (CV= 0.24), and from the southern U.S. Atlantic is 30,196 (CV =0.54). This joint estimate is considered best because the two surveys together have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 29,610 common dolphins (CV=0.39) was obtained from an aerial survey program conducted from 1978 to 1982 on the continental shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). An abundance estimate of 22,215 (CV=0.40) common dolphins was obtained from a June and July 1991 shipboard line-transect sighting survey conducted primarily between the 200 and 2,000 m isobaths from Cape Hatteras to Georges Bank (Waring *et al.* 1992; Waring 1998). An abundance estimate of 1,645 (CV=0.47) common dolphins was obtained from a June and July 1993 shipboard line-transect sighting survey conducted principally between the 200 and 2,000 m isobaths from the southern edge of Georges Bank, across the Northeast Channel to the southeastern edge of the Scotian Shelf (NMFS 1993). An abundance estimate of 6,741 (CV=0.69) common dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered 32,600 km in waters from Virginia to the mouth of the Gulf of St. Lawrence. An abundance estimate of 30,768 (CV=0.32) common dolphins was generated from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN)(Palka 2006). No common dolphins were encountered during the SEFSC component of the 1998 joint surveys. That The SEFSC conducted a shipboard line-transect sighting survey was conducted between 8 July and 17 August 1998 and , surveyed ing 4,163 km of track line in waters south of Maryland (38ºN) and sighting ed no common dolphins (Mullin and Fulling 2003). Although the 1991, 1993, 1995, and 1998 surveys did not sample the same areas or encompass the entire common dolphin habitat (e.g., little effort in Scotian shelf edge waters), they did focus on segments of known or suspected high-use habitats off the northeastern USA coast. –As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

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

An abundance of 6,741 (CV=0.69) common dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; Palka *et al.* Unpublished Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 – 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom depth contour, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom isobath. Data collection and analysis methods used were described in Palka (1996).

An abundance of 30,768 (CV=0.32) common dolphins was estimated from a line transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Figure 1; Palka *et al.* Unpublished. Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.

No common dolphins were encountered during the SEFSC component of the joint surveys. That shipboard line transect sighting survey was conducted between 8 July and 17 August 1998 and surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003)).

Although the 1991, 1993, 1995, and 1998 surveys did not sample the same areas or encompass the entire common dolphin habitat (e.g., little effort in Scotian shelf edge waters), they did focus on segments of known or suspected high-use habitats off the northeastern USA coast. The 1993, 1995 and 1998 data suggest that, seasonally, at least several thousand common dolphins are occupying continental shelf edge waters, with perhaps highest abundance in the Georges Bank region. An abundance estimate of 6,460 (CV=0.74) common dolphins was obtained from an aerial survey conducted in July and August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern

edge of Georges Bank to Maine (Table 1; Palka 2006). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 90,547 (CV= 0.244) common dolphins was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 10,761 km of track-line in waters north of Maryland (38ºN) (Figure Table 1; Palka Unpublished Ms2006.). 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.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 > 50m) 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 50x bigeye binoculuarsbinoculars. 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, 2006; Buckland *et al.* 2001). The resulting abundance estimate for common dolphins between Florida and Maryland was 30,196 (CV =0.537).

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 estimate of abundance for an aerial survey in August 2002 survey was 6,460 (CV=0.74) and 84,000 (CV=0.36) for August 2006. The summer of 2002, 2006 and part of the above 2004 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from the three aerial surveys, while the density estimates were year specific. The 2006 survey covered 10,676 km of trackline in the region from the 2000m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern edge of Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered 6,180 km of trackline in the region from the 100m depth contour on the southern edge of Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed.

The best 2004 abundance estimate for common dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 120,743 (CV = 0.23), where the estimate from the northern U.S. Atlantic is 90,547 (CV= 0.24), and from the southern U.S. Atlantic is 30,196 (CV =0.54). This joint estimate is considered best because together these two surveys have the most complete coverage of the population's habitat.

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

Month/Year	Area	N_{best}	CV
Jul-Sep 1998	Maryland to Gulf of St. Lawrence	30,768	0.32
Aug 2002	S. Gulf of Maine to Maine	6,460	0.74
Jun-Aug 2004	Maryland to Bay of Fundy	90,547	0.24
Jun-Aug 2004	Florida to Maryland	30,196	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	120,743	0.23
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	84,000	0.36

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for common dolphins is 120,743 animals (CV =0.23) derived from the 2004 surveys. The minimum population estimate for the western North Atlantic common dolphin is 99,975.

Current Population Trend

~~There are insufficient data to determine the population trends~~A trend analysis has not been conducted for this species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 99,975 animals. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened, or stocks of unknown status, relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997).~~because this stock is of unknown status.~~ ~~Stock status will be determined when trawl fishery bycatch estimates are complete.~~ PBR for the western North Atlantic stock of common dolphin is 1,000.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality or serious injury to this stock during 2001-2005 was ~~105~~151 (CV=.1~~2~~1) common dolphins (Table 2).

Fishery information

Detailed fishery information is reported in Appendix III.

~~Preliminary fishery mortality estimates have been generated for the years 2000-2004. The estimates will not be reported until scientific review is complete.~~

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeast coast of the U.S. With implementation of the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA), an observer program was established which recorded fishery data and information on incidental bycatch of marine mammals. During the period 1977-1986, observers recorded 123 mortalities in foreign *Loligo* squid-fishing activities ~~(Waring *et al.* 1990)~~. ~~In 1985 and 1986, Italian vessels took 56 and 54 animals, respectively, which accounts for 89% (n=110) of the total takes in foreign *Loligo* squid fishing operations.~~ No mortalities were reported in foreign *Illex* squid fishing operations. ~~Because of spatial/temporal fishing restrictions, most of the bycatch occurred along the continental shelf edge (100m) isobath during winter (December to February).~~

From 1977 to 1991, observers recorded 110 mortalities in foreign mackerel-fishing operations (Waring *et al.* 1990; NMFS unpublished data). This total includes one documented take by a U.S. vessel involved in joint-venture fishing operations ~~in which U.S. captains transfer their catches to foreign processing vessels~~. ~~The bycatch occurred during winter/spring (December to May).~~ A U.S. joint venture (JV) mackerel fishery was conducted in the mid-Atlantic region from February-May 1998. Seventeen incidental takes of common dolphin were observed in this fishery.

~~Most of the estimated marine mammal bycatch was from U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999). B~~In the Atlantic pelagic longline fishery between 1990 and ~~2000~~2005, ~~sixteen~~ 20 common dolphins were observed hooked and released alive ~~(Yeung *et al.* 2000; Yeung 2001)~~.

~~—~~Eight hundred and sixty-one common dolphin mortalities were observed between 1989 and 1998 in the pelagic drift gillnet fishery~~. Mortalities were observed in all seasons and areas. Seven animals were released alive, but 6 were injured. E~~, resulting in an estimated annual mortality and serious injury attributable to this fishery of (CV in parentheses)

was 540 in 1989 (0.19), 893 in 1990 (0.18), 223 in 1991 (0.12), 227 in 1992 (0.09), 238 in 1993 (0.08), 163 in 1994 (0.02), 83 in 1995 (0), 106 in 1996 (0.07) and 255 in 1998 (0).

Since this fishery no longer exists, it has been excluded from Table 2.

Twelve mortalities were observed in the pelagic pair trawl between 1991 and 1995. The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 5.6 in 1991 (0.53), 32 in 1992 (0.48), 35 in 1993 (0.43), 0 in 1994 and 5.6 in 1995 (0.35).). Since this fishery is no longer in operation it has been deleted from Table 2.

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). However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

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, these 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.

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

TThere 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.

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) and 0 in 2000-2004. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized.

No common dolphins were taken in observed mid-Atlantic gillnet fishery trips during 1993 and 1994. Two common dolphins were observed taken in 1995, 1996 and 1997, and no takes were observed from 1998 to 2004. Observed effort was concentrated off New Jersey and scattered between Delaware and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 7.4 in 1995 (0.69), 43 in 1996 (0.79), 16 in 1997 (0.53), and 0 in 1998-2004.

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

Northeast Sink Gillnet

Four common dolphins were observed taken in northeast sink gillnet fisheries in 2005. 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 and 5 (0.80) in 2005. This fishery, which extends from North Carolina to New York, is actually a combination of small vessel fisheries that target a variety of fish species, some of which operate right off the beach. The number of vessels in this fishery is unknown, because records which are held by both state and federal agencies have not been centralized and standardized.

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. One common dolphin was observed taken in 2002, and three in 2004, and five in 2005 (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, and 32 (0.28) in 2005.Preliminary estimates of mortality attributed to the Northeast bottom and Mid-Atlantic bottom trawl fisheries have been generated for the years 2000-2004. The 2001-2005 average mortality attributed to the northeast bottom trawl was 28 animals (CV=0.13).

The estimates will not be reported until scientific review is complete. The scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006.

Mid-Atlantic Bottom Trawl

Three common dolphins were observed taken in mid-Atlantic bottom trawl fisheries in 2000, two in 2001, and nine in

2004, and 15 in 2005 (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, and 141 (0.29) in 2005. The 2001-2005 average mortality attributed to the mid-Atlantic bottom trawl was 118 animals (CV=0.13).~~See Northeast Bottom Trawl.~~

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

Fishery [a]	Years	Vessels	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality [d]	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	01-05	unk	Obs. Data Weighout, Logbooks	.06, .04, .02, .03, .06, .07	0, 0, 0, 0, 0	0, 0, 0, 0, 4	0, 0, 0, 0, 0,	0, 0, 0, 0, 26	0, 0, 0, 0, 26	0, 0, 0, 0, .8	5 (0.8)
Northeast Bottom Trawl [e]	~~00~~01-~~04~~05 [e]	~~tbd~~ unk	Obs. Data Dealer Data VTR Data	~~.01,~~ .01, .03, .04, .05, .12	~~0,~~ 0, 0, 0, 0, 0	~~0,~~ 0, 1, 0, 3, 5	~~0,~~ 0, 0, 0, 0	~~tbd~~ [e] 30, 26, 26, 26, 32	30, 26, 26, 26, 32~~tbd~~ [e]	.30, .29, .29, .29, .28~~tbd~~ [e]	~~tbd~~ [e] 28 (.13)
Mid-Atlantic Bottom Trawl [e]	~~00~~01-~~04~~05 [e]	~~tbd~~unk	Obs. Data Dealer	~~.01,~~ .01, .01, .01, .03 , .03	~~0,~~ 0, 0, 0, 0 , 0	~~3,~~ 2, 0, 0, 9, 15	~~0,~~ 0, 0, 0, 0	~~tbd~~ [e] 103, 87, 99, 159, 141	103, 87, 99, 159, 141~~tbd~~ [e]	~~tbd~~ [e] -.27, .27, .28, .30, .20	~~tbd~~ [e] 118 (.13)
TOTAL											~~tbd~~ [e] -151 (.11)

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

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

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

~~Observer coverage for trawl fisheries is measured in trips.~~ d. The data used to predict bycatch rates to estimate annual mortality were pooled over the years ~~2000~~2001-~~2004~~2005. The data are treated as one data set and assumed to represent average fishing practices during the time period. Regression techniques within a model framework were applied to the pooled data set. Therefore, if there was no observed bycatch reported for any one given year, this does not imply that there was no bycatch during that year. The exception would be if year was selected by the model as an important factor associated with observing bycatch.

e A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast bottom trawl fisheries during 2000-2004. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior

to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2004.

~~. Preliminary estimates of mortality attributed to the Northeast bottom trawl and Mid-Atlantic bottom trawl fisheries have been generated for the years 2000-2004 but scientific review of the analysis is not complete. Therefore, mortality estimates are not reported in the bycatch table. Scientific review will be completed prior to the commencement of the Atlantic trawl take reduction team meeting in September 2006~~

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 1 common dolphin. The incidental mortality rate for common dolphins was 0.007/set.

Other Mortality

From ~~2000~~ 2001to ~~2004~~2005, ~~466~~ 322 common dolphins were reported stranded between Maine and Florida (Table 3). The total includes mass stranded common dolphins in Massachusetts during 2002 (9 animals), 2004 (one event of 6 animals and one of 3 animals), and a total of 25 in 2005 in 4 separate events; and in North Carolina in 2001 (7 animals). Five of the 2005 Massachusetts stranded animals were released alive. One stranded common dolphin calf in New Jersey was relocated to a rehabilitation facility in 2005. ~~Three common dolphins which had stranded alive in Massachusetts in 2000 were released.~~ In 2001, ~~the cause of death of~~ one stranding mortality in Virginia and another animal in North Carolina were designated as human interactions/fishing interactions. Similarly in 2002, ~~the case of death for~~ one stranding in New York and another animal in Virginia were designated as human interactions/fishery interactions. Common dolphins were included in the UME (unusual mortality event) declared for Virginia in 2004 (Marine Mammal Commission 2005). The strandings were primarily bottlenose dolphins, but common dolphins were also involved. Human interactions were implicated in one of the 2004 Virginia common dolphin mortalities. In 2005, one stranding mortality in New York was designated as human interaction.

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

Table 3. Common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
Maine	1	0	0	0	0	1
Massachusetts[a]	8	34	21	26	59	148
Rhode Island	0	1	2	1	0	4
Connecticut	0	0	0	0	0	0
New York	6	5	11	3	4	29
New Jersey	5	1	6	8	4	24
Delaware	1	1	1	2	1	6
Maryland	2	0	0	4	0	6
Virginia[b]	4	3	4	8	2	21
North Carolina[d]	14	0	62	4	1	81
Georgia	0	0	0	0	0	0
Florida	0	1	0	0	0	1
EZ	0	0	0	1	0	1
TOTALS	41	46	107	57	71	322

a. Massachusetts mass strandings (2002 - 9 animals; 2004 - 6 and 3; 2005 - 7,5,25, and 4).

b. Virginia reports 1 common dolphin found in a pound net in 2004.

c. Fishery Interactions (FI)/Human Interactions (HI) - North Carolina reported 1 HI, fishing gear, April 2001; Virginia - 1 FI March 2001).

d. North Carolina mass stranding (2001 - 7 animals).
e. 2002 FI, one in NY, one in Va.

~~Table 3. Common dolphin (*Delphinus delphis*) reported strandings along the U.S. Atlantic coast, 2000-2004.~~

~~STATE~~	~~2000~~	~~2001~~	~~2002~~	~~2003~~	~~2004~~	~~TOTALS~~
~~Maine~~	~~0~~	~~1~~	~~0~~	~~0~~	~~0~~	~~1~~
~~Massachusetts~~[a]	~~10~~	~~8~~	~~34~~	~~21~~	~~26~~	~~99~~
~~Rhode Island~~	~~5~~	~~0~~	~~1~~	~~2~~	~~1~~	~~9~~
~~Connecticut~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~
~~New York~~	~~4~~	~~6~~	~~5~~	~~11~~	~~3~~	~~29~~
~~New Jersey~~	~~5~~	~~5~~	~~1~~	~~6~~	~~8~~	~~35~~
~~Delaware~~	~~1~~	~~1~~	~~1~~	~~1~~	~~2~~	~~6~~
~~Maryland~~	~~3~~	~~2~~	~~0~~	~~0~~	~~4~~	~~9~~
~~Virginia~~[b]	~~1~~	~~4~~[c]	~~3~~	~~4~~	~~8~~	~~20~~
~~North Carolina~~[d]	~~6~~	~~14~~[e]	~~0~~	~~62~~	~~4~~	~~86~~
~~Georgia~~	~~1~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~
~~Florida~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~
~~EZ~~	~~0~~	~~0~~	~~0~~	~~0~~	~~1~~	~~1~~
~~TOTALS~~	~~37~~	~~41~~	~~46~~	~~51~~	~~67~~	~~466~~

~~a. Massachusetts mass strandings (2002 - 9 animals; 2004 - 6 and 3).~~
~~b. Virginia reports 1 common dolphin found in a pound net in 2004.~~
~~c. Fishery Interactions (FI)/Human Interactions (HI) - North Carolina reported 1 HI, fishing gear, April 2001; Virginia - 1 FI March 2001).~~
~~d. North Carolina mass stranding (2001 - 7 animals).~~
~~e. 2002 FI, one in NY, one in Va.~~

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

STATUS OF STOCK

The status of common dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. The 2001-2005 average annual human-related mortality does not exceed PBR; therefore, this is not a strategic stock.

~~The status of this stock cannot be determined until the trawl bycatch mortality analysis is complete (Table 2).~~

REFERENCES CITED

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

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

Buckland, S.T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling: Estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Cramer, J. 1994. Large pelagic logbook newsletter - 1993. NOAA Tech. Mem. NMFS-SEFSC-352. 19 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

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

Gowans, S. and H. Whitehead. 1995. Distribution and habitat partitioning by small odontocetes in the Gully, a submarine canyon on the Scotian Shelf. Can. J. Zool. 73:1599-1608.

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

Hamazaki, Toshihide. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, USA to Nova Scotia, Canada). Mar. Mammal Sci. 18(4):920-939.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson. (eds). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Johnson, D.R., C.A. Brown, and C. Yeung. 1999. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1992-1997. NOAA Technical Memorandum NMFS- SEFSC-418. 70 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Laake, J.L., S.T. Buckland, D.R. Anderson, and K.P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, CO. 72 pp.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES CM 1997/Q:8. 10 pp.

Lucas, Z.N. and S.K. Hooker. 1997. Cetacean strandings on Sable Island, Nova Scotia, 1990-1996. Paper SC/49/06 presented to the IWC Scientific Committee, September 1997. 10 pp.

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Can. Field-Nat.114:45-61.

Marine Mammal Commission. 2006. US Marine Mammal Commission Annual Report to Congress, 2004. Marine Mammal Commission, Bethesda, MD. vi+163pp.
Available at: http://www.nefsc.noaa.gov/nefsc/publication/ 70 pp

Mullin, K.D. and G.L. Fulling. 2003.~~.~~ Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

NMFS [National Marine Fisheries Service]. 1993. Cruise results, NOAA ship DELAWARE II, Cruise No. DEL 93-06, Marine mammal Survey. 5 pp. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int. Whal. Commn (Special Issue) 16:27-50.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc.96-04; 37 pp.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In: Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03, 41 pp.

Payne, P.M., L.A. Selzer, and A.R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023. 245 pp.

Scott, G.P. and C.A. Brown. 1997. Estimates of marine mammal and turtle catch by the U.S. Atlantic pelagic longline fleet in 1994-1995. Miami Laboratory Contribution MIA-96/97-28.

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

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

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Waring, G.T. 1998. Results of the summer 1991 R/V Chapman marine mammal sighting survey. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 98-09, 21 pp.

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry, and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeast United States, 1977-1988. Fish. Bull., U.S. 88(2):347-360.

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

Waring, G.T., E. Josephson, C.P. Fairfield, and K. Maze-Foley. 2007. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201, xxx pp.

Westgate, A. J. 2005. Population structure and life history of short-beaked common dolphins (*Delphinus delphis*) in the North Atlantic. Ph.D thesis. Nicholas School of the Environment and Earth Sciences, Duke University, Beaufort, NC.

Yeung, C. 1999a. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 1999b. Revised Mortality Estimates of Marine Mammal Bycatch in 1992-1997 based on Serious Injury Guidelines. NOAA Tech. Memo. NMFS-SEFSC-429, 23 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C., S. Epperly, and C.A. Brown. 2000. Preliminary revised estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet, 1992-1999. NMFS, Miami Lab. PRD Contribution Number 99/00-13. 58 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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.

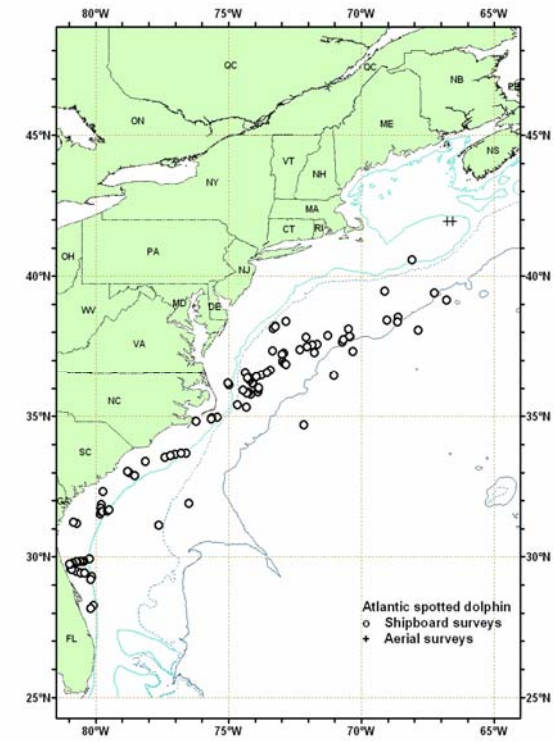


Figure 1. *Distribution of Atlantic spotted dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998 and 2004. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

~~Atlantic spotted dolphins are distributed in tropical and warm temperate waters of the western North Atlantic (Leatherwood *et al.* 1976). Their distribution is from southern New England, south through the Gulf of Mexico and the Caribbean to Venezuela (Leatherwood *et al.* 1976; Perrin *et al.* 1994). The large, heavily spotted form of the Atlantic spotted dolphin along the southeastern and Gulf coasts of the United States, which may warrant designation as a distinct sub-species (Rice 1998), inhabits the continental shelf, usually being found inside or near the 200 m isobath (within 250-350 km of the coast) but sometimes coming into very shallow water adjacent to the beach (Figure 1). Off the northeast U.S. coast, spotted dolphins are widely distributed on the continental shelf, along the continental shelf edge, and offshore over the deep ocean south of 40° N (CETAP 1982). Atlantic spotted dolphins regularly occur in the inshore waters south of Chesapeake Bay and near the continental shelf edge and continental slope waters north of this region (Payne *et al.* 1984; 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).~~ 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.

~~Stock structure in the western North Atlantic is unknown.~~

POPULATION SIZE

Total numbers of Atlantic spotted dolphins off the U.S. or Canadian Atlantic coast are unknown, ~~although estimates~~although estimates are available from selected regions ~~of the habitat do exist~~ for select time periods. Sightings have been concentrated in the slope waters north of Cape Hatteras, but in the shelf waters south of Cape Hatteras sightings extend into the deeper slope and offshore waters of the mid-Atlantic (Fig. 1). The best recent abundance estimate for Atlantic spotted dolphins is the sum of the estimates from the two 2004 western U.S. Atlantic surveys. This joint estimate (3,578+47,400=50,978) is considered best because these two surveys together have the most complete coverage of the species' habitat.

Because *S. frontalis* and *S. attenuata* are difficult to differentiate at sea, the reported abundance estimates, prior to 1998, are for both species of spotted dolphins combined. ~~Sightings were concentrated in the slope waters north of Cape Hatteras, but in the shelf waters south of Cape Hatteras, with sightings extending into the deeper slope and offshore waters of the Mid-Atlantic (Fig. 1).~~ At their November 1999 meeting, the Atlantic SRG recommended that without a genetic determination of stock structure, the abundance estimates for the coastal and offshore forms should be combined. There remains debate over how distinguishable both species are at sea, though in the waters south of Cape Hatteras identification to species is made with very high certainty. This does not, however, account for the potential for a mixed species herd, as has been recorded for several dolphin assemblages. Pending further genetic studies for clarification of this problem, a single species abundance estimate will be used as the best estimate of abundance, combining species specific data from the northern as well as southern portions of the species' ranges.

Earlier abundance estimates

An abundance estimate of 6,107 undifferentiated spotted dolphins (CV=0.27) was ~~estimated~~ 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). ~~As recommended in the GAMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.~~

An abundance estimate of 4,772 (CV=1.27) undifferentiated spotted dolphins was ~~estimated~~ 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 (~~Table 1; Palka *et al.* Unpublished Ms.~~NMFS unpublished data~~anuscript~~). ~~Total track line length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods used were described in Palka (1996).~~

A~~ A~~n abundance estimate of 32,043 (CV=1.39) ~~for offshore~~ Atlantic spotted dolphins was ~~estimated~~ derived from a ~~line~~ line-transect sighting survey conducted during July 6 to September 6, 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N). ~~(Figure 1; Palka *et al.* Unpubished Ms.anuscript). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

An abundance estimate of 14,438 (CV=0.63) ~~for~~ Atlantic spotted dolphins was ~~estimated~~ generated from a shipboard ~~line~~ line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (~~Figure 1;~~ Mullin~~-~~ and Fulling 2003). ~~-~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

~~Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001) where school size bias and ship attraction were accounted for.~~

An abundance estimate of 3,578 (CV= 0.48) ~~for~~ Atlantic spotted dolphins was ~~estimated~~ obtained from a ~~line~~ 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~~ Table 1; Palka ~~u~~Unpublished ~~Ms.~~manuscript2006). Shipboard data were collected using the two independent team ~~line~~ 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 Manuscripts~~2005).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ≥50 m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and ~~there were~~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 ~~analyzed to~~ corrected for visibility bias ~~(~~*g(0)*~~)~~ and group-size bias ~~employing~~ and analyzed using ~~line~~ line-transect distance analysis~~ and the direct duplicate estimator~~ (Palka 1995; Buckland *et al.*~~,~~ 2001). The resulting abundance estimate for Atlantic spotted dolphins between Florida and Maryland was 47,400 animals (CV=0.45)(Table 1).

~~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. This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat. The best 2004 abundance estimate for Atlantic spotted dolphins is the sum of the estimates from the two 2004 western U.S. Atlantic surveys, 50,978 (CV=0.42), where the estimate from the northern U.S. Atlantic is 3,578 (CV=0.48), and from the southern U.S. Atlantic is 47,400 (CV=0.45).~~

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

Month/Year	Area	N_{best}	CV
Jun-Aug 2004	Maryland to the Bay of Fundy	3,578	0.48
Jun-Aug 2004	Florida to Maryland	47,400	0.45
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	50,978	0.42

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). ~~)~~ The best abundance estimate is 50,978 (CV=0. 42). The minimum population estimates based on the combined ~~offshore and coastal~~ abundance estimates is 36,235.

Current Population Trend

There are insufficient data to determine the population trends for this species, because~~given that~~ ~~surveys~~ prior to 1998, ~~did not differentiate between~~ species of spotted dolphins were not differentiated during surveys.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for the Atlantic spotted dolphin is 36,235. The maximum productivity rate is 0.04, the default value

for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is set to 0.5 because this stock is of unknown status. PBR for the combined offshore and coastal forms of Atlantic spotted dolphins is 362.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality or serious injury to this stock during 1999-2003 2001-2005 was 6 (CV=1) zero Atlantic spotted dolphins (*Stenella frontalis* spp.) (Table 2). (Yeung 2001; Garrison 2003; Garrison and Richards, 2004). Due to the potential uncertainty in differentiation between Atlantic spotted and pantropical spotted dolphins, fishery takes reported as either species are included below.

Earlier Interactions

No spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. Bycatch had been observed by NMFS Sea Samplers in the pelagic drift gillnet and pelagic longline fisheries, but no mortalities or serious injuries have been documented in the pelagic pair trawl, Northeast sink gillnet, Mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries. N; and 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 that were sent to the Smithsonian were identified as Ppantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 25 in 1989 (.65), 51 in 1990 (.49), 11 in 1991 (.41), 20 in 1992 (0.18), 8.4 in 1993 (0.40), 29 in 1994 (0.01), 0 in 1995, 2 in 1996 (0.06), no fishery in 1997 and 0 in 1998.

Pelagic Longline

The pelagic longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ. Between 1992 and 2005, 2 spotted dolphins (recorded as Atlantic spotted dolphins) were hooked and released alive in the Atlantic, including one dolphin hooked and released alive with serious injuries in 2003 (in the Mid-Atlantic Bight fishing area), and one dolphin was released alive without serious injuries in 2005 (in the Sargasso fishing area) (Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006.). The estimated fishery-related mortality to Atlantic spotted dolphins in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery between Interactions between the pelagic longline fishery and spotted dolphins have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. From 1999-2003 2001-2005 was 6 (CV=1) (Table 2) , excluding the Gulf of Mexico, where one animal was hooked and released alive (Appendix 1), no Atlantic spotted dolphin bycatches were recorded (Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006).

Table 2. Summary of the incidental mortality and serious injury of Atlantic spotted dolphins (*Stenella frontalis*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the observed mortalities and serious injuries recorded by on-board observers, the estimated annual mortality and serious injury, the combined annual estimates of mortality and serious injury (Estimated Combined Mortality), the

estimated CV of the combined estimates (Estimated CVs) and the mean of the combined estimates (CV in parentheses).

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E)[h]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 1, 0, 0	6 (1)
TOTAL											6 (1)

a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
b. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

Other Mortality

From ~~1999-2003-2005~~2001-2005, ~~17-24~~16 Atlantic spotted dolphins were stranded between Massachusetts and ~~Florida~~ Puerto Rico (NMFS unpublished data). T~~One animal stranded in North Carolina in 1999,~~ wo~~3 animals stranded in North Carolina and 1 stranded in Georgia in 2000, 2~~ animals stranded in North Carolina and ~~3~~3 in Florida in 2001;~~,~~ 2 animals stranded in North Carolina and ~~, and~~ 2 in Florida in 2002~~,~~; ~~and~~ 1 animal stranded in 2003 in Massachusetts~~, 1 in~~, North ~~Carolina and 1 in~~Carolina, and Florida;~~, in 2003,~~ one dolphin stranded in Florida and one in Puerto Rico in 2004; and one dolphin stranded in North Carolina and one in Georgia in 2005. ~~one dolphin stranded in Florida and one in Puerto Rico in 2004, and one dolphin stranded in North Carolina and one in Georgia in 2005.~~ None of these strandings had documented signs of fishery or human interactions.

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

Table 2. Atlantic spotted dolphin (Stenella frontalis) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
Massachusetts	0	0	1	0	0	1
North Carolina	2	2	1	0	1	6
Georgia	0	0	0	0	1	1
Florida	3	2	1	1	0	7
Puerto Rico	0	0	0	1	0	1
TOTALS	5	4	3	2	2	16

STATUS OF STOCK

The status of Atlantic spotted dolphins~~,~~ relative to OSP in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Total U.S. fishery-related mortality and serious injury for ~~this~~ the western North Atlantic stock of Atlantic spotted dolphins is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual ~~fishery~~human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

REFERENCES

Adams, L. and P.E. Rosel. 2006. Population differentiation of the Atlantic spotted dolphin *Stenella frontalis* in the Western North Atlantic, including the Gulf of Mexico. Mar. Biol. 148:671-681.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U. S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. pp. 179-189. *In*: G.W. Garner, S.-C. Amstrup, J.-L. Laake, B.-F.-J. Manly, L.-L. McDonald, and D.-G. Robertson (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam. 287 pp.

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

Mullin, K.-D. and G.-L. Fulling. 2003. Abundance and cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjørge and G.P. Donovan (eds.) *Biology of the Phocoenids*.. Rep. int. Whal. Commn (Special Issue) 16:i-x + 552 pp.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. U.S. Dep. Commer., NOAA/NMFS/NEFSC. Ref. Doc. 96-04; 37 pp. ~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:777-787.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:777-787.

Payne, P.M., L.A. Selzer, and A.R. Knowlton. 1984. Distribution and density of cetaceans, marine turtles, and seabirds in the shelf waters of the northeastern United States, June 1980-December 1983, based on shipboard observations. NOAA/NMFS Contract No. NA-81-FA-C-00023.
~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

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

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

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. pp. 133-147. *In:* W.F. Perrin, G.P. Donovan and J. Barlow (eds.) Gillnets and Cetaceans. Rep. int. Whal. Commn (Special Issue) 15: I-ix + 629 pp.

Rice, D.W. 1998. Marine mammals of the world, systematics and distribution. Spec. Publ. No 4. Society for The Society for Marine Mammalogy, Lawrence, KS. 231 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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-

12, 93 pp. ~~Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.~~

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

~~Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, National Marine Fisheries Service, Miami, FL, 43 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~December 2005~~ ~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pantropical spotted dolphin is distributed worldwide in tropical and some sub-tropical oceans (Perrin *et al.* 1987; Perrin and Hohn 1994). There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin, *Stenella frontalis*, formerly *S. plagiodon*, and the pantropical spotted dolphin, *S. attenuata* (Perrin *et al.* 1987). The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al.* 1987, Perrin and Hohn 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 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 1987; Perrin and Hohn 1994).~~ Sightings of pantropical spotted dolphins ~~this species~~ in the northern Gulf of Mexico occur over the deeper waters, and rarely over the continental shelf or continental shelf edge (Mullin *et al.* 1991; SEFSC, unpublished data). Pantropical spotted dolphins were seen in all seasons during ~~recent~~ seasonal aerial surveys of the northern Gulf of Mexico, and during ~~recent~~ winter aerial surveys offshore of the southeastern U.S. Atlantic coast (SEFSC unpublished data). Some of the Pacific populations have been divided into different geographic stocks based on morphological characteristics (Perrin 1987; Perrin and Hohn 1994).~~; however, there is no information on stock differentiation in the Atlantic population.~~

The western North Atlantic pantropical spotted dolphin population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

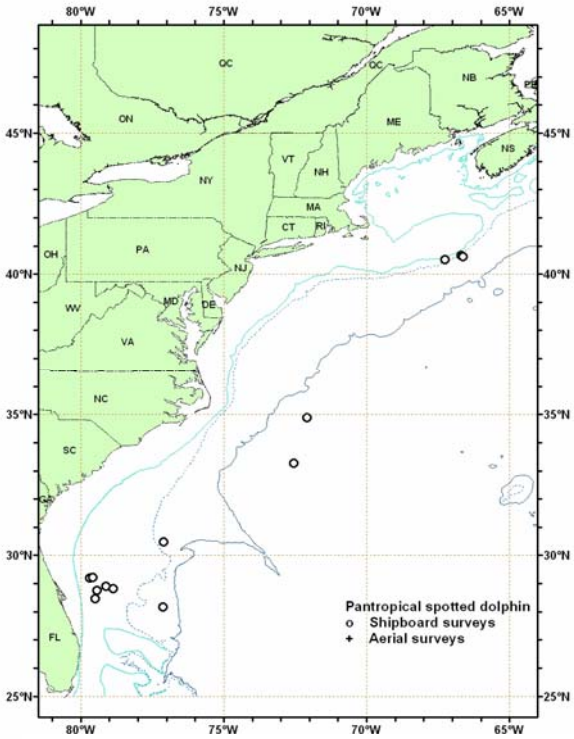


Figure 1. *Distribution of pantropical spotted dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998 and 2004. Isobaths are at 100 m, 1,000 m, and 4,000 m isobaths.*

POPULATION SIZE

Total numbers of pantropical spotted dolphins off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. 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. Sightings were concentrated in the southeastern edge of Georges Bank, along the Florida shelf and to a more limited degree the Florida slope

waters, and offshore in Gulf Stream waters southeast of Cape Hatteras (Fig. 1).

An abundance of 6,107 undifferentiated spotted dolphins (CV=0.27) was estimated from an aerial survey program conducted from 1978 to 1982 on the continental, shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). As recommended in the GAMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations. Further, due to changes in survey methodology these data should not be used to make comparisons to more current estimates.

An abundance of 4,772 (CV=1.27) undifferentiated spotted dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Table 1; Palka *et al.* Unpubl~~.~~ished Ms.). Total trackline length was 32,600 km. The ships covered waters between the 50 and 1000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1000 fathom depth contour line. Data collection and analysis methods used were described in Palka (1996).

An abundance of 343 (CV=1.03) for pantropical spotted dolphins was estimated from a line transect sighting survey conducted during July 6 to September 6, 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N) (Figure 1; Palka *et al.*Unpublished~~.~~ Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.

An abundance of 12, 747 (CV=0.56) for pantropical spotted dolphins was estimated from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38°N) (Figure 1; Mullin and Fulling 2003). This estimate is a recalculation of the same data reported in previous SARs. For more details see Mullin and Fulling (2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2003) where school size bias and ship attraction were accounted for.

An abundance of zero for pantropical spotted dolphins was estimated from a line transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (38° N) to the Bay of Fundy (45° N) (Figure 1; Palka unpubl~~).~~, as no dolphins of this species were observed~~)~~. Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Figure 1; Palka unpublished~~.~~).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths = 50 m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias ~~(~~*g(0)*) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka 1995; Buckland *et al.*, 2001). The resulting abundance estimate for pantropical spotted dolphins between Florida and Maryland was 4,439 (CV=0.49).

~~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. This joint~~

~~estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~ The best 2004 abundance estimate for pantropical spotted dolphins is the sum of the estimates from the two 2004 western U.S. Atlantic surveys, 4,439 (CV=0.49), where the estimate from the northern U.S. Atlantic is 0, and from the southern U.S. Atlantic is 4,439 (CV=0.49). ~~—~~This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

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

Month/Year	Area	N_{best}	CV
Jun-Aug 2004	Maryland to the Bay of Fundy	0	0
Jun-Aug 2004	Florida to Maryland	4,439	0.49
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	4,439	0.49

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-~~-~~normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for pantropical spotted dolphins is ~~4,439 (~~4,439 (CV=0. 49) The minimum population estimate for pantropical spotted dolphins is 3,010.

Current Population Trend

There are insufficient data to determine ~~the~~ population trends for this species, because prior to 1998 spotted dolphins ~~(*Stenella* sp.)~~ were not differentiated during surveys.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for pantropical spotted dolphins is 3,010 . The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because this stock is of unknown status. PBR for pantropical spotted dolphins is 30.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery in

dolphins. Due to the potential uncertainty in differentiation between Atlantic spotted and pantropical spotted dolphins, fishery takes reported as either species are included below.
~~. (Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~

Earlier Interactions

No ~~pantropical~~ spotted dolphin mortalities were observed in 1977-1991 foreign fishing activities. ~~Bycatch has been observed by NMFS Sea Samplers in the pelagic drift gillnet and~~

~~pelagic longline fisheries~~N~~, but n~~o 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. N~~; and n~~o takes have been documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Bycatch has been observed in the pelagic longline fisheries (two dolphins hooked and released alive without serious injuries - one in the Mid-Atlantic Bight area in 1993, and one in the Gulf of Mexico in 1994) (Yeung, 1999) Forty-nine undifferentiated spotted dolphin mortalities were observed in the drift gillnet fishery between 1989 and 1998 and occurred northeast of Cape Hatteras within the 183 m isobath in February-April, and near Lydonia Canyon in October. Six whole animal carcasses ~~that were~~ sent to the Smithsonian were identified as pantropical spotted dolphins (*S. attenuata*). The remaining animals were not identified to species. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 25 in 1989 (.65), 51 in 1990 (.49), 11 in 1991 (.41), 20 in 1992 (0.18), 8.4 in 1993 (0.40), 29 in 1994 (0.01), 0 in 1995, 2 in 1996 (0.06), no fishery in 1997 and 0 in 1998.

Pelagic Longline

Between 1992 and 2005, 2 spotted dolphins (recorded as Atlantic spotted dolphins) were hooked and released alive in the Atlantic, including one dolphin hooked and released alive with serious injuries in 2003 (in the Mid-Atlantic Bight fishing area), and one dolphin was released alive without serious injuries in 2005 (in the Sargasso fishing area) (Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006.). The estimated fishery-related mortality to Atlantic spotted dolphins in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery between 2001-2005 was 6 (CV=1) (Table 2) (Garrison 2003, 2005; Garrison and Richards 2004; Fairfield-Walsh and Garrison 2006).

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

Fishery	Years	Vessels[a]	Data Type[b]	Observer Coverage[c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality[d]	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Pelagic Longline (excluding NED-E)[h]	01-05	98, 87, 63, 60, 60	Obs. Data Logbook	.04, .05, .09, .09, .06	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 0, 0, 0	0, 0, 30, 0, 0	0, 0, 1, 0, 0	6 (1)
TOTAL											6 (1)

a. Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
b. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).

~~The pelagic longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). Interactions between the pelagic longline fishery and spotted dolphins have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. Excluding the Gulf of Mexico where 1 animal was hooked and released alive, no pantropical spotted dolphin bycatches were observed during 1999-2003.~~

Other Mortality

From ~~1999~~2001-~~2~~

~~North Carolina and 1~~animal stranded in Florida in both 2002 and 2003, and one animal stranded in South Carolina in 2004 as part of an Unusual Mortality Event (UME). A Mid-Atlantic Offshore Small Cetacean UME, was declared when 85 small cetaceans stranded from Maryland to Georgia between 3 July 2004 and 16 January 2005. The species involved are generally found offshore and

are not expected to strand along the coast. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn et al. 2006), though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings". Prior to this, 4 animals stranded in Florida in 1999. There were no documented signs of fishery or human interactions in any of these strandings.

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

Table ~~2~~3. Pantropical spotted dolphin (*Stenella attenuate*) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
South Carolina	0	0	0	1[a]	0	1
Florida	1	1	0	0	0	2
TOTALS	1	1	0	1	0	3

[a]One pantropical spotted dolphin stranded in September in South Carolina and was considered part of the North Carolina Unusual Mortality Event.

STATUS OF STOCK

The status of pantropical spotted dolphins, relative to OSP in the western U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual fishery-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1 982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC. 538 pp.

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U.S. Dep. Commer. ,NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. pp. 179-189. *In*: G.W. Garner, S. C. Amstrup, J. L. Laake, B. F. J. Manly, L. L. McDonald, and D. G. Robertson (eds.) Marine mammal survey and assessment methods. Balkema, Rotterdam. 287 pp.

Mullin, K. D. and G. L. Fulling. 2003. Abundance of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

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

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjørge and G.P.Donovan (eds.) Biology of the *Phocoenids*~~.~~... Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 16: I-x + 552 pp.

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. U.S. Dep. Commer., NOAA-NMFS-NEFSC. Ref. Doc. 96-04; 37p. ~~Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:~~-~~777-787.

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

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

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. pp. 133- 147. *In:* W.F. Perrin, G.P. Donovan and J. Barlow (eds.) Gillnets and Cetaceans. Rep. Int. Whal. Commn., Special Issue 15: I-ix + 629 pp.

Rice, D.W. 1998. Marine mammals of the world, systematics and distribution. Spec. Publ. No 4. Society for The Society for Marine Mammalogy, Lawrence, KS. 231 pp.

Scott, G. P. and C. A. Brown. 1997. Estimates of marine mammal and marine turtle catch by the U.S. Atlantic pelagic longline fleet in 1994-1995. Miami Laboratory Contribution MIA-96/97-28

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.

Yeung, C. 1999~~2001~~. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1992-1999~~9-2000~~. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-~~467~~429, 2~~4~~3 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

~~December 2005~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The striped dolphin, *Stenella coeruleoalba*, is distributed worldwide in warm-temperate to tropical seas (Archer and Perrin 1997). Striped dolphins are found in the western North Atlantic from Nova Scotia south to at least Jamaica and in the Gulf of Mexico. In general, striped dolphins appear to prefer continental slope waters offshore to the Gulf Stream (Leatherwood *et al.* 1976; Perrin *et al.* 1994; Schmidly 1981). There is very little information concerning striped dolphin stock structure in the western North Atlantic (Archer and Perrin 1997).

In waters off the northeastern U.S. coast, striped dolphins are distributed along the continental shelf edge from Cape Hatteras to the southern margin of Georges Bank, and also occur offshore over the continental slope and rise in the Mid-Atlantic region (CETAP 1982; Mullin and Fulling 2003; ~~Palka *et al.* Unpub. Ms.;~~ Figure 1). Continental shelf edge sightings in this program were generally centered along the 1,000 m depth contour in all seasons (CETAP 1982). During 1990 and 1991 cetacean habitat-use surveys, striped dolphins were associated with the Gulf Stream north wall and warm-core ring features (Waring *et al.* 1992). Striped dolphins seen in a survey of the New England Sea Mounts (Palka 1997) were in waters that were between 20°and 27°C and deeper than 900 m.

Although striped dolphins are considered to be uncommon in Canadian Atlantic waters (Baird *et al.* 1997), recent summer sightings (2-125 individuals) in the deeper and warmer waters of the Gully (submarine canyon off eastern Nova Scotia shelf) suggest that this region may be an important part of their range (Gowans and Whitehead 1995; Baird *et al.* 1997).

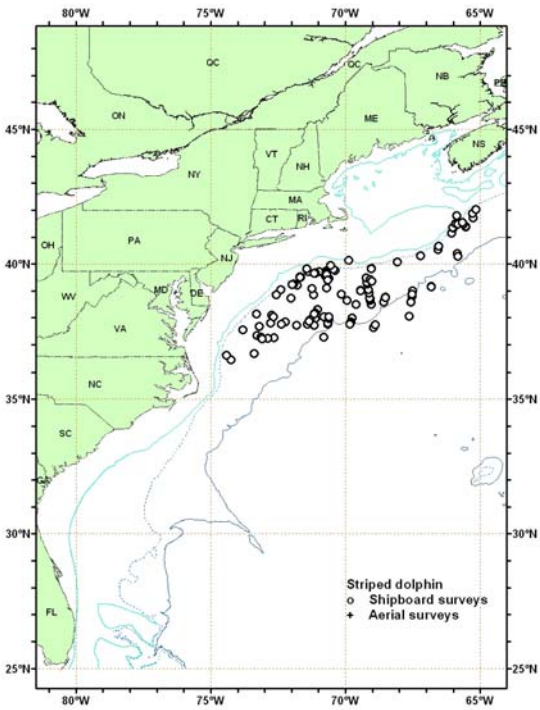


Figure 1. *Distribution of striped dolphin sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer 1998, 1999, and 2004. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

POPULATION SIZE

Total numbers of striped dolphins off the U.S. or Canadian Atlantic coast are unknown, although ~~-~~several estimates from selected regions ~~of the habitat do exist~~are available for select time periods. Sightings ~~were~~ 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 sum of the estimates from the two 2004 U.S. Atlantic surveys, 94,462 (CV =0.40), where the estimate from the northern U.S. Atlantic is 52,055 (CV =0.57), and from the southern U.S. Atlantic is 42,407 (CV =0.53). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.

Earlier abundance estimates

An abundance estimate of 36,780 striped dolphins (CV=0.27) was ~~estimated~~ obtained from an aerial survey program conducted from 1978 to 1982 on the continental, shelf and shelf edge waters between Cape Hatteras, North Carolina and Nova Scotia (CETAP 1982). ~~An a~~Abundance estimates of 25,939 (CV=0.36) and 13,157 (CV=0.45) striped dolphins ~~was~~ were ~~estimated~~ obtained from ~~line~~ line-transect aerial surveys conducted from August to September 1991 using the Twin Otter and AT-11~~, respectively~~ aircraft (NMFS 1991). ~~The study area included that covered in the CETAP study plus several additional continental slope survey blocks. Due to weather and logistical constraints, several survey blocks south and east of Georges Bank were not surveyed.~~ An abundance estimate of 31,669 (CV=0.73) striped dolphins was obtained from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence. An abundance estimate of 49,945 (CV=0.40) striped dolphins was obtained from the sum of the estimate of 39,720 (CV=0.45) striped dolphins from a line-transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Palka 2006), and the estimate of 10,225 (CV=0.91) striped dolphins, estimated from a shipboard

line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Mullin and Fulling 2003). As recommended in the GAMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, ~~therefore~~ 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

~~An abundance of 31,669 (CV=0.73) striped dolphins was estimated from a July to September 1995 sighting survey conducted by two ships and an airplane that covered waters from Virginia to the mouth of the Gulf of St. Lawrence (Palka *et al.* Unpubl. Ms.). Total track line length was 32,600 km. The ships covered waters between the 50 and 1,000 fathom depth contour lines, the northern edge of the Gulf Stream, and the northern Gulf of Maine/Bay of Fundy region. The airplane covered waters in the Mid-Atlantic from the coastline to the 50 fathom depth contour line, the southern Gulf of Maine, and shelf waters off Nova Scotia from the coastline to the 1,000 fathom depth contour line. Data collection and analysis methods used were described in Palka (1996).~~

~~An abundance of 39,720 (CV=0.45) for striped dolphins was estimated from a line transect sighting survey conducted during 6 July to 6 September 1998 by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38ºN) (Figure 1; Palka *et al.* unpublished Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.~~

~~An abundance of 10,225 (CV=0.91) for striped dolphins was estimated from a shipboard line transect sighting survey conducted between 8 July and 17 August 1998 that surveyed 4,163 km of track line in waters south of Maryland (38ºN) (Figure 1; Mullin and Fulling 2003). This estimate is a recalculation of the same data reported in previous SARs. For more details see Mullin and Fulling (2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 1993) where school size bias and ship attraction were accounted for.~~

~~The best 1998 abundance estimate for striped dolphins is the sum of the estimates from the two U.S. Atlantic surveys, 49,945 (CV=0.40), where the estimate from the northern U.S. Atlantic is 39,720 (CV=0.45) and from the southern U.S. Atlantic is 10,225 (CV=0.91). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

Recent surveys and abundance estimates

An abundance estimate of 52,055 (CV=0.57) ~~for~~ striped dolphins was ~~estimated~~ obtained from a ~~line~~ 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) (~~Figure~~ Table 1; Palka ~~unpublished~~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~~ 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~~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) was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye binocluars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream ~~front~~ Front in the Mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were ~~analyzed to~~ corrected for visibility bias (*g(0)*) and group-size bias and analyzed using~~employing~~ ~~line~~ line-transect distance analysis ~~and the direct duplicate estimator~~ (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).

~~The best 2004 abundance estimate for striped dolphins is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 94,462 (CV =0.40), where the estimate from the northern U.S. Atlantic is 52,055 (CV =0.57), and from the southern U.S. Atlantic is 42,407 (CV =0.53). This joint estimate is considered best because together these two surveys have the most complete coverage of the species' habitat.~~

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
~~Jul-Sep 1998~~	~~Maryland to Gulf of St. Lawrence~~	~~39,720~~	~~0.45~~
~~Jul-Aug 1998~~	~~Florida to Maryland~~	~~10,225~~	~~0.91~~

~~Jul-Sep 1998~~	~~Florida to Gulf of St. Lawrence (COMBINED)~~	~~49,945~~	~~0.40~~
Jun-Aug 2004	Maryland to the Bay of Fundy	52,055	0.57
Jun-Aug 2004	Florida to Maryland	42,407	0.53
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	94,462	0.40

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for striped dolphins is 94,462 (CV=0.40) obtained from the 2004 surveys. The minimum population estimate for the western North Atlantic striped dolphin is 68,558.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 68,558. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is 0.5 because this stock is of unknown status. PBR for the western North Atlantic striped dolphin is 686.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual estimated average fishery-related mortality to this stock during ~~1999~~2001-~~2003~~ 2005 was zero striped dolphins.

Fishery Information

Detailed fishery information is reported in Appendix III.

Earlier Interactions

The pelagic drift gillnet fishery is now closed. Forty striped dolphin mortalities were observed between 1989 and 1998 and occurred east of Cape Hatteras in January and February, and along the southern margin of Georges Bank in summer and autumn (Northridge 1996). Estimated annual mortality and serious injury (CV in parentheses) attributable to the pelagic drift gillnet fishery were 39 striped dolphins in 1989 (0.31), 57 in 1990 (0.33), 11 in 1991 (0.28), 7.7 in 1992 (0.31), 21 in 1993 (0.11), 13 in 1994 (0.06), 2 in 1995 (0), 7 in 1996 (CV=0.22), no fishery in 1997 and 4 in 1998 (CV=0).

In the North Atlantic bottom trawl fishery the only reported fishery-related mortalities (two) occurred in 1991, where the total estimated mortality and serious injury attributable to this fishery for 1991 was 181 (CV=0.97).

USA

Bycatch has previously been observed by NMFS ~~Sea Samplers~~ Fisheries Observer Program in the pelagic drift gillnet and North Atlantic bottom trawl fisheries (see above) but no mortalities or serious injuries have recently been documented in any U.S. fishery.

CANADA

No mortalities were documented in review of Canadian gillnet and trap fisheries (Read 1994). However, in a recent review of striped dolphins in Atlantic Canada two records of incidental mortality have been reported (Baird *et al.* 1997) In the late 1960's and early 1970's two mortalities each, were reported in trawl and salmon net fisheries.

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

0.014/set.

Other Mortality

From 1995-1998, 7 striped dolphins were stranded between Massachusetts and Florida (NMFS unpublished data). From 1999-2003, ~~forty-three~~fifty-nine dolphins were reported stranded from Maine to Florida (NMFS unpublished data). There were no signs of human interactions or mass strandings. The number of reported strandings per year were 2005 (16, including 12 from a mass stranding in North Carolina), 2004 (2), 2003 (19), 2002 (5), 2001 (9), 2000 (5), and 1999 (5).

In eastern Canada, 10 strandings were reported off eastern Canada from 1926-1971, and 19 from 1991-1996 (Sergeant *et al.* 1970; Baird *et al.* 1997; Lucas and Hooker 1997). In both time periods, most of the strandings were on Sable Island, Nova Scotia. Two stranding mortalities were reported in Nova Scotia in 2004 and two in 2005.

STATUS OF STOCK

The status of striped dolphins, relative to OSP, in the U.S. Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total U.S. fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR, therefore can be considered to be insignificant and approaching zero mortality and serious injury rate. Average annual ~~fishery~~human-related mortality and serious injury does not exceed the PBR; therefore, this is not a strategic stock.

REFERENCES

Archer, F.~~-~~I., II and W.~~-~~F. Perrin. 1997. Species account of striped dolphins (*Stenella coeruleoalba*). Paper SC/49/SM27 presented to the IWC Scientific Committee, September 1997. 27 pp.

Baird, R.W., S. K. Hooker, H. Whitehead, and R. Etcheberry. 1997. A Review of records of striped dolphins (*Stenella coeruleoalba*) from Canadian waters. IWC Doc. SC/49/SM4, 10 pp.

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

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

Buckland, S.T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

Gowans, S. and H. Whitehead. 1995. Distribution and habitat partitioning by small odontocetes in the Gully, a submarine canyon on the Scotian Shelf. Can. J. Zool. 73:1599-1608.

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *in*: G.W. Garner, S.C. Amstrup, J.L. Laake, B.F.J. Manly, L.L. McDonald, and D.G. Robertson (eds.). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

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

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES CM 1997/Q:8. 10 pp.

Lucas, A.N. and S.K. Hooker. 1997. Cetacean strandings on Sable Island, Nova Scotia, 1990-1996. Paper SC/49/06 presented to the IWC Scientific Committee, September 1997. 10 pp.

Mullin, K.D and G.L. Fulling. 2003. Abundance of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull., U.S 101:603-613.

NMFS [National Marine Fisheries Service]. 1991. Northeast cetacean aerial survey and interplatform study. NOAA, NMFS, NEFSC & SEFSC, 4 pp. Available from NEFSC, Woods Hole Laboratory, Woods Hole, MA.

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500160.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 16:27-50.

~~Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA/NMFS/NEFSC. Ref. Doc. 96-04; 37p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.~~

Palka, D.L. 1997 . A review of striped dolphins (*Stenella coeruleoalba*) in U.S. Atlantic waters. IWC Doc. SC/49/SM26, 13 pp.

Palka, D. and Hammond, P.S. 2001 . Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58: 777-787.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. European Cetacean Society Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03; 41 pp.

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

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. Int. Whal. Commn., Special Issue 15: 133-147.

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

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

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

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

~~December 2005~~~~January~~April 2007

FRASER'S DOLPHIN (*Lagenodelphis hosei*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphins ~~is~~ are distributed worldwide in tropical waters (Perrin *et al.* 1994) and~~. Fraser's dolphins~~ are assumed to be part of the cetacean fauna of the tropical western North Atlantic. The paucity of sightings is probably due to naturally low abundance compared to other cetacean species. Sightings in the more extensively surveyed northern Gulf of Mexico are uncommon but occur on a regular basis. Fraser's dolphins have been observed in oceanic waters (>200 m) in the northern Gulf of Mexico during all seasons (Leatherwood *et al.* 1993; Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling~~,~~ 2004). The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

~~The western North Atlantic population is provisionally being considered one stock for management purposes. Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.~~

POPULATION SIZE

The numbers of Fraser's dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of an estimated 250 Fraser's dolphins was sighted in waters 3300 m deep in the western North Atlantic off Cape Hatteras during a 1999 vessel survey (Figure 1; NMFS 1999). Abundance~~s~~ ~~have~~ has not been estimated from the 1999 vessel survey in western North Atlantic ~~(NMFS 1999);~~ because the sighting was not made during line-~~-~~transect sampling effort; therefore, the population size of Fraser's dolphins is unknown. No Fraser's dolphins have been observed in any other surveys.

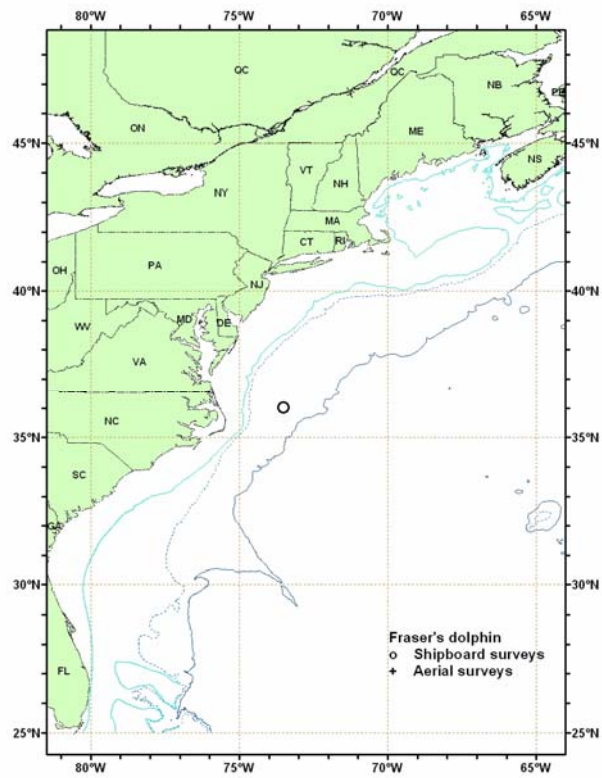


Figure 1. *Distribution of Fraser's dolphins from SEFSC shipboard survey during 1999. All sightings are shown. Solid lines indicate the 100 m, 1,000 m, and 4,000 m isobaths.*

Minimum Population Estimate

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

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

minimum population size is unknown. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because this stock is of unknown status. PBR for the western North Atlantic Fraser's dolphin stock is unknown because the minimum population size is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during 2001-2005 was zero, ~~Fraser's dolphins~~, as there were no reports of mortality or serious injury to Fraser's dolphins.

~~(Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~

Other Mortality

From ~~1999~~2001-2005, 12 Fraser's dolphins were reported stranded between Maine and Puerto Rico (Table 1). The total includes ~~1 animal stranded in Puerto in 1999 and 1~~ one animal stranded in 2002, ~~and~~ 10 mass stranded live animals in April 2003 in Lee, Florida, and one animal stranded in Florida in 2004. Prior to this time period, ~~1~~one animal stranded in Puerto in 1999. There were no indications of fishery or ~~-~~human interactions for these stranded animals.

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

Table 1. Fraser's dolphin (Lagenodelphis hosei) reported strandings along the U.S. Atlantic coast, 2001-2005.

STATE	2001	2002	2003	2004	2005	TOTALS
Florida	0	0	10	1	0	11
Puerto Rico	0	1	0	0	0	1
TOTALS	0	1	10	1	0	12

[1]Florida live mass stranding of 10 animals in Lee, Florida on April 4, 2003

STATUS OF STOCK

The status of Fraser's dolphins~~,~~ relative to OSP~~,~~ in the U.S. western North Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp. Available from NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores Drive, La Jolla, CA, 92037-1508.

~~Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.), Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Leatherwood, S., T. A. Jefferson, J. C. Norris, W. E. Stevens, L. J. Hansen and K. D. Mullin. 1993. Occurrence and sounds of Fraser's dolphin in the Gulf of Mexico. Texas J. Sci. 45(4):349-354.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. Pages 111-172. *In* R. W. Davis, W. E. Evans, and B. Würsig (eds.), Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico, 1996-2001. Mar. Mamm. Sci. 20(4):787-807.

NMFS[National Marine Fisheries Service]. 1999. Cruise results. Summer Atlantic Ocean marine mammal survey. NOAA Ship Oregon II cruise 236 (99- 05), 4 August - 30 September 1999. Available from SEFSC, 3209 Frederic Street, Pascagoula, MS 39567.

Perrin, W. F., S. Leatherwood and A. Collet. 1994. Fraser's dolphin *Lagenodelphis hosei* (Fraser 1956). pp. 225-240. *In*: S. H. Ridgway and R. Harrison (editors)~~,~~ Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.

~~Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.~~

~~December 2005~~January 2007

CLYMENE DOLPHIN (*Stenella clymene*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic (Jefferson and Curry 2003). Clymene dolphins have been commonly sighted in the Gulf of Mexico since 1990 (Mullin *et al.* 1994; Fertl *et al.* 2003), and a Gulf of Mexico stock has been designated since 1995. Four Clymene dolphin groups were sighted during summer 1998 in the western North Atlantic (Mullin and Fulling 2003), and two groups were sighted in the same general area during a 1999 bottlenose dolphin survey (NMFS unpublished). These sightings and stranding records (Fertl *et al.* 2003) indicate that this species routinely occurs in the western North Atlantic. The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

The numbers of Clymene dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this species since it was rarely seen in any surveys.

Clymene dolphins were observed during earlier surveys along the U.S. Atlantic coast. Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. Data were collected using standard line-~~-~~transect techniques conducted from NOAA Ship *Relentless* during July and August 1998 between Maryland (38.00°N) and central Florida (28.00°N) from the 10 m isobath to the seaward boundary of the U.S. EEZ. Transect lines were placed perpendicular to bathymetry in a double saw-tooth pattern. Sightings of Clymene dolphins were primarily on the continental slope east of Cape Hatteras, North Carolina (Fig. 1). The best estimate of abundance for the Clymene dolphin was 6,086 (CV=0.93) (Mullin and Fulling 2003) and represents the first and only estimate to ~~date for~~date for this species in the U.S. Atlantic EEZ. No Clymene dolphins have been observed in subsequent surveys. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable, therefore should not be used for PBR determinations.

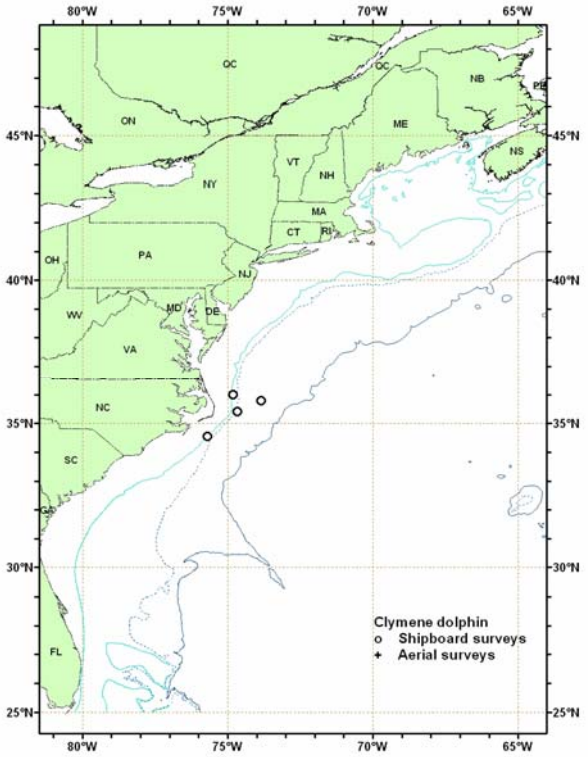


Figure 1. *Distribution of Clymene dolphin sightings from NEFSC and SEFSC vessel and aerial summer surveys during 1998. Isobaths are at 100 m, 1,000 m, and 4,000 m.*

Minimum Population Estimate

~~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 distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for the western North Atlantic Clymene dolphin stock, based on the 1998 surveys, is, is 6,086 (CV=0.93). The minimum population estimate for the western North Atlantic stock is 3,132 Clymene dolphins.~~ No minimum population estimate is available at this time.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one half the maximum net productivity rate, and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~3,132~~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.~~; therefore~~ PBR~~,~~ PBR for the western North Atlantic Clymene dolphin stock is ~~31~~undetermined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated fishery-related mortality and serious injury to this stock during 2001-2005~~1999-2003~~ was zero~~ Clymene dolphins,~~ , as there were no reports of mortalities or serious injury to Clymene dolphins. ~~(Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~

Other Mortality

There has~~ve~~ been 1~~2~~ reported stranding~~s~~ of a Clymene dolphin~~s~~ in the western North Atlantic between~~ 1999-2003~~ 2001-2005, which occurred in NC in August 2004. This stranding was part of the Mid-Atlantic Offshore Small Cetacean UME, which was declared when ~~85~~33 small cetaceans stranded from Maryland to Georgia between ~~3~~ July ~~2004 and 16 January~~ September 200~~5~~4. ~~The species involved are generally found offshore and are not expected to strand along the coast. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn et al. 2006), though no single cause for the UME was determined. The authors could not "definitively conclude that there was or was not a causal link between anthropogenic sonar activity or environmental conditions (or a combination of these factors) and the strandings". Several bottlenose dolphins and the~~One Clymene dolphin ~~that stranded in NC exhibited inflammation in the spinal chord and brain.~~ .was involved in this UME.

Prior to this, one stranding of a Clymene dolphin was recorded in Florida in 1999. No sign ~~s~~ of fishery or human interactions were noted~~ in any either stranding~~. There may be some uncertainty in the identification of this species due to similarities with other *Stenella* species.

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

STATUS OF STOCK

The status of Clymene dolphins, relative to OSP, in the EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine ~~the~~ population trends for this stock. Because there are insufficient data to calculate PBR it is not possible to determine if stock is strategic and if the total U.S. fishery-related mortality and serious injury for this stock is significant and approaching zero mortality and serious injury rate. However, because there are no documented takes in U.S. waters, this stock has been designated as not strategic. ~~The total 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 the average annual fishery-related mortality and serious injury has not exceeded PBR for the last two years.~~

REFERENCES

Barlow, J., S.-L. Swartz, T.-C. Eagle, and P.-R. Wade. 1995. U.S. marine mammal stock assessment: guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech.

Memo. NMFS-OPR-6, National Marine Fisheries Service, Seattle, WA, 73 pp. Available from: NOAA National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115-0070.

Buckland, S.-T., D.-R. Anderson, K.-P. Burnham, J.-L. Laake, D.-L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Fertl, D., T.-A. Jefferson, I.-B. Moreno, A.-N. Zerbini, and K.-D. Mullin. 2003. Distribution of the Clymene dolphin *Stenella clymene*. Mammal Review 33(3):253-271.

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.

Jefferson, T.-A. and B.-E. Curry. 2003. *Stenella clymene*. Mammalian Species 726:1-5.

Mullin, K.-D. and G.-L. Fulling. 2003. Abundance of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull. 101:603-613.

Mullin, K.-D., T.-A. Jefferson, and L.-J. Hansen. 1994. Sightings of the clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. Mar. Mamm. Sci. 10:464-470.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. pp. 27-50 *In*: A. Bjørge and G.P.Donovan (eds.) Biology of the *Phocoenids*. Rep. ~~Int~~int. Whal. Commn~~.,~~ (Special Issue) 16: I-x + 552 pp.

Palka, D. and P.S. Hammond. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58:-777-787.

Thomas, L., J.-L. Laake, J.-F. Derry, S.-T. Buckland, D.-L. Borchers, D.-R. Anderson, K.-P. Burnham, S. Strindberg, S.-L. Hedley, F. F. C. Marques, J. H. Pollard, and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, National Marine Fisheries Service, Seattle, WA, 93pp.~~ Available from: NOAA National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA 98115-0070~~.

~~Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, National Marine Fisheries Service, Miami, FL, 43 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149~~

~~December 2005~~~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Spinner dolphins are distributed in oceanic and coastal tropical waters (Leatherwood *et al.* 1976). This is presumably an offshore, deep-water species (Schmidly 1981; Perrin and Gilpatrick 1994), and its distribution in the Atlantic is very poorly known. In the western North Atlantic, these dolphins occur in deep water along most of the U.S. coast south to the West Indies and Venezuela, including the Gulf of Mexico. Spinner dolphin sightings have occurred exclusively in deeper (>2,000 m) oceanic waters (CETAP 1982; Waring *et al.* 1992; NMFS unpublished data) off the northeast U.S. coast. Stranding records exist from North Carolina, South Carolina, Florida and Puerto Rico in the Atlantic and in Texas and Florida in the Gulf of Mexico. ~~—~~The western North Atlantic population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.
~~Stock structure in the western North Atlantic is unknown.~~

POPULATION SIZE

The numbers of spinner dolphins off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock since it was rarely seen in any of the surveys.

Minimum Population Estimate

Present data are insufficient to calculate a minimum population estimate.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. Total annual estimated average fishery-related mortality and serious injury to this stock during 2001-2005~~1999-2003~~ was zero~~ spinner dolphins~~, as there were no reports of mortalities or serious injury to spinner dolphins ~~(Yeung 2001; Garrison 2003; Garrison and Richards, 2004).~~
.

EARLIER INTERACTIONS

There was no documentation of spinner dolphin mortality or serious injury in distant-water fleet (DWF) activities off the northeast U.S. coast (Waring *et al.* 1990). No takes were documented in a review of Canadian gillnet and trap fisheries (Read 1994).

Bycatch has been observed ~~by NMFS Sea Samplers~~ in the now prohibited pelagic drift gillnet fishery, and in the pelagic longline fishery (one dolphin hooked and released alive without serious injury in 1997) but no mortalities or

serious injuries have been documented in the ~~pelagic longline,~~ pelagic pair trawl, Northeast sink gillnet, Mid-Atlantic coastal gillnet, and North Atlantic bottom trawl fisheries (Yeung 1999)

Pelagic Drift Gillnet

One spinner dolphin mortality was observed in the pelagic driftnet between 1989 and 1993 and occurred east of Cape Hatteras in March 1993 (Northridge 1996). Estimates of total annual bycatch for 1994 and 1995 were estimated from the sum of the observed caught and the product of the average bycatch per haul and the number of unobserved hauls as recorded in self-reported fisheries information. Variances were estimated using bootstrap re-sampling techniques. Estimated annual mortality and serious injury attributable to this fishery (CV in parentheses) was 0.7 in 1989 (1. 00), 1.7 in 1990 (1.00), 0.7 in 1991 (1.00), 1.4 in 1992 (0.31), 0.5 in 1993 (1.00) and zero from 1994-1996. This fishery is no longer in operation.

Other Mortality

From ~~1999-2003, 9~~ 2001-2005, 10 spinner dolphins were reported stranded between Maine and Puerto Rico (Table 1). The total includes 2 animals stranded in North Carolina in 2001, 2 animals stranded in Puerto Rico in 2002, 4 mass stranded live animals in December 2003 in Flagler, Florida (all died on the scene), ~~and~~ 1 ~~additional~~ animal stranded in Florida ~~in~~ 2003and in 2004. There were no indications of fishery or human interactions for these stranded animals.

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

Table 1. Spinner dolphin (*Stenella longirostris*) strandings along the U.S. Atlantic coast, 1999-2003

STATE	2001~~1999~~	2002~~2000~~	2003~~2001~~	~~2002~~2004	~~2003~~2005	TOTALS
North Carolina	2	0	0	0	0	2
South Carolina	0	0	0	0	0	0
Georgia	0	0	0	0	0	0
Florida	0	0	5[a]	1	0	6~~5~~
Puerto Rico	0	2	0	0	0	2~~2~~
TOTALS	2	2	5	1	0	10~~9~~

[a]~~1~~Includes live mass stranding of 4 animals in Flagler, FL~~lorida~~ i~~o~~n December ~~29,~~ 2003.

STATUS OF STOCK

The status of spinner dolphins, relative to OSP, in the U.S. western North Atlantic EEZ is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population size or trends and PBR cannot be calculated for this stock. No fishery-related mortality and serious injury has been observed since 1999; therefore, total fishery-related mortality and serious injury rate can be considered insignificant and approaching zero mortality and serious injury. This is not a strategic stock.

REFERENCES

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp. Available from: NOAA, National Marine Fisheries Service, 7600 Sand Point Way NE, Seattle, WA, 98115-0070.

CETAP. 1982. A characterization of marine mammals and turtles in the mid- and north Atlantic areas of the U.S. outer continental shelf. Cetacean and Turtle Assessment Program, University of Rhode Island. Final Report, Contract AA51-C78-48, Bureau of Land Management, Washington, DC, 538 pp.

~~Fairfield Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-539, 52 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp. Available from~~

~~NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 531, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

~~Garrison, L.P. and P.M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC 527, 57 pp. Available from NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Road, Miami, Fl 33149.~~

Leatherwood, S., D.K. Caldwell, and H.E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. A guide to their identification. U.S. Dep.Commer., NOAA Tech. Rep. NMFS Circ. 396, 176 pp. ~~Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.~~

Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Final report to the Northeast Fisheries Science Center, Contract No. 40ENNF500045, 18 pp. Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.

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

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. pp. 133-147. *In:* W.F. Perrin, G.P. Donovan and J. Barlow (eds.) Gillnets and Cetaceans. Rep. Int. Whal. Commn., Special Issue 15: I-ix + 629 pp.

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

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. ~~Available from: NOAA, National Marine Fisheries Service, 166 Water St., Woods Hole, MA 02543.~~

Waring, G.T., P. Gerrior, P.M. Payne, B.L. Parry, and J.R. Nicolas. 1990. Incidental take of marine mammals in foreign fishery activities off the northeastern United States 1977-1998. Fish. Bull., US. 88(2):347-360.

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

Yeung, C. 1999~~2001~~. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1992-1997~~9 2000~~. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-429~~67~~, 24~~3~~ pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL, 33149.

~~January 2005~~~~December~~April 2006

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two morphologically and genetically distinct bottlenose dolphin morphotypes (Duffield et al. 1983; Duffield 1986) described as the coastal and offshore forms. Both inhabit waters in the western North Atlantic Ocean (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997) along the U.S. Atlantic coast. The ~~offshore and nearshore ecotypes~~two morphotypes are genetically distinct ~~using~~ based upon both mitochondrial and nuclear markers (Hoelzel et al. 1998). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean; however the offshore morphotype has been documented to occur relatively close to shore over the ~~conitnental~~continental shelf south of Cape Hatteras, NC.~~.~~

Bottlenose dolphins which stranded alive in the western North Atlantic in areas with direct access to deep oceanic waters had hemoglobin profiles ~~which~~ that matched that of the offshore morphotype (Hersh and Duffield 1990). Hersh and Duffield (1990) also described morphological differences between offshore morphotype dolphins and dolphins with hematological profiles matching the coastal morphotype which had stranded in the Indian/Banana River in Florida. North of Cape Hatteras, there is ~~clear~~ separation of the two morphotypes ~~along~~across ~~the~~ bathymetry ~~gradient~~ during summer months. Aerial surveys flown during 1979-1981 indicated a concentration of bottlenose dolphins in waters < 25 m deep corresponding to the coastal morphotype, and an area of high abundance along the shelf break corresponding to the offshore stock (CETAP 1982; Kenney 1990). Biopsy tissue sampling and genetic analysis demonstrated that bottlenose dolphins concentrated close to shore were of the coastal morphotype, while those in waters > 40 m depth were from the ~~coastal~~ offshore morphotype (Garrison et al. 2003). However, during winter months and south of Cape Hatteras, NC the range of the coastal and offshore morphotypes overlap to some degree. Torres et al. (2003) found a statistically significant break in the distribution of the ~~ecotypes~~ morphotypes at 34 km from shore based upon the genetic analysis of tissue samples collected in nearshore and offshore waters. The offshore morphotype ~~-~~was found exclusively seaward of 34 km and in waters deeper than 34 m. Within 7.5 km of shore, all animals were of the coastal morphotype. More recently, offshore morphotype animals have been sampled as close as 7.3 km from shore in water depths of 13 m (Garrison et al. 2003). ~~-~~Systematic biopsy collection surveys were conducted coastwide during the summer and winter between 2001-~~2003~~ 2005 to evaluate the degree of spatial overlap between the two morphotypes. Over the continental shelf south of Cape Hatteras, NC the two morphotypes overlap spatially, and the probability of a sampled group being from the offshore morphotype increased with increasing depth based upon a logistic regression analysis~~. Offshore morphotype animals have been sampled as close as 7.3 km from shore in water depths of 13 m~~ (Garrison et al. 2003).

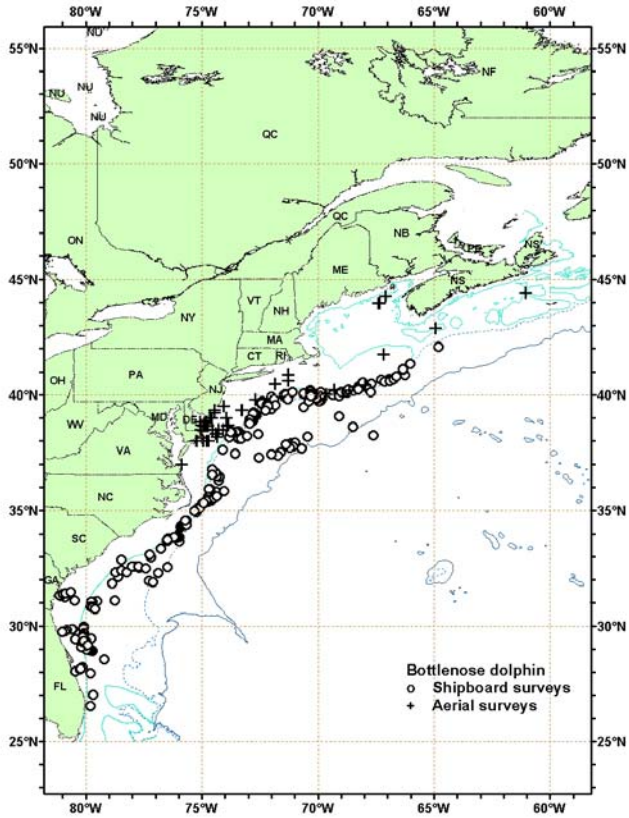


Figure 1. Distribution of bottlenose dolphin sightings from NEFSC and SEFSC aerial surveys during summer in 1998, 1999, ~~and~~ 2002, 2004, and 2006. Isobaths are at 100 m, 1,000 m, and 4,000 m.

Seasonally, bottlenose dolphins occur over the outer continental shelf and inner slope ~~waters~~ as far north as Georges Bank (Figure 1; CETAP 1982; Kenney 1990). Sightings occurred along the continental shelf break from

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

POPULATION SIZE

An abundance of 16,689 (CV=0.32) bottlenose dolphins was estimated from a line-transect sighting survey conducted during July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38˚ N) (Figure 1; Palka ~~et al., in review~~, unpublished). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and g(0), the probability of detecting a group on the track line. Aerial data were not corrected for g(0).

An abundance of 13,085 (CV=0.40) for bottlenose dolphins was estimated from a shipboard line transect sighting line-transect survey conducted between 8 July and 17 August 1998 that surveyed ~~54,570163~~ 4,163 km of track line in waters south of Maryland (38˚N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland et al. 2001; Thomas et al. 1998) where school size bias and ship attraction were accounted for.

During the summer (June - July) of 2002, aerial surveys were conducted along the U.S. Atlantic coast between Florida and New Jersey. A total of 6,734 km of trackline were completed during the summer survey between Sandy Hook, NJ ~~to~~ and Ft. Pierce, FL. The abundance of bottlenose dolphins in survey strata were calculated using line transect methods and distance analysis, and the direct duplicate estimator was used to account for visibility bias (Buckland *et al.* ~~1993~~2001; Palka 1995). These estimates were further partitioned between the coastal and offshore morphotypes based upon the results of the logistic regression models and spatial analyses described above. A parametric bootstrap approach was used to incorporate the uncertainty in the logistic regression models into the overall uncertainty in the abundance estimate for offshore bottlenose dolphins (Garrison *et al.* 2003). The resulting coastwide abundance estimate for the offshore morphotype in waters < 40 m depth was 26,849 (CV = 0.193).

An abundance of ~~10,549~~ 9,786 (CV = 0.56) for offshore morphotype bottlenose dolphins was estimated from a line transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of 38˚ N Figure 1; Palka unpubl.). 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 unpubl.).

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

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths < 50m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with ~~50x~~ "bigeye" ~~binocluars~~binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf ~~stream~~ Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias (g(0)) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka~~,~~ 1995; Buckland *et al.*~~,~~ 2001). The resulting abundance estimate for offshore morphotype bottlenose dolphins between Florida and Maryland was 44,953 (CV = 0.26).

The best available estimate for offshore morphotype bottlenose dolphins is the sum of the estimates from the summer 2002 aerial survey covering the continental shelf, the summer 2004 vessel survey ~~South~~ south of Maryland,

and the summer 2004 vessel and aircraft surveys ~~North~~ north of Maryland. This joint estimate provides complete coverage of the offshore morphotype habitat from central Florida to ~~Georges Bank~~ Canada during summer months. The combined abundance estimate from these surveys is ~~82,351~~ 81,588 (CV = 0.17).

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

Month/Year	Area	N_{best}	CV
Jun-Jul 2002	New Jersey to Florida	26,849	0.19
Aug 2002	S. Gulf of Maine to Maine	5,100	0.41
Jun-Aug 2004	Maryland to Bay of Fundy	9,786	0.56
Jun-Aug 2004	Florida to Maryland	44,953	0.26
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	2,989	1.11

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate for western North Atlantic offshore bottlenose dolphin is ~~71,382~~70,775.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for offshore bottlenose dolphins is ~~71,382~~70,775. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be ~~0.5~~ 0.4 because this stock is of unknown status and due to the uncertainty in bycatch estimates. PBR for the western North Atlantic offshore bottlenose dolphin is therefore 566~~714~~.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~Total estimated mean annual fishery-related mortality for this stock during 1998-2002~~2001-2005 ~~is unknown, however mortalities of offshore bottlenose dolphins were observed during this period in the Northeast Sink Gillnet and Mid-Atlantic Gillnet commercial fisheries. was 27 (CV=1.12) bottlenose dolphins.~~

Fisheries Information

~~Bycatch has been observed by NMFS Sea Samplers in the pelagic drift gillnet, pelagic pair trawl, New England multispecies sink gillnet, North Atlantic bottom trawl and pelagic longline fisheries.~~ Total estimated mean annual

fishery-related mortality for this stock during 2001-2005 is unknown, however mortalities of offshore bottlenose dolphins were observed during this period in the Northeast Sink Gillnet and Mid-Atlantic Gillnet commercial fisheries. Detailed fishery information is reported in Appendix III.

Earlier Interactions

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

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

Thirty-two bottlenose dolphin mortalities were observed in the pelagic pair trawl fishery between 1991 and 1995. Estimated annual fishery-related mortality (CV in parentheses) was 13 dolphins in 1991 (0.52), 73 in 1992 (0.49), 85 in 1993 (0.41), 4 in 1994 (0.40) and 17 in 1995 (0.26).

Although there were reports of bottlenose dolphin mortalities in the foreign squid mackerel butterfish fishery during 1977-1988, there were no fishery-related mortalities of bottlenose dolphins reported in the self-reported fisheries information from the mackerel trawl fishery during 1990-1992.

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

Pelagic Longline

The pelagic longline fishery operates~~.~~ in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ (SEFSC unpublished data). ~~Interactions between the pelagic longline fishery and bottlenose dolphins have been reported; however, a vessel may fish in more than one statistical reporting area and it is not possible to separate estimates of fishing effort other than to subtract Gulf of Mexico effort from Atlantic fishing effort, which includes the Caribbean Sea. During 1993-1998, in waters not including the Gulf of Mexico~~Between 1992 and 2005 in Atlantic waters, ~~1~~ one bottlenose dolphin was observed caught and released alive during 1993, and ~~1~~ one was caught and released alive during 1998. ~~No bottlenose dolphins have been observed taken in the pelagic longline fishery since 1998~~ In addition, one bottlenose dolphin was observed taken and released alive and uninjured in 2005 near the continental shelf break south of Cape Hatteras, NC. No bottlenose dolphin mortalities or serious injuries were observed between 2001 and 2005 (Garrison, 2003; Garrison and Richards, 2004; ~~, Yeung, 1999~~Garrison, 2005, Walsh and Garrison, 2006).

~~**Pelagic Drift Gillnet**~~

~~Estimated bottlenose dolphin mortalities (CV in parentheses) extrapolated for each year were 72 in 1989 (0.18), 115 in 1990 (0.18), 26 in 1991 (0.15), 28 in 1992 (0.10), 22 in 1993 (0.13), 14 in 1994 (0.04), 5 in 1995 (0), 0 in 1996, and 3 in 1998 (0). Since this fishery no longer exists, it has been excluded from Table 1.~~

~~**Pelagic Pair Trawl**~~

~~Thirty-two bottlenose dolphin mortalities were observed between 1991 and 1995. Estimated annual fishery-related mortality (CV in parentheses) was 13 dolphins in 1991 (0.52), 73 in 1992 (0.49), 85 in 1993 (0.41), 4 in 1994 (0.40) and 17 in 1995 (0.26). Since this fishery no longer exists, it has been excluded from Table 1.~~

~~**North Atlantic Bottom Trawl**~~

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

~~**Squid, Mackerel and Butterfish**~~

~~Although there were reports of bottlenose dolphin mortalities in the foreign fishery during 1977-1988, there were no fishery-related mortalities of bottlenose dolphins reported in the self-reported fisheries information from the mackerel trawl fishery during 1990-1992.~~

~~**New England Multispecies**~~ **Northeast Sink Gillnet**

The first observed mortality of bottlenose dolphins was recorded in 2000. This was genetically identified as an offshore~~, deep-water ecotype~~ morphotype animal. The estimated annual fishery-related serious injury and mortality attributable to this fishery (CV in parentheses) was 0 from 1996-1999, and 132 (CV=1.16) in 2000. ~~There have been no observed bottlenose dolphin mortalities since 2000 in this fishery~~ There was one additional observed mortality of a bottlenose dolphin presumed to be from the offshore morphotype in this fishery during 2004. Total mortality estimates for 2001-2005 have not been calculated (Table ~~1~~2).

Mid-Atlantic ~~Coastal~~ Gillnet

~~Bottlenose dolphins were only reported during the trips in 1998, when 1 mortality was observed as a result of this fishery. Though this dolphin was not genetically identified, it is being treated as an offshore, deep-water ecotype because it was caught in the offshore habitat and statistical analyses of all biopsied bottlenose dolphins caught in this offshore habitat indicate this animal has a high probability of being the offshore ecotype. Observed effort was concentrated off New Jersey and scattered between Delaware and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality attributed to this fishery was 0 in 1995 through 1997, 4 (CV=0.7) in 1998, and 0 from 1999 through 2000. A bottlenose dolphin was captured in the region of overlap over the continental shelf in the mid-Atlantic gillnet fishery during May, 2001. Mortality estimates have not been developed for the offshore morphotype during 2001-2002 due to the uncertainties associated with the relative distribution of the two morphotypes.~~Bottlenose dolphin mortalities were observed in this fishery during 1998, 2001, and 2005. In each case, the dolphin was presumed to be of the offshore morphotype based upon its location in deep water over the outer continental shelf. The only prior estimate of total mortality in the fishery was 4 (CV = 0.7) for 1998. Extrapolated estimates of total mortality from 2001-2005 have not been calculated (Table 2).

Table ~~1~~2. Summary of the incidental mortality of offshore morphotype bottlenose dolphins (*Tursiops truncatus*) by commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the mortalities recorded by on-board observers (Observed Mortality), the estimated annual mortality (Estimated Mortality), the estimated CV of the annual mortality (Estimated CVs) and the mean annual mortality (CV in parentheses).

Fishery	Years	Vessels	Data Type [a~~1~~]	Observer Coverage [b~~2~~]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
~~New England Multisp.~~Northeast Sink Gillnet	~~99-03~~ 01-05	unk[c]	Obs. Data Dealer Reports, Logbooks	~~.06, .06,~~ .04, .02, .03, .06, .07	~~0, 1~~, 0, 0, 0, 1, 0	~~0, 132,~~ 0, 0, 0, unk[d], unk[d]	~~0, 1.16~~, 0, 0, 0, , unk[d], unk[d]	~~26 (1.16)~~ unk[d]
~~mid~~Mid-Atlantic ~~Coastal~~ Gillnet	~~99-03~~ 01-05	unk[c] ~~Unk[3]~~	Obs. Data Dealer Reports	~~.02, .02,~~ .02, .01, .01, .02, .03	~~0, 0, 1~~ 0 , 0, 0, 0, 1	~~4, 0, 0, NA, NA~~ unk[d], 0, 0, unk[d], unk[d]	~~U~~unk[d], 0, 0, unk[d], unk[d]~~0.7, 0, 0, NA, NA~~	~~1 (0.7)~~ unk[d]
~~TOTAL~~ TOTAL								~~27 (1.12)~~ unk[d]

[1]a. Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected ~~within the~~by the Northeast Fisheries ~~Science Center (NEFSC) Sea Sampling Program~~Observer Program. ~~Mandatory logbook (logbook) data collected by the Southeast Fisheries Science Center (SEFSC) are used to measure total effort for the pelagic drift gillnet fishery.~~ The NEFSC collects landings data (Dealer Reports), and total landings are used as a measure of total effort for the gillnet fisheries. Mandatory vessel trip reports (Logbook) data are used to determine the spatial distribution of ~~-~~fishing effort in the Northeast ~~multispecies~~ sink gillnet fishery.

[2]b. Observer coverage of the Northeast ~~multispecies~~ sink gillnet ~~fishery is measured as the percentage of trips observed. Observer coverage of~~and ~~the m~~Mmid-Atlantic coastal gillnet ~~fishery~~ fisheries are~~is~~ ~~measured as~~ratios based on the percentage of tons of fish landed.

[3]c. Number of vessels is not known.

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

Other Mortality

Bottlenose dolphins are ~~one of~~among the most frequently stranded small cetaceans along the Atlantic coast. Many of the animals show signs of human interaction (*i.e.*, net marks, mutilation, etc.); however, it is unclear what proportion of these stranded animals is from the offshore morphotype.~~.~~ ~~The estimated number of animals that represent the offshore stock is presently under evaluation.~~

STATUS OF STOCK

The status of this stock relative to OSP in the U.S. Atlantic EEZ is unknown. The western North Atlantic offshore bottlenose dolphin is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. Average ~~1998-2002~~2001-2005 annual U.S. fishery-related mortality and serious injury ~~does not exceed the PBR therefore this is not a strategic stock~~ has not been estimated, and it is therefore unknown whether or not total mortality and serious injury can be considered insignificant.~~.~~ ~~The total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and, therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate.~~

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

~~Buckland, S. T., D. R. Anderson, K. P. Burnham and, J. L. Laake, D. 1993L. DistanceBorchers and L. Thomas. 2001. Introduction to distance sampling: Estimatingestimating abundance of biological populations. *Chapman and Hall*, New YorkOxford University Press, 446432 pp.~~

Buckland, S. T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

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

~~Cramer J. 1994. Large pelagic logbook newsletter 1993. NOAA Tech. Mem. NMFS-SEFSC-352, 19 pp. NMFS, Southeast Fisheries Science Center, Miami, FL.~~

Curry, B. E. and J. Smith. 1997. Phylogeographic structure of the bottlenose dolphin (*Tursiops truncatus*): stock identification and implications for management. Pp. 327-247. *In:* A. E. Dizon, S. J. Chivers and W. F. Perrin (editors), Molecular genetics of marine mammals. Spec. Publ. 3 Society for Marine Mammalogy.

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

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

Garrison, L.P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Technical Memorandum NMFS-SEFSC-515, 51 pp.

Garrison, L.P. 2005. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2004. NOAA Technical Memorandum NMFS-SEFSC-531, 57 p.

Garrison, L. P. and P. M. Richards. 2004. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic

Pelagic Longline Fleet During 2003. NOAA Technical Memorandum NMFS-SEFSC-527, 57 p.

Garrison, L.P., P.E. Rosel, A.A. Hohn, R. Baird, and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin Tursiops truncatus, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Gowans S. and H. Whitehead. 1995. Distribution and habitat partitioning by small odontocetes in the Gully, a submarine canyon on the Scotian Shelf. Can. J. Zool. 73: 1599-1608.

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

Hiby, L. 1999. The objective identification of duplicate sightings in aerial survey for porpoise. Pages 179-189 *In:* Garner *et al.* (eds.). Marine Mammal Survey and Assessment Methods. Balkema, Rotterdam.

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' populations of the bottlenose dolphin. Proc. R. Soc. Lond. B 265:1177-1183.

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

Mead, J. G. and C. W-. Potter. 1995. Recognizing two populations for the bottlenose dolphin (*Tursiops truncatus*) off the Atlantic coast of North America: morphologic and ecologic considerations. International Biological Research Institute Reports 5:31-43.

Mullin, K. D., and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. North Atlantic Ocean during summer 1998. Fish. Bull., U.S. 101:603-613.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int Whal. Commn. Special Issue 16:27-50

Palka, D. and Hammond, P.S. 2001. Accounting for responsive movement in line transect estimates of abundance. Can. J. Fish. Aquat. Sci. 58: 777-787

~~Palka, D., G. Waring and D. Potter. (inIn review). Abundances of cetaceans and sea turtles in the northwest Atlantic during summer 1995 and 1998. *Fish. Bull., U.S.*~~

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving managment of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19:502-514.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Wells, R. S., H. L. Rhinehart, P. Cunningham, J. Whaley, M. Baran, C. Koberna and D. P. Costa. 1999. Long distance offshore movements of bottlenose dolphins. Mar. Mammal Sci. 15(4):1098-1114.

~~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.~~

Walsh, C.F. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. NOAA Technical Memorandum NMFS-SEFSC-539, 52 p.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Stock Structure of the Coastal Morphotype

A. Latitudinal distribution and structure along the coast

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

G~~Recent g~~enetic analyses of samples from northern Florida, Georgia, central South Carolina (primarily the estuaries around Charleston), southern North Carolina, and coastal Virginia, using both mitochondrial DNA and nuclear microsatellite markers~~,~~ indicate that a significant amount of the overall genetic variation can be explained by differences between these areas (NMFS 2001). These results indicate a minimum of five stocks of coastal bottlenose dolphins along the US Atlantic coast and reject the null hypothesis of one homogeneous population.

Photo-identification studies also support the existence of multiple stocks (NMFS 2001). A coastwide photographic catalogue has been established using contributions from 15 sites from Cape May, NJ, to Cape Canaveral, FL (Urian *et al.* 1999). No matches have been found between the northernmost and southernmost sites. However, there appears to be a high rate of exchange among northern field sites, where dolphins occur only seasonally, and central North Carolina. Other areas of frequent exchange include Beaufort and Wilmington, NC. By comparison, the degree of movement along the southern portion of the Atlantic coast is poorly understood and is currently under study. ~~In contrast to the patterns found in the northern end of the range, there appears to be less movement between southern field sites. There are only two confirmed matches between the relatively large catalogs of Jacksonville, FL, and Hilton Head, SC, for example, and no matches between the Charleston, SC site and other sites.~~

Satellite-linked radio transmitters have been deployed on dolphins ~~in~~ off Virginia Beach, VA, Beaufort, NC, Charleston, SC and New Jersey. The movement patterns of animals with satellite tags provide additional information complementary to other stock identification approaches. The results, along with photo-identification of freeze-branded animals, indicate that a significant number of dolphins reside in North Carolina in summer and do not migrate. A dolphin tagged in Virginia Beach, VA, spent the winter between Cape Hatteras and Cape Lookout, NC. indicating seasonal migration between North Carolina and areas further north (NMFS 2001).

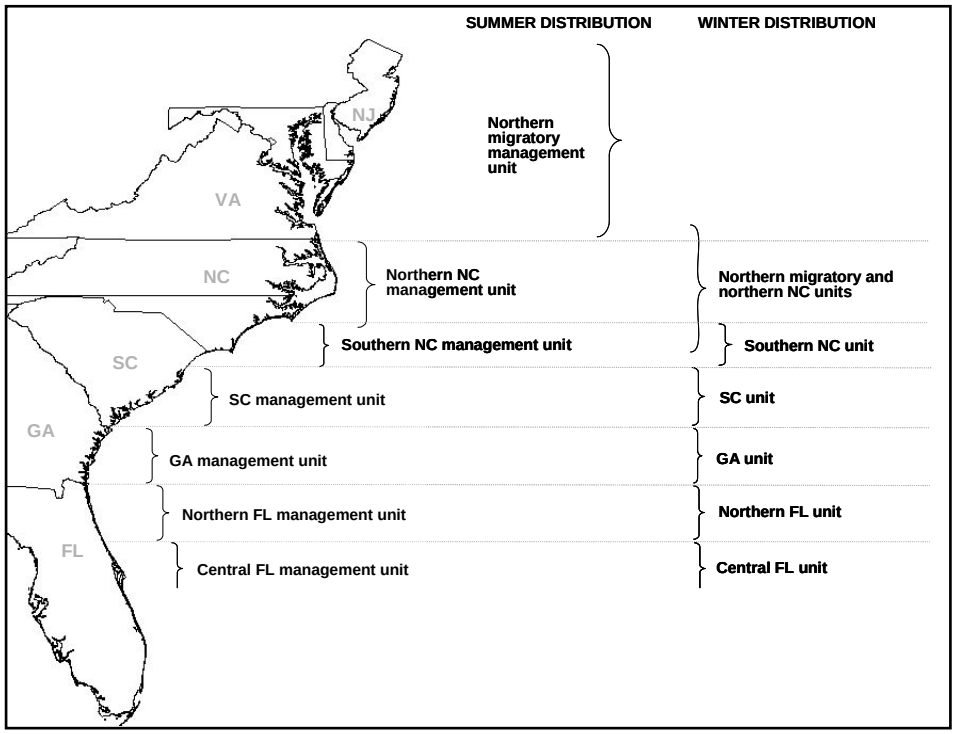
Another potential stock has been identified from stable isotope ratios of oxygen (NMFS 2001). Animals sampled along the beaches of North Carolina between Cape Hatteras and Bogue Inlet during February and March show very low stable isotope ratios of ^{18}O relative to ^{16}O (referred to as depleted ^{18}O or depleted oxygen, Cortese 2000). One possible explanation for the depleted oxygen signature is a resident group of dolphins in Pamlico Sound that move into nearby nearshore areas in the winter. The possibility of a resident group of bottlenose dolphins in Pamlico Sound is supported by results from satellite telemetry and photo-identification results. Alternatively, these animals may represent a component of the migratory animals that spend their summers at the northernmost end of the range of bottlenose dolphins and winter in North Carolina. Either possibility suggests that they represent a separate stock.

There are additional resident estuarine stocks that are likely demographically distinct from coastal stocks, ~~but~~ and they are currently included in the coastal~~-~~ management unit definitions. For example, year-round resident populations have been reported at a variety of sites from Charleston, SC (Zolman ~~1996~~2002; Speakman *et al.* 2006) to central Florida (Odell and Asper 1990). Seasonal residents and migratory or transient animals also occur in these areas (summarized in Hohn 1997). In the northern part of the range, the patterns reported include seasonal residency, year-round residency with large home ranges, and migratory or transient movements (Barco and Swingle 1996). ~~Communities~~ Long-term, year-round, multi-generational resident communities of dolphins have been

recognized in embayments and coastal areas of the Gulf of Mexico (Wells *et al*. 1987;~~,~~ Wells *et al.* 1996; Scott *et al.* 1990; Weller 1998; Wells 2003), and it is not surprising to find similar ~~situations~~ patterns along the Atlantic coast.

I~~n summary, i~~ntegration of the results from genetic, photo-identification, satellite telemetry, and stable isotope studies confirms a complex mosaic of coastal bottlenose dolphin stocks. Based upon available data and analysis, s~~Therefore, s~~even management units within the range of the coastal morphotype of western North Atlantic bottlenose dolphin have been defined (Figure 1). The true population structure is likely more complex than the seven units identified in this report, and research efforts continue to identify that structure.

Figure 1. Management units of the coastal morphotype of bottlenose dolphin along the Atlantic coast of the US as defined from genetic, stable isotope ratio, photo-identification, and telemetry studies (NMFS 2001).



B. Longitudinal distribution

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

Dolphin groups observed during aerial surveys cannot be attributed to a specific morphotype based on sighting information alone. Genetic analysis of tissue samples can be used to identify animals to a specific morphotype (Hoelzel *et al.* 1998;~~,~~ P. Rosel SEFSC unpublished results). An analysis of tissue samples from large vessel surveys during the summers of 1998 and 1999 indicated that bottlenose dolphins within 7.5 km from shore were most likely of the coastal morphotype, and there was an extensive region of overlap between the coastal and offshore morphotypes between 7.5 and 34 km from shore south of Cape Hatteras, NC (Torres *et al.* 2003). However, relatively few samples were available from the region of overlap, and therefore the longitudinal boundaries based on these initial analyses are uncertain (Torres *et al*. 2003). Extensive systematic biopsy sampling efforts were conducted in the summers of 2001 and 2002 to supplement collections from large vessel surveys. During the winters of 2002 and 2003, additional biopsy collection efforts were conducted in nearshore continental shelf waters of North Carolina and Georgia. A small number of additional biopsy samples were collected in deeper continental

shelf waters south of Cape Hatteras during winter 2002. Genetic analyses of these biopsies identified individual animals to the coastal or offshore morphotype. Based upon the genetic results from all surveys combined, a logistic regression approach was used to model the probability that a particular bottlenose dolphin group is of the coastal morphotype as a function of environmental variables including depth, sea surface temperature, and distance from shore. These models were used to partition the bottlenose dolphin groups observed during aerial surveys between the two overlapping morphotypes (Garrison *et al.* 2003).

The genetic results and spatial patterns observed in aerial surveys indicate both regional and seasonal differences in the longitudinal distribution of the two morphotypes in coastal Atlantic waters. North of Cape Lookout, NC (i.e., northern migratory and northern North Carolina management units) during summer months, the previously observed pattern of strong nearshore aggregation of bottlenose dolphins was again observed. All biopsy samples collected from nearshore waters (< 20 m deep) were of the coastal morphotype and all samples collected in deeper waters (> 40 m deep) were of the offshore morphotype. The genetic results confirm separation of the two populations in this region during summer months. South of Cape Lookout, NC, the probability of an observed bottlenose dolphin group being of the coastal morphotype declined with increasing depth; however, there was significant spatial overlap between the two morphotypes. Offshore morphotype bottlenose dolphins were observed at depths as shallow as 13 m, and coastal morphotype dolphins were observed at depths of 31 m and 75 km from shore (Garrison *et al.* 2003). These results indicate significant overlap between the two morphotypes in the southern management units during summer months.

Winter samples were collected primarily from nearshore waters in North Carolina and Georgia. The vast majority of samples collected in nearshore waters of North Carolina during winter were of the coastal morphotype; however, one offshore morphotype group was sampled during November just south of Cape Lookout, North Carolina only 7.3 km from shore. Coastal morphotype samples were also collected further away from shore at 33 m depth and 39 km from shore. The logistic regression model for this region indicated a decline in the probability of a coastal morphotype group with increasing distance from shore; however, the model predictions are highly uncertain due to limited sample sizes and high overlap between the two morphotypes. Samples collected in Georgia waters also indicated significant overlap between the two morphotypes with a declining probability of the coastal morphotype with increasing depth. A coastal morphotype sample was collected well offshore at a distance of 112 km from shore and a depth of 38 m. An offshore sample was collected in 22 m depth at 40 km from shore. As with the North Carolina model, the Georgia logistic regression predictions are uncertain due to limited sample size and high overlap between the two morphotypes (Garrison *et al.* 2003). ~~The logistic regression models were used to predict the probability that an observed bottlenose group is of the coastal morphotype as a function of habitat variables and spatial location.~~ There remain significant sampling gaps in the biopsy collections, particularly during winter months, that increase the uncertainty of model predictions. Both the predicted probability of a coastal morphotype occurring and the associated uncertainty in that prediction are incorporated into the abundance estimates for coastal morphotype bottlenose dolphin management units.

POPULATION SIZE

Previous abundance estimates for the coastal morphotype of WNA bottlenose dolphin were based primarily upon aerial surveys conducted during the summer and winter of 1995. The surveys were designed based upon the previous assumption of a single coastal migratory stock, and therefore they did not provide complete seasonal and spatial coverage for the more recently defined management units. Previous abundance estimates were also not corrected for visibility bias (Garrison and Yeung 2001). Aerial surveys to update the abundance estimates were conducted during winter (January-February) and summer (July-August) of 2002. Survey tracklines were set perpendicular to the shoreline and included coastal waters to depths of 40 m. The surveys employed a stratified design so that most effort was expended in waters shallower than 20 m deep where a high proportion of observed bottlenose dolphins were expected to be of the coastal morphotype. Survey effort was also stratified to optimize coverage in seasonal management units. The surveys employed two observer teams operating independently on the same aircraft to estimate visibility bias.

The winter survey included the region from the Georgia/Florida state line to the southern edge of Delaware Bay. A total of 6,411 km of trackline was completed during the survey, and 185 bottlenose dolphin groups were sighted including 2,114 individual animals. No bottlenose dolphins were sighted north of Chesapeake Bay corresponding to water temperatures < 9.5 ~~E~~ºC. During the summer survey, 6,734 km of trackline were completed between Sandy

Hook, NJ and Ft. Pierce, FL. All tracklines in the 0-20 m stratum were completed throughout the survey range while offshore lines were completed only as far south as the Georgia-Florida state line. A total of 185 bottlenose dolphin groups was sighted during summer including 2,544 individual animals.

Abundance estimates for bottlenose dolphins in each management unit were calculated using line transect methods and distance analysis (Buckland *et al.* 2001). The independent and joint estimates from the two survey teams were used to quantify the probability that animals available to the survey on the trackline were missed by the observer teams, or perception bias, using the direct duplicate estimator (Palka, 1995). These estimates were further partitioned between the coastal and offshore morphotypes based upon the results of the logistic regression models and spatial analyses described above. A parametric bootstrap approach was used to incorporate the uncertainty in the logistic regression models into the overall uncertainty in the abundance estimates for each management unit (Garrison *et al*. 2003).

The aerial surveys included only animals in coastal waters, and the resulting abundance estimates therefore do not include animals inside estuaries that are currently included in the defined management units. An abundance estimate was generated for bottlenose dolphins in estuaries from the North Carolina-South Carolina border to northern Pamlico Sound using mark-recapture methodology (Read *et al.* 2003), and these estimates were post-stratified to be consistent with management unit definitions (Palka *et al.* 2001a; Table 1). Since abundance estimates do not exist for all estuarine waters, the population estimates and PBRs for these management units are negatively biased.

Bottlenose dolphins in the northern migratory stock migrate south during winter months and overlap with those from the northern North Carolina and southern North Carolina management units. It is not possible at this time to apportion the incidental mortality occurring during winter months in North Carolina waters among animals from these three management units. Therefore, a half-year PBR value is applied for each management unit in the summer based upon abundance estimates from summer aerial surveys. During winter months, these three stocks overlap spatially and a half-year PBR is applied to the North Carolina mixed management unit based upon winter aerial survey abundance estimates. For the South Carolina and Georgia management units, the abundance estimates, minimum population size values, and the resulting PBR values are derived using a weighted average of abundance estimates from the winter and summer 2002 aerial surveys. The northern Florida management unit was only surveyed during the summer of 2002 and the winter of 1995. The resulting abundance estimate is therefore a weighted average of the seasonal estimates from the available surveys. Finally, the central Florida management unit was only covered during the 1995 surveys. Due to the age of the available abundance estimates, the PBR of the northern and central Florida management units were set to "undefined".

Table 1. Estimates of abundance and the associated CV, n_{min}, and PBR for each stock of WNA coastal bottlenose dolphins (Garrison *et al.* 2003). The PBR for the Northern Migratory, Northern NC, and Southern NC management units are applied semi-annually. South of NC, the PBR is applied annually. Except where noted, abundance estimates and PBR values do not include estuarine animals. The recovery factor (Fr) used to calculate PBR for each stock is based upon the CV of the ~~abundance~~ mortality estimate based on the guidelines in Wade and Angliss (1997).

Unit		Best Abundance		N_{min}	Recovery Factor (Fr)	PBR	
		Estimate	CV			Annual	½ Yr
SUMMER (May - October)							
Northern migratory		17,466	0.19	14,621	0.50	(146.2)	73.1
Northern NC							
	oceanic	6,160	0.52	3,255	0.48	(31.2)	15.6
	~~estuary~~[4] estuary[a]	919	0.13	828	0.50	(8.2)	4.2
	BOTH	7,079	0.45	4,083	0.48	(39.2)	19.6
Southern NC							
	oceanic	3,645	1.11	1,863	0.40	(14.9)	7.5

	~~estuary~~[4] estuary[a]	141	0.15	124	0.50	(1.2)	0.6
	BOTH	3,786	1.07	1,987	0.40	(15.9)	7.9
WINTER (November ~~-~~ – April)							
NC ~~mixed[1]~~ -mixed[b]		16,913	0.23	13,558	0.50	(135.6)	67.8
ALL YEAR							
South Carolina		2,325	0.20	1,963	0.50	19.6	na
Georgia		2,195	0.30	1,716	0.50	17.2	na
Northern Florida[c,d~~2,3~~]		448	0.38	unk~~na~~	unk~~na~~	unk~~na~~	~~na~~unk
Central Florida[d~~3~~]		10,652	0.46	unk~~na~~	unk~~na~~	unk~~na~~	~~na~~unk

a. Read *et al.* 2003
b. NC mixed = northern migratory, Northern NC, and Southern NC
c. Northern Florida estimates are a weighted mean of abundance estimates from the winter 1995 survey and the summer 2002 survey. Due to the age of the winter abundance estimate, PBR cannot be calculated for this stock.
d. Northern and Central Florida estimates include data from the winter 1995 survey and cannot be used to determine PBR due to their age.

Minimum Population Estimate

The minimum population size (Nmin) for each stock was calculated as the lower bound of the 60% confidence interval for a lognormally distributed mean (Wade and Angliss 1997). For the estimates derived from bootstrap resampling, the appropriate Nmin was taken directly from the bootstrap distribution of abundance estimates. These estimates ~~may be~~are negatively biased because they do not include estuarine animals other than those inside estuaries of North Carolina (Read *et al.* 2003), and they do not fully account for visibility bias. Minimum population sizes for each stock are shown in Table 1.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of the minimum population size, one-half the maximum productivity rate, and a recovery factor (Wade and Angliss 1997). This complex of management units incorporates the range of the former WNA coastal migratory stock that was defined as depleted under MMPA guidelines. At least some of these management units are likely depleted relative to their optimum sustainable population (OSP) size due both to mortality during the 1987-1988 die-off and high incidental mortality in fisheries~~ relative to PBR~~. Given the known population structure within the coastal morphotype bottlenose dolphins, it is appropriate to apply PBR separately to each management unit so as to achieve the goals of the MMPA (Table 1; Wade and Angliss 1997).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Total estimated average annual fishery related mortality during ~~1996-2000~~2001-2005 was 61~~233~~ bottlenose dolphins (CV= ~~0.16~~0.15) in the mid-Atlantic coastal gillnet fishery. The management units affected by this fishery

are the northern migratory, northern North Carolina, and southern North Carolina management units. An estimated ~~6 (CV= 0.89)~~ 5 (CV = 0.53) mortalities occurred annually in the shark drift gillnet fishery off the coast of Florida during ~~1999-2002~~2001-2005, affecting the Central Florida management unit. No observer data are available for other fisheries that may interact with WNA coastal bottlenose dolphins. In addition, there are no estimates of fishery or other human cause mortality for animals residing inside estuaries. Therefore, the total average annual mortality estimate is ~~considered to be~~ a lower bound of the actual annual human-caused mortality for each stock. Detailed fishery information is presented in Appendix III.

Earlier Interactions

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

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

One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast USA Marine Mammal Stranding Network unpublished data), and another was taken in 1996 near the mouth of Winyah Bay, SC, during a research survey. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.

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

~~Bottlenose dolphins interact with commercial fisheries and occasionally are taken in fishing gear including gillnets, seines, long lines, shrimp trawls, and crab pots (Read 1994; Wang *et al.* 1994; Burdett and McFee 2004) in near-shore areas where dolphin density and fishery effort are greatest. There are nine Category II commercial fisheries that interact with WNA coastal bottlenose dolphins in the 2003 MMPA List Of Fisheries (LOF), six of which occur in North Carolina waters. Category II fisheries include the mid-Atlantic coastal gillnet, NC inshore gillnet, mid-Atlantic haul/beach seine, NC long haul seine, NC stop net, Atlantic blue crab trap/pot, Southeast Atlantic gillnet, Southeastern U.S. Atlantic shark gillnet and the Virginia pound net (see 2003 List of Fisheries, 68 FR 41725, July 15 2003). The mid-Atlantic haul/beach seine fishery also includes the haul seine and swipe net fisheries. The term mid-Atlantic refers to the geographic area south of Long Island, landward to 72° 30' W longitude, and north of the line extending due east from the North Carolina/South Carolina border (66 FR 6545, January 22 2001).~~

~~There are five Category III fisheries that may interact with WNA coastal bottlenose dolphins. Three of these are inshore gillnet fisheries: the Delaware Bay inshore gillnet, the Long Island Sound inshore gillnet, and the Rhode Island, southern Massachusetts, and New York Bight inshore gillnet. The remaining two are the shrimp trawl and mid-Atlantic menhaden purse seine fisheries. There have been no takes observed in these fisheries in recent years and no systematic observer coverage.~~

Mid-Atlantic ~~Coastal~~ Gillnet

This fishery has the highest documented level of mortality of WNA coastal morphotype bottlenose dolphins, and the North Carolina sink gillnet fishery is its largest component in terms of fishing effort and observed takes. Of 12 observed mortalities between 1995 and 2000, 5 occurred in sets targeting spiny or smooth dogfish and another in a set targeting "shark" species, 2 occurred in striped bass sets, 2 occurred in Spanish mackerel sets, and the remainder were in sets targeting kingfish, weakfish, or finfish generically (Rossman and Palka 2001). Only two bottlenose dolphin mortalities were observed in 2001-2002, both occurring in the winter mixed North Carolina unit. Two additional mortalities were observed in the northern North Carolina management unit in 2003 and 2004. The overall estimated level of mortality has declined during the past ~~two~~ five years associated with reductions in fishery

effort and reduced observed bycatch ~~-~~(Rossman ~~and Palka~~ in review). Due to these significant changes in the behavior of the fishery, bycatch estimates for these fisheries are separated into two periods: 1996 to 2000 and 2001 to ~~2002~~ 2005 (Table 2). Bycatch rate estimates for the 2001-2005 period are based solely on observed takes during 2001 and 2002. Estimates of total mortality for 2003-2005 are based upon fishery effort reported during those years.~~The mortality estimates for the coastal gillnet fishery have not been updated for 2003 and 2004. These will be updated for the 2007 stock assessment report.~~

Table 2. Summary of the 1996-~~2002~~ 2005 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by management unit in the commercial mid-Atlantic coastal gillnet fisheries. Data include the years sampled (Years), the number of vessels active within the fishery (Vessels), type of data used (Data Type), observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Seasonal Management Unit	Years	Vessels	Data ~~Type[1]~~ Type[a]	Observer Coverage ~~[2]~~[b]	Observed Serious Injury	Observed Mortality	Estimated Mortality[d]	Estimated CVs ~~[3]~~[c]	Mean Annual Mortality
Summer Northern Migratory	1996-2000	~~NA~~unk	Obs. Data, NER Dealer Data	.05, .03, .02, .03, .03,	0, 0, 0, 0, 0	0, 0, 1, 1, 1,	33, 30, 37, 19, 30,	0.48, 0.48, 0.48, 0.48, 0.48	30 (0.22)
	~~2001-2002~~2001-2005			.02, .01, .03, .03, .05	0, 0, 0, 0, 0	0, 0, 0, 0, 0	11, 11, 17, 14, 20	0.35, 0.35, 0.35, 0.35, 0.35	~~11 (0.25)~~15 (0.16)
Summer Northern NC	1996-2000	~~NA~~unk	Obs. Data, NCDMF Dealer Data	.01, 0~~.00~~, <.01, .01, .03,	0, 0, 0, 0, 0	1, 0, 0, 0, 0,	27, 33, 17, 13, 26,	0.61, 0.61, 0.61, 0.61, 0.61	23 (0.29)
	~~2001-2002~~2001-2005			.01, <.01, .01, .02, .,01	0, 0, 0, 0, 0	0, 0, 1, 1, 0	8, 8, 8, 7, 12	1.06, 1.06, 0.82, 0.82, 0.82	~~8 (0.75)~~9 (0.41)
Summer Southern NC	1996-2000	~~NA~~unk	Obs. Data, NCDMF Dealer Data	~~.00~~0, ~~.00~~0, .01, .03, .03,	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	NA	0 (NA)
	~~2001-2002~~2001-2005			.02, <.01, 0, 0, 0	0, 0, unk, unk, unk	0, 0, unk, unk, unk	0, 0, unk, unk, unk	NA	~~0~~ unk (NA)
Winter NC mixed	1996-2000	unk~~NA~~	Obs. Data, NCDMF Dealer Data	.01, .01, .02, .02, .02,	0, 0, 0, 0, 0	1, 0, 1, 2, 2,	173, 211, 175, 196, 146,	0.46, 0.46, 0.46, 0.46, 0.46	180 (0.21)
	~~2001-2002~~2001-2005			.01, .01, .02, .03, .03	0, 0, 0, 0, 0	0, 2, 0, 0, 0	67, 50, 23, 30, 18	0.45, 0.45, 0.40, 0.40, 0.40	~~58~~ 37 (0.~~32~~ 22)
Total	2001-~~2002~~ 2005 Only								~~77~~ 61 (0.~~26~~15)

NA=Not ~~Available~~applicable, unk = unknown or unobserved

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

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

c The annual estimates of mortality are computed by summing mortality estimates over six strata for each management unit. Stratified bycatch rates are ~~from 1998-2000 were generated by applying one bycatch rate per management unit as~~ estimated by a generalized linear model (Palka and Rossman 2001). An aggregate weighted CV is then calculated by weighting the stratified bycatch rates and variances by the proportion of observed metric tons sampled within each stratum. The CV does not account for variability that may exist in the unit of total landings (mt) from each year that are used to expand the bycatch rate. ~~Therefore, the CV is the same for all five annual estimates.~~

d The annual estimates of mortality from 2001-2002 were generated by applying the same method used in Palka and Rossman (2001) with a ~~. An~~ new factor variable ~~was~~ added to the model to separate the time series of historical data (1996-2000) from data collected during the recent time period (2001-2002) (Rossman ~~and Palka~~ in review). Until further model development is completed, mortality estimates for 2003 through 2005 were calculated by applying the bycatch rates from the recent time period (2001-2002) to effort from 2003 to 2005.

South Atlantic Shark Drift Gillnet

Observed takes of bottlenose dolphins occurred primarily during winter months when the fishery operates in waters off of southern Florida. Fishery observer coverage outside of this time and area has increased significantly in the last ~~2~~ several years, and there was one observed mortality during summer months in fishing operations off Cape Canaveral, FL. There have been no observed interactions with bottlenose dolphins since 2003 (Carlson and Betha, 2006). All observed fishery takes are restricted to the Central Florida management unit of coastal bottlenose dolphin. Total bycatch mortality has been estimated for ~~2000-2004~~2001-2005 following methods described in (Garrison 2003, Table 3).

Table 3. Summary of the ~~2000-2004~~2001-2005 incidental mortality of bottlenose dolphins (*Tursiops truncatus*) by management unit in the driftnet fishery in federal waters off the coast of Florida. Data include years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), annual observer coverage (Observer Coverage), mortalities recorded by on-board observers (Observed Mortality), estimated annual mortality (Estimated Mortality), estimated CV of the annual mortality (Estimated CVs), and mean annual mortality (CV in parentheses).

Seasonal Management Unit	Years	Vessels	Data Type ~~1~~[a]	Observer Coverage ~~2~~[b, c]	Observed Serious Injury	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northern Florida	~~2000-2004~~2001-2005	6	Obs. Data, SEFSC FVL	~~0.23,~~ ~~0~~.07, ~~0~~.20, ~~0~~.05, ~~0~~.10, unk[c]	0, 0, 0, 0,0	0, 0,0,0,0	0, 0, 0, 0, 0	NA	0
Central Florida	~~2000-2004~~2001-2005	6	Obs. Data, SEFSC FVL	~~0.15, 0~~.42, ~~0~~.25, ~~0~~.09, ~~0~~.19, .26[c]	0, 0, 0, 0,0	~~1,~~ 4, 1,2,0, 0	~~2,~~ 4, 7, 13, 0, 0	~~1,~~ 0, 1, .81, NA, NA	~~5 (0.49)~~5 (.53)

unk = unknown, NA = cannot be calculated	
a	Observer data are used to estimate bycatch rates. The SEFSC Fishing Vessel Logbook (FVL) is used to estimate effort as total number of vessel trips per bottlenose dolphin management unit.
b	Observer coverage in the central Florida management unit approaches 100% during the period between January - March south of 27° 51' N latitude.
c	During 2005, the number of observed sets exceeded the number of sets reported to the FVL system for specific areas and seasons within the central Florida management unit, therefore the true effort level is unknown. Estimates of effort are problematic for this fishery because logbook data does not distinguish between types of fishing sets including sink, drift, and strike gillnets sets.

Beach Haul Seine

~~A total of 2~~Two coastal bottlenose dolphin takes ~~was~~were ~~-~~observed in the mid-Atlantic beach haul seine fishery: 1 in May 1998 and 1 in December 2000.

Crab Pots

Between 1994 and 1998, 22 bottlenose dolphin carcasses (4.4 dolphins per year on average) recovered by the Stranding Network between North Carolina and Florida's Atlantic coast displayed evidence of possible interaction with a trap/pot fishery (i.e., rope and/or pots attached, or rope marks). Additionally, at least 5 dolphins were reported to be released alive (condition unknown) from blue crab traps/pots during this time period. During 2003, two bottlenose dolphins were observed entangled in crab pot lines in South Carolina, including one confirmed mortality, and two bottlenose dolphins were disentangled alive from crab pots in Virginia. In 2004, the SER stranding network reported observing 3 bottlenose dolphins (including one mortality) entangled in crab pot lines in Florida, one in Georgia, and three in South Carolina. In 2005, one entanglement was observed in Florida, one in Georgia, and one in Virginia. With the exception of the mortality in Florida during 2004, all animals were released from entangling gear and were not described to be seriously injured (SER Stranding Network). A review of stranding network data from South Carolina between 1992-2003 indicated that 24% of known bottlenose dolphin entanglements could be confirmed as involving crab pots, and an additional 19% of known entanglements were probable interactions with crab pots (Burdett and McFee, 2004). Since there is no systematic observer program, it is not possible to estimate the total number of interactions or mortalities associated with crab pots. However, it is clear that this interaction is a common occurrence and does result in mortalities of coastal morphotype bottlenose dolphins.

~~**Shrimp Trawl**~~

~~One bottlenose dolphin was recovered dead from a shrimp trawl in Georgia in 1995 (Southeast USA Marine Mammal Stranding Network unpublished data), and another was taken in 1996 near the mouth of Winyah Bay, SC, during a research survey. No other bottlenose dolphin mortality or serious injury has been reported to NMFS. There has been very little systematic observer coverage of this fishery during the last decade.~~

~~**Menhaden Purse Seine**~~

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

Virginia Pound Nets

Stranding data for 2002-2005 indicate interactions between coastal bottlenose dolphins and pound nets in Virginia. Fifteen dolphins were removed dead from pound nets and 4 were disentangled and released alive. Additionally, 17 animals stranded with twisted twine line marks consistent with nearby pound net lead (SER Stranding Network)

Other Mortality

From 1997 to ~~2001~~2002, ~~1,654~~1,967 bottlenose dolphins were reported stranded along the Atlantic coast from New York to Florida (Hohn and Martone 2001; Hohn *et al.* 2001; Palka *et al.* 2001b, Northeast Regional Stranding Program, Southeast Regional Stranding Program). Between ~~2002~~ 2003 and ~~2004~~2005, ~~963~~ 935 bottlenose dolphins stranded along the Atlantic coast from New York to Florida (Table 4). Of these, it was possible to determine whether or not a human interaction had occurred for 449 (48%)~~487 (51%)~~; for the remainder it was not possible to make that determination. Of those cases where ~~a cause could be determined~~an evaluation was possible, 32% ~~-~~of the carcasses ~~were determined to have been involved in a~~had evidence of fisheries interaction; however, it should be noted that this was not necessarily the cause of death.~~.~~ T~~However, t~~his proportion ~~ranged widely and~~ was highest for Virginia (~~60~~56%) and North Carolina (~~40~~38%). 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.

There have been occasional mortalities of bottlenose dolphins during research activities including both directed live capture studies and fisheries surveys. In March 2002, a dolphin was entangled in the lazy line of a turtle relocation trawl off of Bogue Banks, North Carolina. In August 2002, a dolphin died during a fisheries research project using a trammel net in South Carolina (NMFS Protected Resources Division). Similarly, in March and November 2004, three dolphin mortalities occurred, including a mother-calf pair during a fisheries research project using a Trammel net in Georgia (SER Stranding Network). During 2004, one female bottlenose dolphin died during a health assessment capture study in Charleston, SC (NMFS Protected Resources Division). ~~-~~In July and October 2006, two mortalities occurred during a fisheries research project using trawl gear in South Carolina and North Carolina (SER Stranding Network). Two ~~or possibly three~~ bottlenose dolphins tagged with an experimental transmitter package deployed during a NMFS research program off North Carolina died within several weeks of tagging during spring 2006 (NMFS Protected Resources Division).

The nearshore and estuarine habitats occupied by the coastal morphotype are~~is~~ adjacent to areas of high human population ~~and in the northern portion of its range~~and some are~~is~~ highly industrialized. The blubber of stranded dolphins examined during the 1987-88 mortality event contained ~~anthropogenic contaminants in levels among the highest recorded for a cetacean~~very high concentrations of organic pollutants (~~Geraci 1989~~Kuehl *et al*. 1991). More recent studies have examined persistent organic pollutant concentrations in bottlenose dolphin tissues from several estuaries along the Atlantic coast and have likewise found evidence of high blubber concentrations particularly near Charleston, SC and Beaufort, NC (Hansen *et al.* 2004). The concentrations found in male dolphins from both of these sites exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002, Hansen *et al.* 2004). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring~~,~~ and higher contaminant concentrations in these calves and in primiparous females (Wells et al. 2005). ~~There are no estimates of indirect human-caused mortality resulting from pollution or habitat degradation.~~While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Table 4. Summary of bottlenose dolphins stranded along the Atlantic Coast of the US. Total Stranded is further stratified into carcasses with signs of human interaction, those without any signs, and those where human interaction could not be determined (CBD). Human Interaction is stratified into stranded animals with line or nets marks or gear attached (Fishery Interaction), and other indications of human interactions such as ~~propellor~~propeller wounds, mutilation, or gunshot wounds. Florida strandings include only the Atlantic coast of Florida extending to Key West.

STATE	2003	2004	~~2004~~2005	STATE	2003 ~~2002~~	2004 ~~2003~~	2005 ~~2004~~
New York Total Stranded	2	0	0~~0~~	**N. Carolina** Total Stranded	69~~94~~	89 ~~69~~	78~~88~~
Human Interaction				Human Interaction			
---- Fishery Interaction	0	0	0~~0~~	---- Fishery Interaction	11~~13~~	15~~11~~	9~~15~~
---- Other	0	0	0~~0~~	---- Other	0 ~~2~~	1 ~~0~~	3~~1~~

No Human Interaction	1	0	0~~0~~
CBD	1	0	0~~0~~
New Jersey Total Stranded	**7**	**15**	**13~~15~~**
Human Interaction			
---- Fishery Interaction	1	1	0~~1~~
---- Other	0	1	0~~1~~
No Human Interaction	5	11	7~~11~~
CBD	1	2	6~~2~~
Delaware Total Stranded	**18**	**16**	**9~~16~~**
Human Interaction			
---- Fishery Interaction	1	1	1~~1~~
---- Other	0	0	0~~0~~
No Human Interaction	13	11	1~~11~~
CBD	4	4	7~~4~~
Maryland Total Stranded	**10**	**10**	**4~~10~~**
Human Interaction			
---- Fishery Interaction	1	1	1~~1~~
---- Other	0	0	0~~0~~
No Human Interaction	8	6	0~~6~~
CBD	1	3	3~~3~~
Virginia Total Stranded	**60**	**75**	**60~~75~~**
Human Interaction			
---- Fishery Interaction	25	22	13~~22~~
---- Other	0	2	0~~2~~
No Human Interaction	12	13	20~~13~~
CBD	23	38	27~~38~~

No Human Interaction	16~~15~~	22~~16~~	14~~22~~
CBD	42~~62~~	51~~42~~	52~~50~~
S. Carolina Total Stranded	**35~~28~~**	**46~~35~~**	**38~~46~~**
Human Interaction			
---- Fishery Interaction	3~~4~~	3~~3~~	5~~3~~
---- Other	0~~0~~	3~~0~~	0~~3~~
No Human Interaction	17~~13~~	22~~17~~	17~~22~~
CBD	15~~11~~	18~~15~~	16~~18~~
Georgia Total Stranded	**17~~11~~**	**27~~17~~**	**14~~27~~**
Human Interaction			
---- Fishery Interaction	0~~0~~	3~~0~~	2~~3~~
---- Other	0~~0~~	1~~0~~	0~~1~~
No Human Interaction	2~~0~~	9~~2~~	2~~9~~
CBD	15~~11~~	14~~15~~	10~~14~~
Florida Total Stranded	**74~~82~~**	**81~~74~~**	**68~~81~~**
Human Interaction			
---- Fishery Interaction	11~~8~~	7~~11~~	6~~7~~
---- Other	0~~2~~	2~~0~~	2~~2~~
No Human Interaction	21~~50~~	27~~21~~	14~~27~~
CBD	42~~22~~	45~~42~~	46~~45~~
Total	**292~~313~~**	**359~~292~~**	**284~~358~~**

STATUS OF STOCKS

The coastal migratory stock was designated as depleted under the MMPA. From 1995 to 2001, NMFS recognized only a single migratory stock of coastal bottlenose dolphins in the WNA, and the entire stock was listed as depleted. The management units in this report ~~now~~ replace the single coastal migratory stock. It should be noted that dolphins residing in a number of bays, sounds, and estuaries in the mid-Atlantic region adjacent to the named stocks are ~~not~~ included in ~~any of~~ these stocks, but for the most part ~~and~~they have not been assessed and are not included in the reported abundance, mortality, and PBR estimates. ~~A re-analysis of the depletion designation on a management unit basis needs to be undertaken. In the interim, because~~ Since one or more of the management units may be depleted, all management units retain the depleted designation. M~~In addition, m~~ortality exceeded PBR in the North Carolina winter mixed stocks during the period from 1996 to 2000. However, due to recent declines in fishery effort and apparent declines in bycatch rates, estimated fishery mortality does not exceed PBR for any of the stocks (Table 1). It should be noted that the gillnet fishery effecting the summer southern North Carolina management unit has not been observed in recent years, and the impact of entanglements with crab pots in Georgia and South Carolina is unknown. ~~-~~ The total U.S. fishery-related mortality and serious injury for most stocks is not less than 10% of the calculated PBR, and thus~~ and, therefore,~~ cannot be considered to be insignificant and approaching zero mortality and serious injury rate.

The species is not listed as threatened or endangered under the Endangered Species Act, but the management units are strategic stocks due to the depleted listing under the MMPA.

REFERENCES

Barco, S. G. and W. M. Swingle. 1996. Sighting patterns of coastal migratory bottlenose dolphins (*Tursiops truncatus*) in the nearshore waters of Virginia and North Carolina. Final Report to the Virginia Dept. of Environmental Quality, Coastal Resources Management Program through Grant #NA47OZ0287-01 from NOAA, Office of Ocean and Coastal Resource Management. 32 pp.

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and a Summary of the 1995 Assessments. NOAA Technical Memorandum NMFS-OPR-6, 73 pp.

~~Bellman, S.A., Music, J.A., Klinger, R.C., Byles, R.A., Keinath, J.A., and D.E. Barnard. 1997. Ecology of Sea Turtles in Virginia. Final Report to National Marine Fisheries Service Northeast Region. Contract number NA80FAC-00004. Virginia Institute of Marine Science, Gloucester Point, Virginia.~~

Buckland, S. T., D.R. Andersen, K.P Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling estimating abundance of biological populations. Oxford University Press, New York, 432 pp.

Burdett, L.G. and W.E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorisation. Journal of Cetacean Research and Management 6: 231-240.

Carlson, J,K. and D.M. Betha. 2006. The directed shark gillnet fishery: Catch and Bycatch 2005. National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City Lab Contribution #06-01.~~Carlson, J.K. and D. Lee. 2000. The directed shark drift gillnet fishery: Catch and bycatch 1998-1999. NMFS/SEFSC/Sustainable Fisheries Division #SFD-99/00-87.~~

Cortese, N.A. 2000. Delineation of bottlenose dolphin populations in the western Atlantic Ocean using stable isotopes. Master's thesis, University of Virginia, 118 pp.

Curry, B. E. 1997. Phylogenetic relationships among bottlenose dolphins (genus *Tursiops*) in a world-wide context. Ph.D. dissertation, Texas A&M University, Texas, USA. 138 pp.

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

Duffield, D.A. and R.S. Wells. 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. Pages 3-11 in C.J. Pfeiffer (ed.), Molecular and Cell Biology of Marine Mammals. Krieger Publishing Co., Melbourne, FL, 464 pp.

Garrison, L.P. 2003. Protected species interactions with the directed shark gillnet fishery off Florida and Georgia from 1999-2002. NMFS/SEFSC Internal report. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L.P., P.E. Rosel, A.A. Hohn, R. Baird, and W. Hoggard. 2003. Abundance of the coastal morphotype of bottlenose dolphin Tursiops truncatus, in U.S. continental shelf waters between New Jersey and Florida during winter and summer 2002. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Garrison, L.P. and C. Yeung. 2001. Abundance Estimates for Atlantic Bottlenose Dolphin Stocks During Summer and Winter, 1995. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L.J., L.H. Schwacke, G.B. Mitchum, A.A. Hohn, R.S. Wells, E.S. Zolman, and P.A. Fair. 2004. Geographic variation in polychlorinated biphenyl and organohaline pesticide concentrations in the blubber of bottlenose dolphins from the US Atlantic coast. The Science of the Total Environment 319: 147-172.~~Geraci, J. R. 1989. Clinical investigation of the 1987-88 mass mortality of bottlenose dolphins along the U.S. central and south Atlantic coast. Final Report to National Marine Fisheries Service, U.S. Navy, Office of Naval Research, and Marine Mammal Commission, 63 pp.~~

Hoelzel, A.R., Potter, C.W., and Best, P.B. 1998. Genetic differentiation between parapatric nearshore and offshore populations of the bottlenose dolphin. Proceedings of the Royal Society of London 265: 1177-1183.

Hohn, A. A. 1997. Design for a multiple-method approach to determine stock structure of bottlenose dolphins in the mid-Atlantic. NOAA Technical Memorandum NMFS-SEFSC-401, 22 pp. NFS, Southeast Fisheries Science Center, Miami, FL.

Hohn, A.A. and P. Martone. 2001. Characterization of bottlenose dolphin strandings in North Carolina, 1997-2000. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hohn, A.A., B. Mase, J. Litz, W. McFee, and B. Zoodsma. 2001. Characterization of human-caused strandings of bottlenose dolphins along the Atlantic coast from South Carolina to Southern Florida, 1997-2000. NMFS/SEFSC report prepared and reviewed for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

Kuehl, D.W., R. Haebler, C. Potter. 1994. Chemical residues in dolphins from the US Atlantic coast including Atlantic bottlenose obtained during the 1987/1988 mass mortality. Chemosphere 1991; 22: 1071-1084.

~~McFee, W. E., D. L. Wolf, D. E. Parshley and P. A. Fair. 1996. Investigation of marine mammal entanglement associated with a seasonal coastal net fishery. NOAA Technical Memo. NMFS SEFSC 38, 22 pp. + 8 Tables, 5 Figures, 6 Appendices. NMFS, Southeast Fisheries Science Center, Miami, FL.~~

~~McFee, W. E. and W. Brooks, Jr. 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: a summary. U.S. Fish and Wildlife Service. Unpublished Report.~~

McLellan, W.M., A.S. Friedlaender, J.G. Mead, C.W. Potter, and D.A. Pabst. 2003.
Analysing 25 years of bottlenose dolphin (*Tursiops truncatus*) strandings along the Atlantic coast of the USA: do historic records support the coastal migratory stock hypothesis? Journal of Cetacean Research and Management 4: 297-304.

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

NMFS. 2001. Stock structure of coastal bottlenose dolphins along the Atlantic coast of the US. NMFS/SEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. int Whal. Commn. Special Issue 16:27-50

Palka, D., L.P. Garrison, A.A. Hohn, and C. Yeung. 2001a. Summary of abundance estimates and PBR for coastal *Tursiops* for waters between New York and Florida during 1995 to 2000. NMFS/NEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS-Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Palka, D., F. Wenzel, D. Hartley, and M. Rossman. 2001b. Summary of bottlenose dolphin strandings from New York to Virginia. NMFS/NEFSC Report prepared for the Bottlenose Dolphin Take Reduction Team. Available from: NMFS-Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn. Special Issue 15: 133-147.

Read, A.J., B. Foster, K. Urian, B. Wilson, and D. Waples. 2003. Abundance of bottlenose dolphins in the bays, sounds, and estuaries of North Carolina. Marine Mammal Science 19: 59-73.

Rossman, M.C. and D.L. Palka. 2001. Bycatch estimates of coastal bottlenose dolphin (*Tursiops truncatus*) in the U.S. mid-Atlantic gillnet fisheries for 1996 to 2000. Northeast Fisheries Science Center Reference Document 01-15. 77 pp.

Schwacke L.H., E.O. Voit, L.J. Hansen, R.S. Wells, G.B. Mitchum, A.A. Hohn, P.A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environmental Toxicology and Chemistry 2002;21:2752-2764.

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

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. Pp. 235-244 In: S. Leatherwood and R. R. Reeves. The Bottlenose Dolphin. Academic Press, San Diego. 653 pp.

~~Smith, J.W. 1999. Distribution of Atlantic menhaden, *Brevoortia tyrannus*, purse seine sets and catches from southern New England to North Carolina, 1985-96. U.S. Dept. of Commerce, NOAATechnical Memorandum, NMFS-144. 22p.~~Speakman, T., E.S. Zolman, J. Adams, R.H. Defran, D. Laska, L. Schwacke, J. Craigie, and P. Fair. 2006. Temporal and spatial aspects of bottlenose dolphin occurrence in coastal and estuarine waters near Charleston, South Carolina. NOAA Technical Memorandum NOS-NCCOS-37, 243 pp.

~~Steve, C., J. Gearhart, D. Borggaard, L. Sabo and A.A. Hohn. 2001. Characterization of North Carolina Commercial Fisheries with Occasional Interactions with Marine Mammals. NOAA Technical Memorandum NMFS-SEFSC-458. 60 pp.~~

Torres, L.G., P.E. Rosel, C. D'Agrosa, and A.J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Marine Mammal Science 19:502-514.

~~Trent, L., D.E. Parshley, and J.K. Carlson. 1997. Catch and bycatch in the shark drift gillnet fishery off Georgia and East Florida. Marine Fisheries Review 59(1): 19-28.~~

Urian, K., A.A. Hohn, and L.J. Hansen. 1999. Status of the photo-identification catalogue of coastal bottlenose dolphins of the western north Atlantic: report of a workshop of catalogue contributors. NOAA Tech. Memo. NMFS-SEFSC-425.

~~Vaughan, D.S., J.W. Smith, E.H. Williams, and M.H. Prager. 2001. Analyses on the status of the Atlantic menhaden stock. Report prepared for the Atlantic States Marine Fisheries Commission. 57 pp~~

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

Wang, K. R., P. M. Payne and V. G. Thayer. 1994. Coastal stock(s) of Atlantic bottlenose dolphin: status review and management: Proceedings and recommendations from a workshop held in Beaufort, North Carolina, 13-14 September 1993. NOAA Technical Memorandum NMFS-OPR-4, 120 pp.

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph.D. dissertation, Texas A&M University, Galveston, TX. 142 pp.

Wells, R.S. 2003. Dolphin social complexity: Lessons from long-term study and life history. Pp. 32-56 *In:* F.B.M. de Waal and P.L. Tyack, eds., Animal Social Complexity: Intelligence, Culture, and Individualized Societies. Harvard University Press, Cambridge, MA.

Wells, R.S., M.D. Scott, and A.B. Irvine. 1987. The social structure of free ranging bottlenose dolphins. Pages 247-305 in Genoways, H. (ed.) Current Mammology, Vol. 1. Plenum Press, New York, 519 pp.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr, and M. D. Scott. 1996. Low-level monitoring of bottlenose dolphins (Tursiops truncatus), in Tampa Bay, Florida: 1988-1993. NOAA Technical Memorandum NMFS- SEFSC-385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.

Wells, R.S., V. Tornero, A. Borrell, A. Aguilar, T.K. Rowles, H.L. Rhinehart, S. Hofmann, W.M. Jarman, A.A. Hohn, and J.C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Science of the Total Environment 349:106-119.

~~Zolman, E. S. 1996. Residency patterns, relative abundance and population ecology of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Master of Science thesis. University of Charleston, South Carolina, USA. 128 pp.~~ Zolman, E. S. 2002. Residence patterns of bottlenose dolphins (*Tursiops truncatus*) in the Stono River Estuary, Charleston County, South Carolina. Marine Mammal Science 18: 879-892.

~~April 2006~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

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

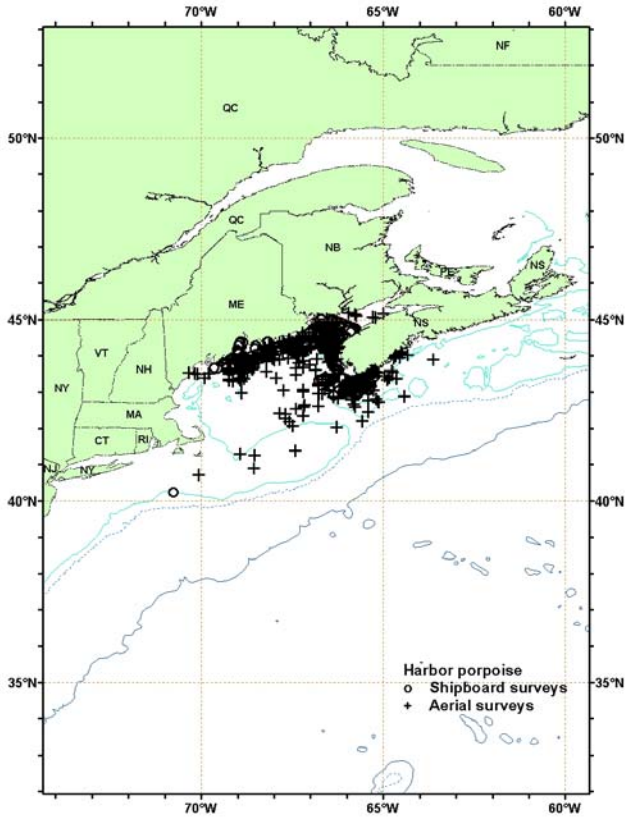


Figure 1. *Distribution of harbor porpoises from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, and 2006. Isobaths are the 100m, 1000m, and 4000m depth contours.*

Gaskin (1984, 1992) proposed that there were four separate populations in the western North Atlantic: the Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland and Greenland populations. Recent analyses involving mtDNA (Wang *et al.* 1996; Rosel *et al.* 1999a, 1999b), organochlorine contaminants (Westgate *et al.*1997; Westgate and Tolley 1999), heavy metals (Johnston 1995), and life history parameters (Read and Hohn 1995) support Gaskin's proposal. Genetic studies using mitochondrial DNA (Rosel *et al.* 1999a) and contaminant studies using total PCBs (Westgate and Tolley 1999) indicate that the Gulf of Maine/Bay of Fundy females were distinct from females from the other populations in the Northwest Atlantic. Gulf of Maine/Bay of Fundy males were distinct from Newfoundland and Greenland males, but not from Gulf of St. Lawrence males according to studies comparing mtDNA (Rosel *et al.* 1999a; Palka *et al.* 1996) and CHLORs, DDTs, PCBs and CHBs (Westgate and Tolley 1999). Analyses of stranded animals from the mid-Atlantic states suggest that this aggregation of harbor porpoises consists of animals from more than just the Gulf of Maine/Bay of Fundy stock (Rosel *et al.* 1999a). However, the majority of the samples used in the Rosel *et al.* (1999a) study were from stranded juvenile animals.

Further work is needed to examine adult animals from this region. Nuclear microsatellite markers have also been applied to samples from these four populations, but this analysis failed to detect significant population sub-division in either sex (Rosel *et al.* 1999a). These patterns may be indicative of female philopatry coupled with dispersal of males. This report follows Gaskin's hypothesis on harbor porpoise stock structure in the western North Atlantic, where the Gulf of Maine and Bay of Fundy harbor porpoises are recognized as a single management stock separate from harbor porpoise populations in the Gulf of St. Lawrence, Newfoundland and Greenland.

POPULATION SIZE

To estimate the population size of harbor porpoises in the Gulf of Maine/Bay of Fundy region, seven~~four~~ line-transect sighting surveys were conducted during the summers of 1991, 1992, 1995, ~~and~~ 1999, 2002, 2004, and 2006 ~~(Table 1; Figure 1)~~. The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 89,054~~75,438~~ (CV=0.47~~3~~), based on the 2006 survey results (Table 1). This is because the 2006 estimate is the most current, and this survey covered the largest portion of the harbor porpoise range.

Earlier abundance estimates

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

Kingsley and Reeves (1998) estimated there were 12,100 (CV=0.26) harbor porpoises in the entire Gulf of St. Lawrence during 1995, and 21,700 (CV=0.38) in the northern Gulf of St. Lawrence during 1996. These estimates are presumed to be of the Gulf of St. Lawrence stock of harbor porpoises. The highest densities were north of Anticosti Island, with lower densities in the central and southern Gulf. During the 1995 survey, 8,427km of track lines were flown in an area of 221,949 km^2 during August and September. During the 1996 survey, 3,993km of track lines were flown in an area of 94,665 km^2 during July and August. Data were analyzed using Quenouille's jackknife bias reduction procedure on line transect methods that modeled the left truncated sighting curve. These estimates were not corrected for visibility biases such as *g(0)*. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable and should not be used for PBR determinations.

Recent surveys and abundance estimates

~~and~~ An abundance estimate of 89,700 (CV=0.22, 95% CI=53,400-150,900) harbor porpoises was obtained from a July to August 1999 sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence (Table 1; Palka 2000). Total track line length was 8,212 km. One of the reasons the 1999 estimate is larger than previous estimates is that, for the first time, the upper Bay of Fundy and northern Georges Bank were surveyed and harbor porpoises were seen in both areas. This indicates the harbor porpoise summer habitat is larger than previously thought (Palka 2000).

~~in 1999 (CV=0.22, 95% CI=53,400-150,900) (Palka 2000),~~ An abundance estimate of 64,047~~59,400~~ (CV=0.48~~5~~) harbor porpoises was derived from an aerial survey conducted in August 2002 which covered 7,465 km of trackline over waters from the 1000 m depth contour on the southern edge of Georges Bank to Maine (Table 1~~; Palka 2006~~). The value of g(0) used for this estimation was derived from the pooled data of 2002, 2004 and 2006 aerial survey data.

An abundance estimate of 51,520~~66,660~~ (CV=0.65~~4~~) harbor porpoises was obtained from a line-transect sighting survey conducted during 12 June to 4 August 2004 by a ship and plane that surveyed 6,180 km of trackline from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy. The Scotian shelf south of Nova Scotia was not surveyed~~.~~ (Table 1~~; Palka 2006.~~). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential

covariates (Palka 2005).

An abundance estimate of 89,054~~75,440~~ (CV=0.47~~3~~) harbor porpoises was generated from an aerial survey conducted in August 2006 -which surveyed 10,676 km of trackline in the region from the 2000 m depth contour on the southern edge of Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence. (Table 1; Palka pers. comm.).

~~59,400 in 2002 (CV=0.45), 66,660 in 2004 (CV=0.64), and 75,440 in 2006 (CV=0.43). The inverse variance weighted average abundance estimate (Smith *et al.* 1993) of the 1991 to 1995 estimates was 54,300 harbor porpoises (CV=0.14, 95% CI=41,300-71,400). Possible reasons for inter-annual differences in abundance and distribution include experimental error, inter-annual changes in water temperature and availability of primary prey species (Palka 1995b), and movement among population units (e.g., between the Gulf of Maine and Gulf of St. Lawrence). One of the reasons the 1999 estimate is larger than previous estimates is that, for the first time, the upper Bay of Fundy and northern Georges Bank were surveyed and harbor porpoises were seen in both areas. This indicates the harbor porpoise summer habitat is larger than previously thought (Palka 2000).~~

~~The shipboard sighting survey procedure used in the 1991 to 1999 all four surveys involved two independent teams on one ship that searched using the naked eye in non-closing mode. Abundance, corrected for *g(0)*, the probability of detecting an animal group on the track line, was estimated using the direct duplicate method (Palka 1995a) and variability was estimated using bootstrap re-sampling methods. Potential biases not explicitly accounted for include ship avoidance and submergence time. The effects of these two potential biases are unknown. During 1995 and 1999 a section of the region was surveyed by airplane while the rest of the region was surveyed by ship, as in previous years (Palka 1996; 2000). During 1995, in addition to the Gulf of Maine/Bay of Fundy area, waters from Virginia to the mouth of the Gulf of St. Lawrence were surveyed and harbor porpoises were seen only in the vicinity of the Gulf of Maine/Bay of Fundy. During 1999, waters from south of Cape Cod to the mouth of the Gulf of St. Lawrence were surveyed (Palka 2000).~~

~~The summer 2002, 2004 and 2006 sighting surveys were conducted on the NOAA Twin Otter using the circle-back data collection methods, which allow the estimation of g(0) (Palka 2005). The estimate of g(0) was derived from the pooled data from all three years, while the density estimates were year-specific. The 2006 survey covered the largest portion of the habitat (10,676 km of trackline), from the 2000m depth contour on the southern Georges Bank to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawerence. The 2002 survey covered 7,465 km of trackline waters from the 1000m depth contour on the southern Georges Bank to Maine; while the Bay of Fundy and Scotian shelf south of Nova Scotia was not surveyed. The 2004 survey covered the smallest portion of the habitat (6,180 km of trackline), from the 100m depth contour on the southern Georges Bank to the lower Bay of Fundy; while the Scotian shelf south of Nova Scotia was not surveyed. The surveys in 2002 and 2006 were conducted in August, while the 2004 survey was earlier, in June to July.~~

~~The best current abundance estimate of the Gulf of Maine/Bay of Fundy harbor porpoise stock is 75,438~~89,700 ~~(CV=0.4~~322~~), based on the 2006~~1999 ~~survey results not averaged with other years (Table 1). This is because the 2006~~1999 ~~estimate is the most current, and this survey covered the largest~~discovered ~~portions of the harbor porpoise range not covered previously.~~

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

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

Month/Year	Area	N_{best}	CV
Jul-Aug 1999	S. Gulf of Maine to upper Bay of Fundy and to Gulf of St. Lawerence	89,700	0.22
Aug 2002	S. Gulf of Maine to Maine	64,047	0.48

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

Month/Year	Area	N_{best}	CV
Jun-Jul 2004	Gulf of Maine to lower Bay of Fundy	51,520	0.65
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawerence	89,054	0.47

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor porpoises is 89,054~~89,700~~ (CV=0.47~~22~~). The minimum population estimate for the Gulf of Maine/Bay of Fundy harbor porpoise is 60,970~~74,695~~.

Current Population Trend

A trend analysis has not been conducted for this species.

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 60,970~~74,695~~. 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~~ the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997)~~status~~. PBR for the Gulf of Maine/Bay of Fundy harbor porpoise is 610~~747~~.

ANNUAL HUMAN-CAUSED MORTALITY

Data to estimate the mortality and serious injury of harbor porpoise come from U.S. and Canadian Sea Sampling Programs, from records of strandings in U.S. and Canadian waters, and from records in the Marine

Mammal Authorization Program (MMAP). See Appendix III for details on U.S. fisheries and data sources. Estimates using Sea Sampling Program and MMAP data are discussed by fishery under the Fishery Information section (Table 2). Strandings records are discussed under the Unknown Fishery in the Fishery Information section (Table 3) and under the Other Mortality section (Table~~s~~ 4~~ to 5~~).

The total annual estimated average human-caused mortality is ~~575~~ 734~~6~~ (CV=0.~~17~~16) harbor porpoises per year. This is derived from four components: ~~515~~ 652 harbor porpoise per year (CV=0.~~17~~16) from U.S. fisheries using observer and MMAP data, ~~55~~ 77~~9~~ per year (unknown CV) from Canadian fisheries using observer data, and 5~~4~~.~~2~~ 0 per year from U.S. unknown fisheries using strandings data~~, and 1.2 per year from unknown human-caused mortality (mutilated stranded harbor porpoises)~~.

Fishery Information

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

Earlier Interactions

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

U.S.

Northeast Sink Gillnet

In 1984 the Northeast sink gillnet fishery was investigated by a sampling program that collected information concerning marine mammal bycatch. Approximately 10% of the vessels fishing in Maine, New Hampshire, and Massachusetts were sampled. Among the 11 gillnetters who received permits and logbooks, 30 harbor porpoises were reported caught. It was estimated, using rough estimates of fishing effort, that a maximum of 600 harbor porpoises were killed annually in this fishery (Gilbert and Wynne 1985, 1987).

In 1990, an observer program was started by NMFS to investigate marine mammal takes in the Northeast sink gillnet fishery (Appendix III). There have been ~~501~~ 552 harbor porpoise mortalities related to this fishery observed between 1990 and ~~2004~~ 2005 and one was released alive and uninjured. Bycatch in the northern Gulf of Maine occurs primarily from June to September, while in the southern Gulf of Maine, bycatch occurs from January to May and September to December. Estimated annual bycatch (CV in parentheses) from this fishery during 1990-~~2004~~ 2005 was 2,900 in 1990 (0.32), 2,000 in 1991 (0.35), 1,200 in 1992 (0.21), 1,400 in 1993 (0.18) (Bravington and Bisack 1996; CUD 1994), 2,100 in 1994 (0.18), 1,400 in 1995 (0.27) (Bisack 1997), 1,200 in 1996 (0.25), 782 in 1997 (0.22), 332 in 1998 (0.46), 270 in 1999 (0.28) (Rossman and Merrick 1999), 507 in 2000 (0.37), 53 (0.97) in 2001, 444 (0.37) in 2002, 592 (0.33) in 2003, ~~and~~ 654 (0.36) in 2004, and 630 (0.23) in 2005. ~~The increase in the CV in recent years is mainly due to the small number of observed takes.~~

In November 2001, there were two takes reported through the Marine Mammal Authorization Program (MMAP) that were taken in one sink gillnet haul located near Jeffery~~'~~s Ledge. These two takes were then added to the 2 observed takes and 51 estimated total take that was derived from the observer data because the MMAP takes were in a time and area not included in any of the above observer-based bycatch estimates. This then results in 4 observed takes and 53 (0.97) total takes in 2001 from this fishery (Table 2).

There appeared to be no evidence of differential mortality in U.S. or Canadian gillnet fisheries by age or sex in animals collected before 1994, although there was substantial inter-annual variation in the age and sex composition of the bycatch (Read and Hohn 1995). Using observer data collected during 1990-1998 and a logit regression model, females were 11 times more likely to be caught in the offshore southern Gulf of Maine region, males were more likely to be caught in the south Cape Cod region, and the overall proportion of males and females caught in a gillnet and brought back to land were not significantly different from 1:1 (Lamb 2000).

Two preliminary experiments, using acoustic alarms (pingers) attached to gillnets, were conducted in the Gulf of Maine during 1992 and 1993 and took 10 and 33 harbor porpoises, respectively. During fall 1994, another controlled scientific experiment was conducted in the southern Gulf of Maine, where 25 harbor porpoises were taken in 423 strings with non-active pingers (controls) and 2 harbor porpoises were taken in 421 strings with active pingers (Kraus *et al.* 1997). In addition, 17 other harbor porpoises were taken in nets that did not follow the

experimental protocol (Table 2). After 1994, experimental fisheries were conducted where all nets in a designated area were required to use pingers and only a sample of the nets ~~were~~ was observed. During November-December 1995, an experimental fishery was conducted in the southern Gulf of Maine (Jeffreys Ledge) region, where no harbor porpoises were observed taken in 225 pingered nets. During 1995, all takes from pingered nets were added directly to the estimated total bycatch for that year. During April 1996, 3 other experimental fisheries occurred. In the Jeffreys Ledge area, in 88 observed hauls using pingered nets, 9 harbor porpoises were taken. In the Massachusetts Bay region, in 171 observed hauls using pingered nets, 2 harbor porpoises were taken. And, in a region just south of Cape Cod, in 53 observed hauls using pingered nets, no harbor porpoises were taken. During 1997, experimental fisheries were allowed in the mid-coast region during March 25 to April 25 and November 1 to December 31. During the 1997 spring experimental fishery, 180 hauls were observed with active pingers and 220 hauls were controls (silent). All observed harbor porpoise takes were in silent nets: 8 in nets with control (silent) pingers and 3 in nets without pingers. Thus, there was a statistical difference between the catch rate in nets with pingers and silent nets (Kraus and Brault 1997). During the 1997 fall experimental fishery, out of 125 observed hauls using pingered nets no harbor porpoises were taken.

From 95 stomachs of harbor porpoises collected in groundfish gillnets in the Gulf of Maine between September and December 1989-1994, Atlantic herring (*Clupea harengus*) was the most important prey. Pearlsides (*Maurolicus weitzmani*), silver hake (*Merluccius bilinearis*) and red and white hake (*Urophycis* spp.) were the next most common prey species (Gannon *et al.* 1998).

Average estimated harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery during 1994-1998, before the Take Reduction Plan, was 1,163 (0.11). The average annual harbor porpoise mortality and serious injury in the Northeast sink gillnet fishery from ~~2000~~ 2001 to ~~2004~~ 2005 was ~~450~~ 475 (0.~~18~~16) (Table 2).

Mid-Atlantic Gillnet

Before an observer program was in place for this fishery, Polacheck *et al.* (1995) reported one harbor porpoise incidentally taken in shad nets in the York River, Virginia. In July 1993 an observer program was initiated in the mid-Atlantic ~~coastal~~ gillnet fishery by the NEFSC Sea Sampling program (Appendix III). Documented bycatch after 1995 were from December to May. Bycatch estimates were calculated using methods similar to that used for bycatch estimates in the Northeast sink gillnet fishery (Bravington and Bisack 1996; Bisack 1997). After 1998, a separate bycatch estimate was made for the drift gillnet and set gillnet sub-fisheries. The number presented here is the sum of these two sub-fisheries. The estimated annual mortality (CV in parentheses) attributed to this fishery was 103 (0.57) for 1995, 311 (0.31) for 1996, 572 (0.35) for 1997, 446 (0.36) for 1998, 53 (0.49) for 1999, 21 (0.76) for 2000, 26 (0.95) for 2001, unknown in 2002, 76 (1.13) in 2003, ~~and~~ 137 (0.91) in 2004, and 470 (0.51) in 2005. During 2002, the overall observer coverage was lower than usual, 1%, where 65% of that coverage was off of Virginia, and most of the rest of the area was not sampled at all. Thus, due to this non-representative and low observer coverage, a bycatch estimate for harbor porpoises cannot be confidently estimated. Annual average estimated harbor porpoise mortality and serious injury from the mid-Atlantic ~~coastal~~ gillnet fishery during 1995 to 1998, before the Take Reduction Plan, was 358 (CV=0.20). The average annual harbor porpoise mortality and serious injury in the mid-Atlantic ~~coastal~~ gillnet fishery from ~~2000~~ 2001 to ~~2004~~ 2005 was ~~65~~ 177 (0.~~49~~40), which is the 4-year average estimate from ~~2000,~~ 2001, 2003, ~~and~~ 2004, and 2005.

Unknown Fishery

The strandings and entanglement database, maintained by the New England Aquarium and the Northeast Regional Office/NMFS, reported 228, 27, 113, 79, 122, ~~and~~ 118 and 174~~7~~ stranded harbor porpoises on U.S. beaches during 1999 to ~~2004~~2005, respectively (see Other Mortality section for more details). Of these, it was determined that the cause of death of 19, 1, 3, 2, 9, and 6 stranded harbor porpoises in 1999 to 2004, respectively, were due to unknown fisheries ~~(Table 5)~~ and these animals were in areas and times that were not included in the above mortality estimate derived from observer program data (Table 3). As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. The average harbor porpoise mortality and serious injury in this unknown fishery category from ~~2000~~ 2001 to ~~2004~~ 2004~~5~~ is 5~~4.2~~ 0 (CV is unknown).

Northeast Bottom Trawl

This fishery is active in New England waters in all seasons. Two harbor porpoise mortalities were observed in the North Atlantic bottom trawl fishery between 1989 and 2004. The first take occurred in February 1992 east of Barnegat Inlet, New Jersey at the continental shelf break. The animal was clearly dead prior to being taken by the trawl, because it was severely decomposed and the tow duration of 3.3 hours was insufficient to allow extensive decomposition. The second take occurred in January 2001 off New Hampshire in a haul trawling for flounder. This animal was clearly dead prior to being taken by the trawl, because it was severely decomposed (the skull broke off

while the net was emptying) and the tow duration was 3.1 hours. This take was observed in the same time and area stratum that had documented gillnet takes. One fresh dead take was observed in the Northeast bottom trawl fishery in 2003 and 4 in 2005. Estimates have not been generated for this fishery. ~~In conclusion, the estimated bycatch of harbor porpoises due to this fishery is 0.~~

CANADA

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

Bay of Fundy Sink Gillnet

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

More recently, an observer program implemented in the summer of 1993 provided a total bycatch estimate of 424 harbor porpoises (± 1 SE: 200-648) from 62 observed trips, (approximately 11.3% coverage of the Bay of Fundy trips) (Trippel *et al.* 1996). During 1994, the observer program was expanded to cover 49% of the gillnet trips (171 observed trips). The bycatch was estimated to be 101 harbor porpoises (95% confidence limit: 80-122), and the fishing fleet consisted of 28 vessels (Trippel *et al.* 1996). During 1995, due to groundfish quotas being exceeded, the gillnet fishery was closed from July 21 to August 31. During the open fishing period of 1995, 89% of the trips were observed, all in the Swallowtail region. Approximately 30% of these observed trips used pingered nets. The estimated bycatch was 87 harbor porpoises (Trippel *et al.* 1996). No confidence interval was computed due to lack of coverage in the Wolves fishing grounds. During 1996, the Canadian gillnet fishery was closed during July 20-31 and August 16-31 due to groundfish quotas. From the 107 monitored trips, the bycatch in 1996 was estimated to be 20 harbor porpoises (Trippel *et al.* 1999; DFO 1998). Trippel *et al.* (1999) estimated that during 1996, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 68% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. During 1997, the fishery was closed to the majority of the gillnet fleet during July 18-31 and August 16-31, due to groundfish quotas. In addition a time-area closure to reduce porpoise bycatch in the Swallowtail area occurred during September 1-7. From the 75 monitored trips, 19 harbor porpoises were observed taken. After accounting for total fishing effort, the estimated bycatch in 1997 was 43 animals (DFO 1998). Trippel *et al.* (1999) estimated that during 1997, gillnets equipped with acoustic alarms reduced harbor porpoise bycatch rates by 85% over nets without alarms in the Swallowtail area of the lower Bay of Fundy. The number of monitored trips (and observed harbor porpoise mortalities were 111 (5) for 1998, 93 (3) for 1999, 194 (5) for 2000, and 285 (39) for 2001. The estimated annual mortality estimates were 38 for 1998, 32 for 1999, 28 for 2000, and 73 for 2001 (Trippel and Shepard, 2001). Estimates of variance are not available.

There ~~was~~ has been no observer program during the summer ~~s of~~ since 2002~~ to 2004~~ in the Bay of Fundy region, but the fishery was active. Thus, it is not known what the bycatch for these years is. The ~~two-year~~ average estimated harbor porpoise mortality in the Canadian groundfish sink gillnet fishery during ~~2000~~ 2001 was 73~~51~~ (Table 2). An estimate of variance is not possible.

Herring Weirs

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

Westgate, pers. comm.).

Clinical hematology values were obtained from 29 harbor porpoises released from Bay of Fundy herring weirs (Koopman *et al.* 1999). These data represent a baseline for free-ranging harbor porpoises that can be used as a reference for long-term monitoring of the health of this population, a mandate by the MMPA. Blood for both hematology and serum chemistry, including stress and reproductive hormones, is currently being collected; with 57 samples from 2001, 15 from 2002, 7 from 2003, ~~and~~ 24 from 2004, 3 from 2005, and 5 from 2006 (A. Westgate and H. Koopman, pers. comm).

Average estimated harbor porpoise mortality in the Canadian herring weir fishery during 2001~~0~~-2004 was 5.5~~4.4~~ (Table 2). An estimate of variance is not possible.

Gulf of St. Lawrence gillnet

This fishery interacts with the Gulf of St. Lawrence harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Using questionnaires to fishermen, Lesage *et al.* (2006~~3~~) determined a total of 2215~~180~~ (95% CI 1151~~012~~-3~~802~~662) and 2394~~478~~ (95% CI 1440~~591~~-3~~464~~348) harbor porpoises were taken in 2000 and 2001, respectively. The largest takes were in July and August around Miscou and the North Shore of the Gulf of St. Lawrence. According to the returned questionnaires, the fish species most usually associated with incidental takes of harbor porpoises include Atlantic cod, herring and mackerel. An at-sea observer program was also conducted during 2001 and 2002. However, due to low observer coverage that was not representative of the fishing effort, Lesage *et al.* (2006~~3~~) concluded that resulting bycatch estimates were unreliable.

Newfoundland gillnet

This fishery interacts with the Newfoundland harbor porpoise stock, not the Gulf of Maine/Bay of Fundy harbor porpoise stock. Estimates of incidental catch of small cetaceans, where the vast majority are likely harbor porpoises was 811 in 2001, 1671 in 2002, and 2228 in 2003~~ are currently being calculated for 2001-2003~~ for the Newfoundland nearshore cod and Greenland halibut fisheries, and the Newfoundland offshore fisheries in lumpfish, herring, white hake, monkfish and skate (~~pers. comm. J. Lawson, DFO~~Benjamins *et al.* in press).

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
U.S.								
Northeast Sink Gillnet	~~00~~01-~~04~~05	~~NA~~unk	Obs. Data, Weighout, Trip Logbook	~~06,~~ .04, .02 .03, .06, .07	~~15[e],~~ 4[c,f], 10[c], 12[c], 27[c], 51[c]	~~507[e],~~ 53[c,f], 444[c], 592, 654[c], 630[c]	~~.37,~~ .97, .37, .33, .36, .23	~~450~~475 (0.~~18~~16)
Mid-Atlantic Gillnet	~~99-03~~ ~~00~~01-~~04~~05	~~NA~~unk	Obs. Data Weighout	~~.02,~~ .02, .01, .01, .02, .03	~~1,~~ 1,unk[g], 1, 2, 15	~~21,~~ 26, unk[g], 76, 137, 470	~~.76,~~ .95, unk[g], 1.13, .91, .51	~~65[g]~~177[g] (0.~~49~~40)
Northeast bottom trawl	01-05	unk	Obs. Data Weighout	.004, .021, .028 .045, unk	0,0,1,0,4	0,0,unk[i],0,unk[i]	0, 0, unk, 0, unk	unk[i]
U.S. TOTAL	~~2000~~2001-~~2004~~2005							~~515~~652 (0.~~17~~16)
CANADA								

Groundfish Sink Gillnet	01~~0~~-05~~4~~	~~NA~~unk	Can. Trips	~~.41, .~~56, 0[h],0[h], 0[h], 0[h]	~~5,~~ 39, unk[h], unk[h], unk[h], ~~,~~ unk[h] unk[h]	~~28,~~ 73, unk[h], unk[h], ~~,~~ unk[h] unk[h]	~~NA~~unk	73~~51~~ (~~NA~~unk)
Herring Weir	01~~0~~-05~~4~~	1998=255 licenses[d] 2002=22[e]	Coop. Data	~~NA~~unk	~~0,~~ 14, 3, 1, 4, 0	~~0,~~ 14, 3, 1, 4, 0	NA	4.4~~4.4~~ (~~NA~~unk)
CANADIAN TOTAL	2000-2004							~~55~~77 (~~NA~~unk)
GRAND TOTAL								~~570~~72931 (~~NA~~unk)

NA = Not available.

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

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

c. ~~During 2000, a harbor porpoise was taken on a non-pingered string within a stratum that did not require pingers but that stratum had other trips where strings with pingers were observed; and d~~During ~~1999~~2001-~~2004~~2005, harbor porpoises were taken on pingered strings within strata that required pingers but that stratum also had observed strings without pingers. For estimates made during 1998 and after, a weighted bycatch rate was applied to effort from both pingered and non-pingered hauls within a stratum. The weighted bycatch rate was:

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

There were 10, 33, 44, 0, 11, 0, 2, 8, 6, 2, 26, 2, ~~and~~ 4, and 12 observed harbor porpoise takes on pinger trips from 1992 to ~~2004~~2005, respectively, that were included in the observed mortality column. In addition, there were 9, 0, 2, 1,1, 4, 0, 1, 7, ~~and~~ 21, and 33 observed harbor porpoise takes in 1995 to 2004, respectively, on trips dedicated to fish sampling versus dedicated to watching for marine mammals; these were also included in the observed mortality column (Bisack 1997).

d. There were 255 licenses for herring weirs in the Canadian Bay of Fundy region.

e. There were 22 active weirs around Grand Manan. The number of weirs elsewhere is unknown.

f. During 2001 in the U.S. Northeast sink gillnet fishery, there were 2 takes observed in the NEFSC observer program, this resulted in an estimate of 51 total bycaught harbor porpoises. In November 2001, there were two takes reported through the Marine Mammal Authorization Program that were from one sink gillnet haul that was located near Jeffery's Ledge. These two takes were then added to the 2 observed takes and 51 estimated total take derived from the observer data, resulting in 4 observed takes and 53 total takes for the fishery during 2001.

g. Sixty-five percent of sampling by the NEFSC fisheries observer program was concentrated in one area off the coast of Virginia. Coverage in other areas of the mid-Atlantic was <1%. Because of the low level of sampling that was not distributed proportionally throughout the mid-Atlantic region, the observed mortality is considered unknown in 2002. The four-year average (~~2000~~ 2001 and 2003-~~2004~~2005) estimated mortality was applied as the best representative estimate.

h. The Canadian gillnet fishery was not observed during 2002 and afterwards~~to 2004~~, but the fishery was active; thus, the bycatch estimate is unknown. The average bycatch for this fishery is from the two preceding years, 2000 to 2001.

i. Estimates~~Analysis~~ of bycatch mortality attributed to the Northeast bottom trawl fishery have not been generated.

Table 3. From strandings and entanglement data, summary of confirmed incidental mortality of harbor porpoises (*Phocoena phocoena*) by fishery: includes years sampled (Years), number of vessels active within the fishery (Vessels), type of data used (Data Type), mortalities assigned to this fishery (Assigned Mortality), and mean annual mortality.					
Fishery	Years	Vessels	Data Type [a]	Assigned Mortality	Mean Annual Mortality
Unknown gillnet fishery	~~00~~01-~~04~~05	NA	Entanglement & Strandings	~~1,~~ 3, 2, 9, 6, unk~~0~~[b]	5~~4~~.~~2~~0
TOTAL					5~~4~~.~~2~~0

NA=Not Available.
a Data from records in the entanglement and strandings data base maintained by the New England Aquarium and the Northeast Regional Office/NMFS (Entanglement and Strandings).
b. As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates~~In 2005, no stranded harbor porpoises, including necropsied animals, were assigned fishery interactions as cause of death~~.

Other Mortality
U.S.

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

During 1993, 73 harbor porpoises were reported stranded on beaches from Maine to North Carolina (Smithsonian Marine Mammal Database). Sixty-three of those harbor porpoises were reported stranded in the U.S. mid-Atlantic region from New York to North Carolina between February and May. Many of the mid-Atlantic carcasses recovered in this area during this time period had cuts and body damage suggestive of net marking (Haley and Read 1993). Five out of 8 carcasses and 15 heads from the strandings that were examined showed signs of human interactions (net markings on skin and missing flippers or flukes). Decomposition of the remaining animals prevented determination of the cause of death. Earlier reports of harbor porpoise entangled in gillnets in Chesapeake Bay and along the New Jersey coast and reports of apparent mutilation of harbor porpoise carcasses raised concern that the 1993 strandings were related to a coastal net fishery, such as the American shad coastal gillnet fishery (Haley and Read 1993). Between 1994 and 1996, 107 harbor porpoise carcasses were recovered from beaches in Maryland, Virginia, and North Carolina and investigated by scientists. Only juvenile harbor porpoises were present in this sample. Of the 40 harbor porpoises for which cause of death could be established, 25 displayed definitive evidence of entanglement in fishing gear. In 4 cases it was possible to determine that the animal was entangled in monofilament nets (Cox *et al.* 1998).

Records of harbor porpoise strandings prior to 1997 are stored in the Smithsonian's Marine Mammal Database and records from 1997 to present are stored in the NE Regional Office/NMFS strandings and entanglement database. According to these records, the numbers of harbor porpoises that stranded on U.S. beaches from North Carolina to Maine during 1994 to ~~2004~~ 2005 were 106, 86, 94, 118, 59, 228, 27, 113, 79, 122, ~~and~~ 118, and 174~~7~~ respectively (Table 4). Of these, 3 stranded alive on a Massachusetts beach in 1996, were tagged, and subsequently released. In 1998, 2 porpoises that stranded on a New Jersey beach had tags on them indicating they were originally taken on an observed mid-Atlantic ~~coastal~~ gillnet vessel. During 1999, 6 animals stranded alive and were either tagged and released or brought to Mystic Aquarium for rehabilitation (Table 4).

During 1999, over half of the strandings occurred on beaches of Massachusetts and North Carolina. The states with the next largest numbers were Virginia, New Jersey and Maryland, in that order. The cause of death was investigated for all the 1999 strandings. Of these, it was possible to determine that the cause of death of 38 animals was fishery interactions. Of these 38, 19 animals were in an area and time that were not part of a bycatch estimate

derived using observer data. Thus, these 19 mortalities are attributed to an unknown gillnet fishery. One additional animal was found mutilated (right flipper and fluke was cut off) and cause of death was attributed to an unknown human-caused mortality.

During 2000, only 27 harbor porpoises stranded on beaches from Maine to North Carolina (Table 4). Of these, most came from Massachusetts (8) or North Carolina (6). The cause of death for 1 animal was in an area and time that was not part of a bycatch estimate derived from observer data, and thus was attributed to an unknown gillnet fishery (Table~~s~~ 3~~ and 5~~). This animal was found on a beach in Virginia during May with mono-filament line wrapped around it. In addition, 1 animal was found mutilated and so cause of death was attributed to an unknown human-caused mortality~~ (Table 5)~~.

During 2001, 113 harbor porpoises were reported stranded on an Atlantic US beach, of these most came from Massachusetts (39), Virginia (28), and North Carolina (21) (Table 4). Thirteen of these strandings displayed signs of fishery interactions, and of these, 3 animals were in an area and time that were not part of a bycatch estimate derived from the observer data (Table~~s~~ 3~~ and 5~~).

During 2002, 79 harbor porpoises were reported stranded on an Atlantic US beach, of which over half come from Massachusetts (42) (Table 4). Eleven animals displayed signs of emaciation and two signs of fishery interactions (Table 4). Both of the strandings with fishery interactions were in the mid-Atlantic (Maryland and Virginia) during March and were not in a time and area that was part of a bycatch estimate derived from observer data (Table~~s~~ 3~~ and 5~~).

During 2003, 122 harbor porpoises were reported stranded, of which approximately 1/3 came from Massachusetts (35) and an additional 1/3 came from North Carolina (39) (Table 4). The number of reported fishery interactions by state are: 1 in Massachusetts (October), 1 in Maryland (March), 6 in Virginia (3 in March, 2 in April, and 1 in May), and 1 in North Carolina (February). Three harbor porpoises were reported mutilated in North Carolina. All of these strandings reported with fishery interactions were in areas and times that were not part of a bycatch estimate derived from the observer data (Table~~s~~ 3~~ and 5~~).

During 2004, 118 harbor porpoises were reported stranded on an Atlantic US beach, of which about 40% came from Massachusetts (49) (Table 4). There were 16 strandings in Maine, the highest number for Maine on recent record. There were 8 reported fishery interactions by state are: 1 in Massachusetts (May), 1 in New York (May), and 3 in Virginia (February, March, and April), and 3 in North Carolina (April). In addition, there was 1 mutilation in Delaware during March. Of these 8 fishery interactions, six were in areas and times that were not part of a bycatch estimated derived from the observer data (Table~~s~~ 3~~ and 5~~).

During 2005, 174 harbor porpoises were reported stranded on Atlantic US beaches, of which approximately 1/3 stranded in Massachusetts (53) and another ¼ (42) stranded in North Carolina. Although 24 animals were classified as having signs of human interaction, and of those 24, 7 showed signs of fishery interaction, in no case was cause of death directly attributable to these interactions. An Unusual Mortality Event was declared for harbor porpoise in North Carolina, as 38 stranded in that state between 1 January and 28 March 2005. Most of these were young of the year, and histopathological examinations of 6 of these animals showed no common symptoms other than emaciation or any systemic disease (Marine Mammal Commission 2006).

As of 2005, the cause of death of stranded animals is not being evaluated and so will not be included in annual human-induced mortality estimates. Averaging ~~2000~~ 2001 to ~~2004~~2004~~5~~, there were 1.2 animals per year that were stranded and mutilated and so cause of death was attributed to an unknown human-caused mortality~~ (Table 5)~~.

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

Table 4. Harbor Porpoise (*Phocoena phocoena*) reported strandings along the U.S. Atlantic coast and Nova Scotia, 2001-2005.

Area	Year					**Total**
	2001	2002	2003	2004	2005	
Maine[a]	4	8	5	16	9	**42**
New Hampshire	0	2	2	2	0	**6**
Massachusetts[b]	39	42	35	49	53	**218**
Rhode Island	1	1	2	3	6	**13**

Connecticut	0	1	0	0	1	**2**
New York[c]	7	6	8	8	15	**44**
New Jersey	6	6	5	14	17	**48**
Delaware	3	3	1	1	3	**11**
Pennsylvania					1	**1**
Maryland	4	1	5	2	4	**16**
Virginia	28	6	19	8	22	**83**
North Carolina[d]	21	3	39	15	42	**120**
Florida	0	0	1	0	0	**1**
EEZ					1	**1**
TOTAL U.S.	**113**	**79**	**122**	**118**	**174**	**604**
Nova Scotia	2	5	3	4	6	**20**
GRAND TOTAL	**115**	**84**	**125**	**122**	**180**	**624**

a. In Maine, one animal stranded alive in March 2002, brought to Mystic Aquarium but died 2 days later.

b. In Massachusetts, during 1999, five animals stranded alive and were tagged and released. During 2002, three animals stranded alive and were rehabilitated at Mystic Aquarium (1 in February, March and May). In 2005, 2 animals were relocated and released.

c. In New York, one animal stranded alive in 1999, rehabilitated at Mystic Aquarium and died at the aquarium in April 2000.

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

~~Table 4. Summary of number of stranded harbor porpoises in the U.S. and Nova Scotia during January 1, 2000 to December 31, 2004, by year and area.~~

~~Area~~	~~Year~~					~~Total~~
	~~2000~~	~~2001~~	~~2002~~	~~2003~~	~~2004~~	
~~Maine[a]~~	~~2~~	~~4~~	~~8~~	~~5~~	~~16~~	~~35~~
~~New Hampshire~~	~~0~~	~~0~~	~~2~~	~~2~~	~~2~~	~~6~~
~~Massachusetts[b]~~	~~8~~	~~39~~	~~42~~	~~35~~	~~49~~	~~173~~
~~Rhode Island~~	~~0~~	~~1~~	~~1~~	~~2~~	~~3~~	~~7~~
~~Connecticut~~	~~0~~	~~0~~	~~1~~	~~0~~	~~0~~	~~1~~
~~New York[c]~~	~~2~~	~~7~~	~~6~~	~~8~~	~~8~~	~~31~~
~~New Jersey~~	~~2~~	~~6~~	~~6~~	~~5~~	~~14~~	~~33~~
~~Delaware~~	~~1~~	~~3~~	~~3~~	~~1~~	~~1~~	~~9~~
~~Maryland~~	~~3~~	~~4~~	~~1~~	~~5~~	~~2~~	~~15~~
~~Virginia~~	~~3~~	~~28~~	~~6~~	~~19~~	~~8~~	~~64~~
~~North Carolina~~	~~6~~	~~21~~	~~3~~	~~39~~	~~15~~	~~84~~
~~Florida~~	~~0~~	~~0~~	~~0~~	~~1~~	~~0~~	~~1~~

~~TOTAL U.S.~~	~~27~~	~~113~~	~~79~~	~~122~~	~~118~~	~~459~~
~~Nova Scotia~~	~~3~~	~~2~~	~~5~~	~~3~~	~~4~~	~~17~~
~~GRAND TOTAL~~	~~30~~	~~115~~	~~84~~	~~125~~	~~122~~	~~476~~

~~a In Maine, one animal stranded alive in March 2002, brought to Mystic Aquarium but died 2 days later.~~

~~b In Massachusetts, during 1999, five animals stranded alive and were tagged and released. During 2002, three animals stranded alive and were rehabilitated at Mystic Aquarium (1 in February, March and May).~~

~~c In New York, one animal stranded alive in 1999, rehabilitated at Mystic Aquarium and died at the aquarium in April 2000.~~

~~Table 5. Cause of mortality of U.S. stranded harbor porpoises during January 1, 2000 to December 31, 2004. "Unique FI" is a fishery interaction that is in a time and area that could not be part of the mortality estimate derived from the observer program. "Not unique FI" is a fishery interaction that was in a time and area that may be part of the observer program derived mortality estimate. "No FI" is the cause of death was determined not to be related to a fishery interaction. "Alive" is stranded animal not dead. "CBD/Unk" is cause of death could not be determined or was unknown.~~

~~Year~~	~~Unique FI[a]~~	~~Mutilation[b]~~	~~Not unique FI~~	~~No FI~~	~~Emaciated~~	~~CBD/Unk~~	~~Alive~~	~~Total~~
~~2000~~	~~1~~	~~1~~	~~0~~	~~2~~	~~0~~	~~22~~	~~0~~	~~26~~
~~2001~~	~~3~~	~~1~~	~~10~~	~~32~~	~~0~~	~~64~~	~~3~~	~~113~~
~~2002~~	~~2~~	~~0~~	~~0~~	~~2~~	~~11~~	~~60~~	~~4~~	~~79~~
~~2003~~	~~9~~	~~3~~	~~0~~	~~61~~	~~3~~	~~44~~	~~2~~	~~122~~
~~2004~~	~~6~~	~~1~~	~~2~~	~~38~~	~~4~~	~~59~~	~~8~~	~~118~~
~~Avg 00-04~~	~~4.2~~	~~1.2~~	~~2.4~~	~~27.0~~	~~3.6~~	~~49.8~~	~~3.4~~	~~91.6~~

~~a. Attributed to an unknown fishery.~~

~~b. Attributed to an unknown human-caused mortality.~~

CANADA

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

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

USA Management measures taken to reduce bycatch

A ruling to reduce harbor porpoise bycatch in USA Atlantic gillnets was published in the Federal Register (63 FR 66464) on 01 December 1990 and became effective 01 January 1999. The Gulf of Maine portion of the plan pertains to all fishing with sink gillnets and other gillnets capable of catching multispecies in New England waters, from Maine through Rhode Island. This portion of the rule includes time and areas closures, some of which are complete closures; others are closed to multispecies gillnet fishing unless pingers are used in the prescribed manner. Also, the rule requires those who intend to fish to attend training and certification sessions on the use of the technology. The mid-Atlantic portion of the plan pertains to waters west of 72º30'W longitude to the mid-Atlantic shoreline from New York to North Carolina. This portion of the rule includes time and area closures, some of which are complete closures; others are closed to gillnet fishing unless the gear meets certain restrictions. The MMPA mandates that the take reduction teams that developed the above take reduction measures periodically meet to evaluate the effectiveness of the plan and modify it as necessary.

STATUS OF STOCK

The status of harbor porpoises, relative to OSP, in the U.S. Atlantic EEZ is unknown. On January 7, 1993, the National Marine Fisheries Service (NMFS) proposed listing the Gulf of Maine harbor porpoise as threatened under the Endangered Species Act (NMFS 1993). On January 5, 1999, NMFS determined the proposed listing was not warranted (NMFS 1999). On August 2, 2001, NMFS made available a review of the biological status of the Gulf of Maine/Bay of Fundy harbor porpoise population. The determination was made that listing under the Endangered Species Act (ESA) was not warranted and this stock was removed from the ESA candidate species list (NMFS 2001). Population trends for this species have not been investigated. ~~There are insufficient data to determine population trends for this species.~~ The total U.S. fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be insignificant and approaching zero mortality and serious injury rate. This is ~~not~~ a strategic stock because average annual ~~fishery~~human-related mortality and serious injury ~~does not~~ exceeds PBR~~, though the fishery-related bycatch has been increasing over the last three years (2002-2004)~~.

REFERENCES CITED

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

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S.Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Benjamins, S., J. Lawson., and G. Stenson. (in press). Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. J. Cetacean Res. Manage.

Bisack, K.D. 1997. Harbor porpoise bycatch estimates in the New England multispecies sink gillnet fishery: 1994 and 1995. Rep. int Whal. Comm 47:-705-14.

Bravington, M.V. and K.D. Bisack. 1996. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-1993. Rep. int Whal. Comm 46:567-74.

Caswell, H., S. Brault, A. Read, and T. Smith. 1998. Harbor porpoise and fisheries: an uncertainty analysis of incidental mortality. Ecological Applications 84(4):1226-1238.

Cox, T.M., A.J. Read, S. Barco, J. Evans, D. P. Gannon, H.N. Koopman, W.A. McLellan, K. Murray, J. Nicolas, D. A. Pabst, C.W. Potter, W.M. Swingle, V.G. Thayer, K.M. Touhey, and A.J. Westgate. 1998. Documenting the bycatch of harbor porpoises, *Phocoena phocoena*, in coastal gill net fisheries from stranded carcasses. Fish. Bull. U.S. 96(4):727-734.

CUD [Conservation and Utilization Division]. 1994. Estimating harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery. NOAA, NMFS, NEFSC Ref. Doc. 94-24. [Available from: NMFS, Northeast Fisheries

Science Center, 166 Water St., Woods Hole, MA 02543.]

DFO [Department of Fisheries and Oceans]. 1998. Harbour porpoise bycatch in the lower Bay of Fundy gillnet fishery. DFO Maritimes Regional Fisheries Status Report 98/7E. [Available from Department of Fisheries and Oceans, Resource management Branch, P.O. Box 550, Halifax, NS B3J 2S7, Canada.]

Gannon, D.P., J.E. Craddock, and A. J. Read. 1998. Autumn food habits of harbor porpoises, *Phocoena phocoena*, in the Gulf of Maine. Fish. Bull. U.S. 96(3):428-437.

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

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

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

Gilbert, J.R. and K. M. Wynne. 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. Fourth Annual Report, Contract NA-80-FA-C-00029, to NMFS, Northeast Fisheries Center, 166 Water St., Woods Hole, MA. 15 pp.

Gilbert, J.R. and K.M. Wynne. 1987. Harbor seal populations and fisheries interactions with marine mammals in New England. Final Report, Contract NA-EA-C-0070, to NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. 15 pp.

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

Hooker, S.K., R.W. Baird, and M.A. Showell. 1997. Cetacean strandings and bycatches in Nova Scotia, Eastern Canada, 1991-1996. Meeting document SC/49/O5 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

Johnston, D.W. 1995. Spatial and temporal differences in heavy metal concentrations in the tissues of harbour porpoises (*Phocoena phocoena* L.) from the western North Atlantic. M.S. Thesis, University of Guelph, Guelph, Ontario, Canada. 152 pp.

Kingsley, M. C.S. and R.R. Reeves. 1998. Aerial surveys of cetaceans in the Gulf of St. Lawrence in 1995 and 1996. Can. J. Zool. 76:1529-1550.

Koopman, H.N., A.J. Westgate, and A.J. Read. 1999. Hematology values of wild harbor porpoise (*Phocoena phocoena*) from the Bay of Fundy Canada. Mar. Mammal Sci. 15(1):52-64.

Kraus, S.D. and S. Brault. 1997. A springtime field test of the use of pingers to reduce incidental mortality of harbor porpoises in gillnets. Meeting document SC/49/SM42 submitted to the 1997 International Whaling Commission Scientific Committee meeting in Bournemouth, UK.

Kraus, S.D., A. Read, E. Anderson, K. Baldwin, A. Solow, T. Sprawling, and J. Williamson. 1997. Acoustic alarms reduce porpoise mortality. Nature 388:525.

Kraus, S.D., J.H. Prescott, and G.S. Stone. 1983. Harbour porpoise, *Phocoena phocoena*, in the U.S. coastal waters of the Gulf of Maine: A survey to determine seasonal distribution and abundance. Report to the Director, National Marine Fisheries Service, 166 Water St., Woods Hole, MA. 15 pp.

Lamb, A. 2000. Patterns of harbor porpoise mortality in two US Atlantic sink gillnet fisheries and changes in life history parameters. Masters Thesis from Boston University.

Lesage, V., J. Keays, S. Turgeon, and S. Hurtubise. 2006~~3~~. Bycatch of harbour porpoises (Phocoena phocoena) in gillnet fisheries of the ~~Incidental mortality of harbour porpoises in the gillnet fishery of the~~ Estuary and Gulf of St. Lawrence in 2000-2002. J. Cetacean Res. Manage. 8(1):67-78~~Canadian Science Advisory Secretariat. Research Document 2003/069. Available at http://www.dfo-mpo.gc.ca/csas/~~.

Lucas, Z.N. and S.K. Hooker. 2000. Cetacean strandings on Sable Island, Nova Scotia, 1970-1998. Canadian Field-Naturalist 114(1): 46-61.

Marine Mammal Commission. 2006. US Marine Mammal Commission Annual Report to Congress, 2004. Marine Mammal Commission, Bethesda MD. Vi+163pp. Available at: htt://www.nefsc.noaa.gov/nefsc/publication/ 70 pp.

Neimanis, A.S., A.J. Read, A.J. Westgate, H.N. Koopman, J. Y. Wang, L. D. Murison and D. E. Gaskin. 1995. Entrapment of harbour porpoises (*Phocoena phocoena*) in herring weirs in the Bay of Fundy, Canada. Working paper SC/47/SM18 for the International Whaling Commission, Dublin, Ireland.

Neimanis, A.S., H.N. Koopman, A.J. Westgate, L.D. Murison and A.J. Read. 2004. Entrapment of harbour porpoises (Phocoena phocoena) in herring weirs in the Bay of Fundy, Canada. J.Cet. Res. Manag. 6(1):7-

17.

NEFSC [Northeast Fisheries Science Center]. 1992. Harbor porpoise in eastern North America: Status and research needs. Results of a scientific workshop held May 5-8, 1992 at the Northeast Fisheries Science Center, Woods Hole, MA. NOAA, NMFS, NEFSC Ref. Doc. 92-06. [Available from: NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543.]

NMFS [National Marine Fisheries Service]. 2001. Status review of the Gulf of Maine/Bay of Fundy population of harbor porpoise under the Endangered Species Act (ESA). Federal Register 66(203): 53195-53197, October 19, 2001.

NMFS [National Marine Fisheries Service]. 1999. Listing of Gulf of Maine/Bay of Fundy population of harbor porpoise as threatened under the Endangered Species Act. Federal Register 64 (2): 465-471, January 05, 1999.

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

Palka, D. 2000. Abundance of the Gulf of Maine/Bay of Fundy harbor porpoise based on shipboard and aerial surveys during 1999. NOAA-NMFS-NEFSC Ref. Doc. 00-07. 29 pp. ~~[Available from: NMFS, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543.]~~

Palka, D. 1996. Update on abundance of Gulf of Maine/Bay of Fundy harbor porpoises. NOAA-NMFS-NEFSC Ref. Doc. 96-04; 37 pp.

Palka, D. 1995a. Abundance estimate of the Gulf of Maine harbor porpoise. Pp. 27-50 *in*: A. Bjρrge and G.P. Donovan (eds.) Biology of the Phocoenids. Rep. int Whal. Commn (Special Issue) 16.

Palka, D. 1995b. Influences on spatial patterns of Gulf of Maine harbor porpoises. pp. 69-75 *In:* A.S. Blix, L. Wallρe and θ. Ulltang (eds.) Whales, seals, fish and man. Elsevier Science B.V. The Netherlands.

Palka, D.L., A.J. Read, A.J. Westgate, and D.W. Johnston. 1996. Summary of current knowledge of harbour porpoises in U.S. and Canadian Atlantic waters. Rep. int Whal. Commn 46:559-565.

Palka, D. 2005. Aerial surveys in the northwest Atlantic: estimation of g(0). In Proceedings of the workshop on Estimation of g(0) in line-transect surveys of cetaceans, ed. F. Thomsen, F. Ugarte, and P.G.H. Evans. ECS Newletter No. 44 – Special Issue. April 2005. Pgs 12-7.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. U.S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 06-03, 41 pp.

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

Polacheck, T., F.W. Wenzel. and G. Early. 1995. What do stranding data say about harbor porpoises (*Phocoena phocoena*). Pp 169-180 *in:* A. Bjρrge and G.P. Donovan (eds.) Biology of the Phocoenids. Rep. int Whal. Commn (Special Issue) 16.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn (Special Issue) 15:133-147.

Read, A.J. and A.J. Westgate. 1997. Monitoring the movements of harbour porpoises (*Phocoena phocoena*) with satellite telemetry. Marine Biology 130:315-22.

Read, A.J., J.R. Nicolas, and J.E. Craddock. 1996. Winter capture of a harbor porpoise in a pelagic drift net off North Carolina. Fish. Bull. U.S. 94:381-83.

Read, A.J. and A.A. Hohn. 1995. Life in the fast lane: The life history of harbour porpoises from the Gulf of Maine. Mar. Mammal Sci. 11(4):423-440.

Rosel, P.E., S.C. France, J.Y. Wang, and T.D. Kocher. 1999a. Genetic structure of harbour porpoise *Phocoena phocoena* populations in the northwest Atlantic based on mitochondrial and nuclear markers. Molecular Ecology 8: S41-S54.

Rosel, P.E., R. Tiedemann, and M. Walton. 1999b. Genetic evidence for limited trans-Atlantic movements of the harbor porpoise *Phocoena phocoena*. Marine Biology 133: 583-591.

Rossman, M.C. and R.L. Merrick. 1999. Harbor porpoise bycatch in the Northeast multispecies sink gillnet fishery and the mid-Atlantic coastal gillnet fishery in 1998 and during January-May 1999. NOAA-NMFS-NEFSC Ref. Doc. 99-17, 36 pp.

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

Smith, T., D. Palka, and K. Bisack. 1993. Biological significance of bycatch of harbor porpoise in the Gulf of

Maine demersal gillnet fishery. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc. 93-23, Woods Hole, Massachusetts.

Trippel, E.A., and T.D. Shepherd. 2004. By-Catch of Harbour Porpoise (*Phocoena phocoena*) in the Lower Bay of Fundy Gillnet Fishery from 1998-2001. DFO Res. Doc. 2004/2521.

Trippel, E.A., J.Y. Wang, M.B. Strong, L. S. Carter, and J. D. Conway. 1996. Incidental mortality of harbour porpoise (*Phocoena phocoena*) by the gillnet fishery in the lower Bay of Fundy. Can. J. Fish. Aquat. Sci. 53:1294-1300.

Trippel, E.A., M.B. Strong, J.M. Terhune, and J.D. Conway. 1999. Mitigation of harbour porpoise (*Phocoena phocoena*) bycatch in the gillnet fishery in the lower Bay of Fundy. Can. J. Fish. Aquat. Sci. 56:113-123.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp.

Wang, J.Y., D.E. Gaskin, and B.N. White. 1996. Mitochondrial DNA analysis of harbour porpoise, *Phocoena phocoena*, subpopulations in North American waters. Can J Fish Aquat Sciences 53:1632-45.

Westgate, A.J. and K.A. Tolley. 1999. Geographical differences in organochlorine contaminants in harbour porpoises *Phocoena phocoena* from the western North Atlantic. ~~Marine~~ Mar. ~~Ecology~~Ecol. ~~-~~Prog~~ress~~. ~~Series~~ Ser. 177:255-268.

Westgate, A. J., A. J. Read, T. M. Cox, T. D. Schofield, B. R. Whitaker, and K. E. Anderson. 1998. Monitoring a rehabilitated harbor porpoise using satellite telemetry. Mar. Mammal Sci. 14(3):599-604.

Westgate, A. J., D. C. G. Muir, D. E. Gaskin, and M. C. S. Kingsley. 1997. Concentrations and accumulation patterns of organochlorine contaminants in the blubber of harbour porpoises, *Phocoena phocoena*, from the coast of Newfoundland, the Gulf of St. Lawrence and the Bay of Fundy/Gulf of Maine. Envir. Pollut 95: 105-119.

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

~~April 2006~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas above about 30° N ~~-~~(Katona *et al*. 1993). In the western North Atlantic, they are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Mansfield 1967; Boulva and McLaren *1979*; Katona *et al.* 1993; Gilbert and Guldager 1998; Baird 2001). Stanley *et al.* (1996) examined worldwide patterns in harbor seal mitochondrial DNA, which indicate that western and eastern North Atlantic harbor seal populations are highly differentiated. Further, they suggested that harbor seal females are only regionally philopatric, thus population or management units are on the scale of a few hundred kilometers. Although the stock structure of the western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population (Temte *et al.* 1991). In U.S. waters, breeding and pupping normally occur in waters north of the New Hampshire/Maine border, although breeding occurred as far south as Cape Cod in the early part of the twentieth century (Temte *et al.* 1991; Katona *et al.* 1993).

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

Prior to spring 2001 live capture and radio tagging of adult harbor seals~~, including a pregnant female, in Chatham, Massachusetts (Waring *et al*. 2006 in press)~~, it was believed that the majority of seals moving into southern New England and mid-Atlantic waters ~~are~~ were subadults and juveniles (Whitman and Payne 1990; Katona *et al.* 1993; Slocum *et al.* 1999). The 2001 study established that adult animals also made this migration. Seventy-five percent (9/12) of the tagged seals were detected at least once during the May/June 2001 abundance survey along the Maine coast (Gilbert *et al*. 2005; Waring *et al*. ~~in press~~2006).

POPULATION SIZE

Since passage of the MMPA in 1972, the observed count of seals along the New England coast has been increasing. ~~Five c~~Coast-wide aerial surveys along the Maine coast ~~have been~~were conducted in May/June 1981, 1986, 1993, 1997, and 2001during pupping~~.~~ ~~(Uncorrected counts, with number of pups in parentheses, between 1981 and 2001 were 10,543 (676) in 1981, 12,940 (1,713) in 1986, 29,538 (4,257) in 1993, 31,078 (5,395) in 1997 and 38,014 (9,282) in 2001 (Table1;~~ Gilbert and Stein 1981; Gilbert and Wynne 1983, 1984; Kenney 1994; Gilbert and Guldager 1998; Gilbert *et al.* 2005). ~~As recommended in the GAMMS Workshop Report~~However, ~~(Wade and Anglis 1997),~~ estimates older than eight years are deemed unreliable (Wade and Anglis 1997), and ~~therefore~~ should not be used for PBR determinations. Therefore, only the 2001 estimate is useful for population assessment. The 2001 survey, conducted in May/June, included replicate surveys and radio tagged seals to obtain a correction factor for animals not hauled out. The corrected estimate for 2001 is 99,340 (23,722). ~~Prior to 2001, the numbers are considered to be a minimum abundance estimate because they are uncorrected for animals in the water or outside the survey area. In addition, the surveys conducted in 1981 and 1986 were conducted in late June, after peak pupping.~~ 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; Hoover *et al.* 1999; Slocum *et al.* 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 1980's, 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 less by 2002 ~~30 in 1997~~ (Baird 2001; Bowen *et al.* 2003). A decline in the number of juveniles and adults did not occur immediately, but a decline was observed in these age classes as a result of the reduced number of pups moving into the older age classes (Bowen *et al.* 2003). Possible reasons for this decline may be increased use of the island by gray seals and increased predation by sharks (Stobo and Lucas 2000; Bowen *et al.* 2003). Helicopter surveys have also been flown to count hauled-out animals along the coast and around small islands in parts of the Gulf of St. Lawrence and the St Lawrence estuary. In the estuary, surveys were flown during June 1995, 1996, and 1997, and in August during 1994, 1995, 1996 and 1997 and in different parts of the Gulf during June 1996 and 2001 (Robillard *et al.* 2005). Changes in counts over time in sectors that were flown under similar conditions were examined at nine sites that were surveyed in June and in August. Although all slopes were positive, only one was significant, indicating numbers are likely stable or increasing slowly. Overall, the June surveys resulted in an average of 469 (SD=60, N=3) hauled-out animals, which is lower than a count of 621 (SD=41, N=3) hauled-out animals flown under similar conditions in August. Aerial surveys in the Gulf of St. Lawrence resulted in counts of 467 animals in 1996 and 423 animals in 2001 for a different area (Robillard *et al.* 2005).

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

Month/Year	**Area**	**N_{best}** [a]	**CV**
~~May/June 1997~~	~~Maine coast~~	~~31,078 (5,395)~~	~~None reported~~
May/June 2001	Maine coast	99,340 (23,722) [b]	CV=.097

[a] Pup counts are in brackets
[b] Corrected estimate based on uncorrected count of 38,011 (9,278)

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for harbor seals is 99,340 (CV=.097). The minimum population estimate is 91,546 based on corrected total counts along the Maine coast in 2001.

Current Population Trend

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

~~Possible factors contributing to harbor seal population increase include MMPA protection, fishery management regulations (e.g., closed areas, fishing effort reduction) designed to rebuild groundfish stocks, and possible increased food availability. Since 2001, the trend in numbers of harbor seals is unknown.~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

A reliable estimate of the maximum net productivity rate is currently unavailable for this population. Based on uncorrected haulout counts over the 1981 to 2001 survey period, the harbor seal population is growing at approximately 6.6% (Gilbert *et al.* 2005). However, a population grows at the maximum growth rate (R_{MAX}) only when it is at a very low level; thus the 6.6% growth rate is not considered to be a reliable estimate of (R_{MAX}). For purposes of this assessment, the maximum net productivity rate was assumed to be 0.12. This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate (½ of 12%), and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 91,546. The recovery factor (F_R) for this stock is ~~1.~~0.5, the value for stocks of unknown status~~, but~~

~~known to be increasing~~. PBR for U.S. waters is 2,746~~5,493~~.

ANNUAL HUMAN-CAUSED MORTALITY

For the period ~~2000~~2001-~~2004~~ 2005 the total human caused mortality and serious injury to harbor seals is estimated to be ~~925~~ 893 per year. The average is derived from ~~two~~ three components: 1) ~~906~~ 882 (CV=0.~~18~~16); Table 2) from the ~~2000~~2001-~~2004~~ 2005 observed fishery; ~~and~~ 2) ~~19~~ 10 from average ~~2000~~2001-~~2004~~ 2005 ~~stranding mortalities resulting from boat strikes, power plant entrainments, shooting, and other sources~~non-fishery related, human interaction stranding mortalities (NMFS unpublished data); and 3) 1 incidental scientific take in 2001 (Waring 2006).

Researchers and fishery observers have documented incidental mortality in several fisheries, particularly within the Gulf of Maine (see below). An unknown level of mortality also occurred in the mariculture industry (i.e., salmon farming), and by deliberate shooting (NMFS unpublished data). However, no data are available to determine whether shooting still takes place.

Fishery Information

Detailed Fishery information is given in Appendix III.

U.S.

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

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

~~Incidental takes in lobster traps in inshore waters off Maine are reportedly rare. Captures of approximately two seal pups per port per year were recorded by mid coastal lobstermen off Maine (Gilbert and Wynne 1985). Seals have been reported to rob bait from inshore lobster traps, especially in the spring, when fresh bait is used. These incidents may involve only a few individual animals. Lobstermen claim that seals consume shedding lobsters, but there are no data to support this.~~

~~Current: Commercial fisheries observed for harbor seal bycatch are the Northeast Sink Gillnet, Mid Atlantic Coastal Gillnet, and North Atlantic Bottom Trawl fisheries.~~

~~**US**~~

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 ~~472~~ 542 harbor seal mortalities observed in the Northeast sink gillnet fishery between 1990 and ~~2004~~2005, excluding three animals taken in the 1994 pinger experiment (NMFS unpublished data). Williams (1999) aged 261 harbor seals caught in this fishery from 1991 to 1997, and 93% were juveniles (e.g. less than four years old). ~~Annual estimates of harbor seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. .~~ Estimated annual mortalities (CV in parentheses) from this fishery ~~during 2000-2004~~ 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~~;~~, ~~and~~ 792 (0.34) in 2004, and 719 (0.20) in 2005~~.~~ (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). There were ~~5,~~ 8, 2, 2, ~~and~~ 9, and 14 unidentified seals observed during ~~2000~~2001-~~2004~~2005, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2000~~2001-~~2004~~ 2005 was ~~902~~ 862 harbor seals (CV=0.~~18~~16) (Table 2). ~~The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The bycatch occurred in the Midcoast closure region (2) and east of Cape Cod (1) between January and April. Between May and August 6 animals were caught off Massachusetts and New Hampshire, and between September and December 4 were caught in the Midcoast closure area.~~

Mid-Atlantic Coastal Gillnet

No harbor seals were taken in observed trips during 1993-1997, ~~and~~ or 1999-2003. Two harbor seals ~~-~~were observed taken in 1998, ~~and~~ one in 2004~~.~~ ~~Observed effort was distributed from New York to North Carolina year round . One harbor seal was observed taken in 2004~~, and one in 2005. ~~The 2004 bycatch was in December off of New Jersey.~~ Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997 and 1999-2003, 11 in 1998 (0.77), ~~and~~ 15 (0.86) in 2004, and 63 (0.67) in 2005. In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality attributable to this fishery during ~~2000-2004~~2001-2005 was ~~X~~20 (CV = ~~xx~~0.57) ~~4 (CV =0.86)~~ harbor seals (Table 2). ~~In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002.~~

Northeast Bottom Trawl

Vessels in the Northeast bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management ~~needs~~, rather than marine mammal management, needs. In the 2005 list of fisheries (LOF) this fishery ~~has been~~was elevated to Category II. ~~No mortalities were observed between 1991 and 1999, and 4~~ Two mortalities were observed between ~~2000~~ 2001 and ~~2004~~ 2005 (Table 2). Observer coverage, expressed as number of trips, was < 1% from 1998 to 2001, and 2% in 2002 (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery ~~are currently being determined.~~ has not been generated.

Gulf of Maine Atlantic Herring Purse Seine Fishery

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

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.

~~In 1996, observers recorded 7 harbor seals (one released alive) in Spanish deep-water trawl fishing on the southern edge of the Grand Banks (NAFO Areas 3) (Lens, 1997). Seal bycatches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).~~

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast [c] Sink Gillnet	~~00-04~~ 01-05	~~301~~unk [d]	Obs. Data, Weighout, Logbooks	~~.06,~~ .04, .02, .03, .06, .07	~~26,~~ 32, 12, 21, 45, 70	~~917,~~ 1471, 787, 542, 792, 719	~~.43,~~ .38, .32, .28, .34, .20	~~902~~ 862 (0.~~18~~16)
~~mid~~Mid-Atlantic ~~Coastal Sink~~ Gillnet	~~00~~01-~~04~~ 05	unk [d]	Obs. Data, Weighout	~~.02,~~ .02, .01, .01~~,~~, ~~.02~~ 02, .03	~~0,~~ 0, unk [e], 0, 1, 2	~~0,~~ 0, unk [e], 0, 15, 63	~~0,~~ 0, unk [e], 0, .86, .67	~~4~~ 20 (0.~~86~~57) [e]

Northeast Bottom Trawl	~~00~~01-~~04~~05	~~TBD~~unk[d]	Obs. Data, Weighout	~~.004,~~ .00401, .02103, ~~028~~ .04 .04505, tbd	~~0,~~ 0, ~~4~~1, 0, 0, 1	~~0,~~ 0, ~~tbd~~[f] unk[f], 0, 0, unk	~~0,~~ 0, ~~tbd~~[f] unk[f], 0, 0, unk	~~TBD~~[f] unk[f]
TOTAL								~~906~~882 (0.~~18~~16)

[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 ~~coastal~~ gillnet fisheries are ~~measured i~~ratios based on tons of fish landed and coverages for the northease bottom trawl are ratios based on trips.

[c] Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In ~~2000~~ 2001 - ~~2004~~2005, respectively, 8, 10, 3, 0, 8, 3 takes were observed in nets with pingers. In ~~2000~~ 2001 – ~~2004~~2005, respectively, ~~18,~~ 22, 9, 21, 37, 67 takes were observed in nets without pingers.

[d] Number of vessels is not known.

[e] Sixty-five percent of sampling in the mid-Atlantic coastal gillnet by the NEFSC fisheries observer program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionately throughout the mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (~~2000~~ 2001, and 2003~~, and~~ - ~~2004~~2005) estimated mortality was applied as the best representative estimate.

[f] Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery for the years ~~2000~~2001-200~~4~~5 ~~is in progress. The estimates will not be reported until the analysis and scientific review is complete~~has not been generated.~~. Complete review is anticipated prior to the commencement of the Atlantic trawl take reduction team in September 2006.~~

Other Mortality

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

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

Small numbers of harbor seals strand each year throughout their migratory range. Stranding data provide insight into some of these sources of mortality. From ~~2000~~2001-~~2004~~2005, ~~2,059~~2 ~~-~~ 1,806 harbor seal stranding~~s~~ mortalities were reported ~~(219 in 2000, 246 in 2001, 337 in 2002, 479 in 2003, and 774 in 2004, and 428 in 2005)~~ in all states between Maine and North Carolina (Table 3; NMFS unpublished data). ~~Ninety-nine~~ Fifty-eight (~~4.8~~3.2%) of the seals stranded during this five year period showed signs of human interaction (9 in 2001, 18 in 2002, 2 in 2003, 15 in 2004, and 14 in 2005), with 17 having some sign of fishery interaction (1 in 2001, 9 in 2002, 0 in 2003, 3 in 2004, and 4 in 2005) ~~as a direct cause of mortality~~. An Unusual Mortality Event (UME) was declared for harbor seals in northern Gulf of Maine waters ~~during 2004~~in 2003 and continued into 2004. No consistent cause of death could be determined. The UME was declared over in spring 2005. ~~(Marine Mammal Commission 2005).~~ 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 grey seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).

Table 3. Harbor seal (*Phoca vitulina*) stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004[b]	2005	Total
ME	85	149	212	358	194	998
NH	5	2	15	21	32	75
MA	57	90	98	146	122	513
RI	5	4	12	11	6	38
CT	4		1	3	2	10
NY	12	8	10	14	33	77
NJ	4	6	15	5	11	41
DE			2		10	12
MD			1	1	6	8
VA	2	1	2	1	6	12
NC	3	2	8		8	21
FL			1			1
Total	177	262	377	560	430	1806
Unspecified seals (all states)	37	35	27	33	19	151

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated

b. Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2003-2004.

~~Table 3. Harbor seal (*Phoca vitulina*) reported strandings along the U.S. Atlantic coast (2002-2004).~~

~~State~~	~~2002~~	~~2003~~	~~2004[c]~~	~~Total~~
~~Maine~~	~~183~~	~~259~~	~~509[a]~~	~~951~~
~~New Hampshire~~	~~3~~	~~15~~	~~24~~	~~42~~
~~Massachusetts~~	~~108~~	~~109~~	~~170~~	~~387~~
~~Rhode Island~~	~~4~~	~~12~~	~~12~~	~~28~~
~~Connecticut~~	~~0~~	~~1~~	~~3~~	~~4~~
~~New York~~	~~18~~	~~22~~	~~31~~	~~71~~
~~New Jersey~~	~~15~~	~~30~~	~~16[b]~~	~~61~~
~~Delaware~~	~~0~~	~~2~~	~~0~~	~~2~~
~~Maryland~~	~~0~~	~~2~~	~~1~~	~~3~~
~~Virginia~~	~~3~~	~~6~~	~~5~~	~~14~~
~~North Carolina~~	~~3~~	~~23~~	~~4~~	~~30~~
~~Florida~~	~~0~~	~~0~~	~~1~~	~~1~~
~~Total~~	~~337~~	~~481~~	~~776~~	~~1,594~~

~~[a] Unusual Mortality Event (UME) declared for harbor seals in northern Gulf of Maine waters during 2004.~~

~~[b] Harbor seals were treated and released in New Jersey.~~

~~[c] During 2004, the Northeast region had 37 seal strandings where species could not be determined. In 2004, 13 harbor seals had signs of human interaction as the cause of death.~~

~~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.~~

~~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 grey seal for food resources (Stobo and Lucas 2000; Bowen *et al.* 2003).They suggest that the combined predation mortality is likely impacting the Sable Island population growth, and may be contributing to the observed population decline.~~

STATUS OF STOCK

The status of the western North Atlantic harbor seal stock~~s~~, relative to OSP, in the U.S. Atlantic EEZ is unknown, but the stock's abundance~~population~~ is increasing. The species is not listed as threatened or endangered under the Endangered Species Act. ~~Gilbert *et al.* 2005 estimated a 6.6% annual rate of increase of this stock in Maine coastal waters based on 1981 to 2001 surveys conducted along the Maine coast. The population is increasing despite the known fishery-related and other human-sources of mortality.~~ Total fishery-related mortality and serious injury for this stock is not less than 10% of the calculated PBR and, therefore, cannot be considered to be approaching zero mortality and serious injury rate. This is not a strategic stock because fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Baird, R. W. 2001. Status of harbor seals, *Phoca vitulina*, in Canada. Can. Field-Nat. 115:663-675.

Barlas, M. E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) and gray seals (*Halichoerus grypus*) in southern New England, winter 1998- summer 1999. MA Thesis, Boston University, Graduate School of Arts and Sciences., Boston, MA. 52 pp.

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bisack, K. D. 1997. Harbor porpoise bycatch estimates in the New England multispecies sink gillnet fishery: 1994 and 1995. Rep. int Whal. Commn~~.~~ 47:705-14.

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

Bowen, W.D., Ellis, S.L., Iverson, S.J., and Boness, D.J. 2003. Maternal and newborn life-history traits during periods of contrasting population trends: implications for explaining the decline of harbour sels (*Phoca vitulina*), on Sable Island. J. Zool.~~,~~ Lond. 261:155-163.

Bravington, M. V. and K. D. Bisack. 1996. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-93. Rep. int Whal. Commn~~.~~ 46:567-574.

Cairns, D.K, D.M. Keen, ~~D.M.,~~ P-Y. Daoust, ~~P-Y.,~~ D.J. Gillis, ~~D.J.~~ and M.0. Hammill~~, M.O~~. 2000. Conflicts between seals and fishing gear on Prince Edward Island. Can. Tech. Rep. Fish. Aquat. Sci. No 2333. 39 pp.

deHart, P. A. P. 2002. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) in the Woods Hole region. MA Thesis, Boston University, Graduate School of Arts and Sciences. Boston, MA, 88 pp.

Gilbert, J.~~-~~R., G.~~-~~T. Waring, K.~~-~~M. Wynne, and N. Guldager. 2005. Changes in abundance and distribution of harbor seals in Maine, 1981-2001. Mar. Mammal Sci. 21:~~-~~519-535.

Gilbert, J.~~-~~R. and J.~~-~~L. Stein. 1981. Harbor seal populations and marine mammal fisheries interactions, 1981. Annual report, Contract NA-80-FA-C-00029, to NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. 35 pp.

Gilbert, J.~~-~~R. and K.~~-~~M. Wynne. 1983. Harbor seal populations and marine mammal fisheries interactions, 1982. Second annual report, Contract NA-80-FA-C-00029, to NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. 43 pp.

Gilbert, J.~~-~~R. and K.~~-~~M. Wynne. 1984. Harbor seal populations and marine mammal fisheries interactions, 1983. Third annual report, Contract NA-80-FA-C-00029, to NMFS, Northeast Fisheries Science Center, 166 Water St, Woods Hole, MA. 52 pp.

~~Gilbert, J. R. and K. M. Wynne. 1985. Harbor seal populations and fisheries interactions with marine mammals in New England, 1984. Interim Rep., NOAA NA 84 EAC 00070, to NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. 15 pp.~~

~~Gilbert, J. R. and K. M. Wynne. 1987. Marine mammal interactions with New England gillnet fisheries. Final Report, Contract No. NA 84 EAC 00070, to NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. 21 pp.~~

Gilbert, J.-R. and N. Guldager. 1998. Status of harbor and gray seal populations in northern New England. Final Report under NMFS/NER Cooperative Agreement 14-16-009-1557, to NMFS, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA. 13 pp.

Hoover, K., S. Sadove, and P. Forestell. 1999. Trends of harbor seal, *Phoca vitulina*, abundance from aerial surveys in New York waters: 1985-1999. Proceedings of the 13th Biennial Conference on the Biology of Marine -Mammals, Wailea, Hawaii, Nov. 28 - Dec. 3, 1999. (Abstract).

Jacobs, S. R. and J. M. Terhune. 2000. Harbor seal (*Phoca vitulina*) numbers along the New Brunswick coast of the Bay of Fundy in autumn in relation to aquaculture. Northeastern Naturalist 7(3): 289-296.

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

Kenney, M.-K. 1994. Harbor seal population trends and habitat use in Maine. M.S. Thesis. University of Maine, Orono, ME. 55 pp.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES C.M. 8/Q. 10 pp.

Mansfield, A.-W. 1967. Distribution of the harbor seal, *Phoca vitulina* Linnaeus, in Canadian Arctic waters. J. Mamm. 48(2):-249-257.

Marine Mammal Commission. 2006. US Marine Mammal Commission Annual Report to Congress, 2004. Marine Mammal Commission, Bethesda MD. Vi+163pp. Available at: htt://www.nefsc.noaa.gov/nefsc/publication/ 70 pp.

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

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

Read, A.-J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn. (Special Issue) 15:-133-147.

Richardson, D.-T. 1976. Assessment of harbor and gray seal populations in Maine 1974-1975. Final report, contract No. MM4AC009, Marine Mammal Commission., Washington, DC, 46 pp.

Robillard, A., V. Lesage, ~~V.~~ and M.O. Hammill~~, M.O~~. 2005. Distribution and abundance of harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) in the estuary and Gulf of St Lawrence, 1994-2001. Can. Tech. Rep. Fish. Aquat. Sci. 2613. 152 pp.

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

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission, Contract T10155615, 28 pp. NTIS Pub. PB95-191391.

Schneider, D.-C. and P.-M. Payne. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. J. Mamm. 64(3):-518-520.

Schroeder, C. L. 2000. Population status and distribution of the harbor seal in Rhode Island waters. M.S. Thesis, University of Rhode Island, Kingston, RI. 197 pp.

Slocum, C.J., R. Schoelkopf, S. Tulevech, M. Stevens, S. Evert, and M. Moyer. 1999. Seal populations wintering in New Jersey (USA) have increased in abundance and diversity. Proceedings of the 13th Biennial Conference on the Biology of Marine Mammals, Wailea, Hawaii, Nov. 28 - Dec. 3, 1999. (Abstract).

Stanley, H.-F., S. Casey, J.-M. Carnahan, S. Goodman, J. Harwood, and R. K. Wayne. 1996. Worldwide patterns of mitochondrial DNA differentiation in the harbor seal (*Phoca vitulina*). Mol. Biol. Evol. 13:-368-382.

Stobo, W.-T. and G.-M. Fowler. 1994. Aerial surveys of seals in the Bay of Fundy and off southwest Nova Scotia. Can. Tech. Rep. Fish. Aquat. Sci. 1943:57 pp.

Stobo, W.-T. and Z. Lucas. 2000. Shark-inflicted mortality on a population of harbour seals (*Phoca vitulina*) at Sable Island, Nova Scotia. J. Zool. Lond. 252:-405-414.

Temte, J.-L., M.-A. Bigg, and O. Wiig. 1991. Clines revisited: the timing of pupping in the harbour seal (*Phoca vitulina*). J. Zool. Lond. 224:-617-632.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

Waring, G.-T., J.-R. Gilbert, J. Loftin, and N. Cabana. 2006. Short term movements of radio tagged harbor seals in New England. Northeast. Nat. In press13(1):1-14.

Whitman, A.–A. and P.–M. Payne. 1990. Age of harbour seals, *Phoca vitulina concolor*, wintering in southern New England. Can. Field-Nat. 104(4):-579-582.

Williams, A.-S. 1999. Prey selection by harbor seals in relation to fish taken by the Gulf of Maine sink gillnet fishery. M.S. Thesis University of Maine, Orono, ME. 62 pp.

Wilson, S.-C. 1978. Social organization and behavior of harbor seals, *Phoca concolor*, in Maine. Final Report -contract MM6ACO13, GPO-PB-280-188, Marine Mammal Commission, Washington, DC, 36 pp.

~~April 2006~~ ~~January~~April 2007

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The gray seal is found on both sides of the North Atlantic, with three major populations: eastern Canada, northwestern Europe and the Baltic Sea (Katona *et al.* 1993). The western North Atlantic stock is equivalent to the eastern Canada population, and ranges from New England to Labrador (Mansfield 1966; Katona *et al.* 1993; Davies 1957; Lesage and Hammill 2001). This stock is separated by geography, differences in the breeding season, and mitochondrial DNA variation from the northwestern 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 ~~have been~~ observed on several isolated islands along the Maine coast and in Nantucket-Vineyard Sound, Massachusetts (Katona *et al.* 1993; Rough 1995; J. R. Gilbert, pers. comm., University of Maine, Orono, ME). In the late 1990's, a year-round breeding population of approximately 400+ animals was documented on outer Cape Cod and Muskeget Island (D. Murley, pers. comm., Mass. Audubon Society, Wellfleet, MA). In December 2001, NMFS initiated aerial surveys to monitor gray seal pup production on Muskeget Island and at the Monomoy National Wildlife Refuge (NWR; S. Wood, pers. comm., University of Massachusetts, Boston, MA). Gilbert (pers. comm.) has also documented resident colonies and pupping in Maine since 1994.

POPULATION SIZE

Current estimates of the total western Atlantic gray seal population are not available; although estimates of portions of the stock are available for select time periods. The size of the Canadian population from 1993 to 2004 has been estimated from three surveys.~~, inhabiting the Gulf of St. Lawrence and Sable Island, appears to be growing.~~ A 1993 survey estimated the population at 144,000 animals (DFO 2003, Mohn and Bowen 1996), ~~and~~ a 1997 survey estimated 195,000 (DFO 2003), and a~~,, and aA~~ 2004~~–~~ survey estimated between 208,720 (SE=29,730) and 223,220 (SE=17,376) (Trzcinski *et al.* 2005)..~~250,000 animals (DFO website)~~. ~~While the overall population in increasing, the population in the Gulf of St. Lawrence is declining (Bowen *et al.* 2003). the~~ The population at Sable Island ~~is~~ had been increasing by approximately 13% per year for nearly 40 years (Bowen *et al.* 2003), but the most recent (2004) survey results indicate this population increase has declined ~~dropped~~ to 7% (Trzcinski *et al.* 2005; Bowen *et al.* in press~~Bowen *et eal* 2006~~).~~while~~ The non-Sable Island (Gulf of St Lawrence and Eastern Shore) has increased from 20,900 (SE=200) in 1970 to 52,500 (SE=7,800) in 2004 (Hammill 2005). ~~the population in the Gulf of St. Lawrence is declining (Bowen *et al.* 2003).~~

The population in US waters is also increasing. Maine coast-wide surveys conducted during summer (all other surveys were conducted January-May) revealed 597 and 1,731 gray seals in 1993 and 2001, respectively (Gilbert *et al*. 2005). In 2002, the maximum counts of two breeding colonies in Maine, with number of pups in parentheses, were 193 (9) on Seal Island and 74 (31) on Green Island (S. Wood, pers. comm.). Gray seal numbers are increasing in Massachusetts at Muskeget Island off the coast of Nantucket, and at Monomoy Island, off the coast Chatham, Cape Cod. Pup counts on Muskeget have increased from 0 in 1989 to 1,023 in 2002 (Rough 1995, S. Wood, pers. comm.). Gray seal numbers increase in this region in the spring (April-May) when molting occurs. In April-May 1994 a maximum count of 2,010 was obtained for Muskeget Island and Monomoy combined (Rough 1995). In March 1999 a maximum count of 5,611 was obtained in the region south of Maine (between Isles of Shoals, NH and Woods Hole, MA) (Barlas 1999). No gray seals were recorded at haul out sites between Newport, RI and Montauk Pt., NY (Barlas 1999), although, more recently small numbers of gray seals have been recorded in this region (deHart 2002; R. DiGiovanni, pers. comm., The Riverhead Foundation, Riverhead, NY). Recently, a small number of gray seals have maintained a winter presence in the Woods Hole region (Vineyard Sound) (deHart 2002).

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

Month/Year	Area	Nmin[a]	CV
March 1999	Muskeget Island and Monomoy NWR, MA	5,611	None reported
May 2001	Maine coast	1,731	None reported
January 2004[b]	Gulf of St Lawrence + Nova Scotia Eastern Shore	46,300	0.15
January 2004[b]	Sable Island	125,541 144,610 169,064	None reported

[a] These counts pertain to animals seen in U.S. waters, and the stock relationship to animals in Canadian waters is unknown.

[b] These are model based estimate~~d~~s derived from pup surveys.

Minimum Population Estimate

~~It is estimated that there are at least 195,000approximately 250,000 gray seals in Canada (DFO 2003????website).~~ Depending on the model used, the N_{min} for the~~-~~ Canadian gray seal population was estimated ~~in 2004~~ to range between 125,541 and 169,064 (Trzcinski *et al*. 2005) Present data are insufficient to calculate the minimum population estimate for U.S. waters.

Current Population Trend

Gray seal abundance is likely increasing in the U.S. Atlantic Exclusive Economic Zone (EEZ), but the rate of increase is unknown. The population in eastern Canada was greatly reduced by hunting and bounty programs, and in the 1950~~'~~s the gray seal was considered rare (Lesage and Hammill 2001). The Sable Island population was less affected and has been increasing for several decades~~-~~. Pup production on Sable Island, Nova Scotia, has increased exponentially at a rate of 12.8% annually for more than 40 years (Stobo and Zwanenberg 1990; Mohn and Bowen 1996; Bowen *et al*. 2003; Trzcinski *et al*. 2005; Bowen *et al*. in press),~~has been about 13% per year since 1962 (Stobo and Zwanenberg 1990; Mohn and Bowen 1996);~~ but has declined to 7% in 2004 (Trzcinski *et al*. 2005; Bowen *et al*. in press). ~~In t~~The non Sable Island population increased from 6,900 in the mid-1980s to a peak of 11,100 (SE=1,300) animals in 1996 (Hammill and Gosselin 2005). Pup production declined to 6,100 (SE=900) in 2000, then increased to 15,900 (SE=1,200) in 2004 (Hammill and Gosselin 2005). ~~Wwhereas, in the Gulf of St. Lawrence the population appears to be declining, and may have been declining since 1990 (DFO 2003).~~ Approximately 57% of the western North Atlantic population is from the Sable Island stock. In recent years pupping has been established on Hay Island, off the Cape Breton coast (Lesage and Hammill 2001).

Winter breeding colonies in Maine and on Muskeget Island may provide some measure of gray seal population trends and expansion in distribution. Sightings in New England increased during the 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, between~~-~~ 883 ~~–~~and 1,023 pups were counted on Muskeget Island and surrounding shoals (S. Wood, pers. comm.). These observations continue the increasing trend in pup production reported by Rough (1995). NMFS recently initiated a collaborative program with the University of Massachusetts, Boston and University of Maine to monitor gray seal population trends and pup production in New England waters. The change in gray seal counts at Muskeget and Monomoy from 2,010 in 1994 to 5,611 in 1999 represents an annual increase rate of 20.5%, however, it can not be determined what proportion of the increase represents growth or immigration.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. A recent study ~~One study~~ estimated the annual rate of increase at 7% ~~an annual or net productivity increase in pup production of 7%13%~~ on Sable Island (Trzcinski et al. 2005; Bowen *et al*. in press), which represents a 45% decline from previous estimates (Mohn and Bowen 1996; Bowen *et al*. 2003).

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

POTENTIAL BIOLOGICAL REMOVAL

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

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2000~~2001-~~2004~~2005, the total estimated human caused mortality and serious injury to gray seals was ~~371~~ 449 per year. The average was derived from three components: 1) ~~228~~ 304 (CV=0.22) Table 2) from the ~~2000~~2001-~~2004~~ 2005 U.S. observed fishery; 2) ~~5~~ 7 from average ~~2000~~2001-~~2004~~ 2005 stranding mortalities in U.S. waters resulting from power plant entrainments, oil spill, shooting, boat strike, and other sources (NMFS unpublished data), and 3) 138 from average 2000-2003 kill in the Canadian hunt (DFO 2003, Stenson unpublished data; 2004 and 2005 data not yet available, but possibly higher due to recently increased TAC levels).

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 ~~73~~ 96 gray seal mortalities observed in the Northeast sink gillnet fishery between 1993 and ~~2004~~2005. 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, ~~and~~ 504 (0.34) in 2004, and 574 (0.44) in 2005 (Table 2). There were 5, 8, 2, 2, ~~and~~ 9, and 14 unidentified seals observed during ~~2000~~2001-~~2004~~2005, respectively. Since 1997 unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2000~~2001-~~2004~~ 2005 was ~~211~~ 287 gray seals (CV=~~0.23~~0.23) (Table 2). The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996).

Mid-Atlantic Coastal Gillnet

No gray seals were taken in observed trips during 1998-2000, and 2003. One gray seal was observed taken ~~during~~ in 2001and and one in 2004 (Table 2). In 2001 the gray seal was taken at 44 fathom depth during the month of April off the coast of New Jersey near Hudson Canyon. The 2004 take was off Virginia in April. Observed effort was scattered between New Jersey and North Carolina from 1 to 50 miles off the beach. In 2002, 65% of sampling was concentrated in one area and not distributed proportionally across the fishery. Therefore, observed mortality is considered unknown in 2002. Average annual estimated fisher-related mortality and serious injury to this stock attributable to this fishery during ~~2000~~2001-~~2004~~ 2005 was 17 gray seals (CV=0.92) (Table 2).

Gulf of Maine Atlantic Herring Purse Seine Fishery

The Gulf of Maine Atlantic Herring Purse Seine Fishery is a Category III fishery. This fishery was not observed until 2003. No mortalities have been observed, but 15 gray seals were captured and released alive in 2004 and 19 in 2005. In addition, 5 seals of unknown species were captured and released alive in 2004 and 2 in 2005.

Northeast Bottom Trawl

Vessels in the North Atlantic bottom trawl fishery, a Category III fishery under MMPA, were observed in order to meet fishery management ~~needs~~, rather than marine mammal management needs. No mortalities were observed prio~~t~~r to 2005, when one mortality was attributed to this fishery. Observer coverage, expressed as number of trips, was < 1% from 1998 to 2001, 2% in 2002, almost 3% in 2003 and over 4% in 2004 (Table 2). The estimated annual fishery-related mortality and serious injury attributable to this fishery was 0 between 2001 and 2004. Estimates have not been generated for 2005.

CANADA

An unknown number of gray seals have been taken in Newfoundland and Labrador, Gulf of St. Lawrence, and Bay of Fundy groundfish gillnets, Atlantic Canada and Greenland salmon gillnets, Atlantic Canada cod traps, and in Bay of Fundy

herring weirs (Read 1994). In addition to incidental catches, some mortalities (e.g., seals trapped in herring weirs) were the result of direct shooting, and there were culls of about 1,700 animals annually during the 1970's and early 1980's 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 bycatches occurred year-round, but interactions were highest during April-June. Many of the seals that died during fishing activities were unidentified. The proportion of sets with mortality (all seals) was 2.7 per 1,000 hauls (0.003).

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

Fishery	Years	Vessels	Data Type[a]	Observer Coverage[b]	Observed Mortality	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet[c]	~~00-04~~01-05	~~301~~ unk	Obs. Data, Weighout, Logbooks	~~.06,~~ .04, .02, .03, .06, .07	~~5,~~ 2, 0, 5, 21, 33	~~193,~~ 117, 0, 242, 504 , 574	~~.55,~~ .59, 0, .47, .34 , .44	~~211~~ 287 (0.23)
Mid-Atlantic ~~Coastal~~ Gillnet[d]	~~00~~01-~~04~~ 05	unk[e]	Obs. Data, Weighout	~~.02,~~ .02, .01, .01, .02 , .03	~~0,~~ 1, ~~unk~~[f] unk[e], 0, 1 , 0	~~0,~~ 0[d], ~~unk~~[f] unk[e], 0, 69 , 0	~~0,~~ 0, ~~unk~~[f] unk[e], 0, .92 , 0	17 (0.92)
Northeast Bottom Trawl	01-05	unk	Obs. Data, Weighout	.004, .021, 028 .045, unk[f]	0, 0, 0, 0, 4	0, 0, 0, 0, unk[f]	0, 0, 0, 0, unk[f]	unk[f]
TOTAL								~~228~~304 (0.22)

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 ~~coastal~~ gillnet fisheries are ratios based on tons of fish landed.

c. Since 1998, takes from pingered and non-pingered nets within a marine mammal time/area closure that required pingers, and takes from pingered and non-pingered nets not within a marine mammal time/area closure were pooled. The pooled bycatch rate was weighted by the total number of samples taken from the stratum and used to estimate the mortality. In 1998, 1 take was observed in a net without a pinger that was within a marine mammal closure that required pingers. In ~~2000~~ 2001 - ~~2004~~2005, respectively, ~~2,~~ 0, 0, 1, 1, 1 takes were observed in nets with pingers. In ~~2000~~ 2001 – ~~2004~~2005, respectively, ~~3,~~ 2, 0, 4, 20, 32 takes were observed in nets without pingers.

d. The one observed take in the mid-Atlantic gillnet fisheries (2001) was on a "fish trip", therefore no mortality estimate was extrapolated. See Bisack (1997) for "trip" type definitions.

~~[e] Number of vessels is not known.~~

e. Sixty-five percent of sampling in the mid-Atlantic coastal gillnet by the Northeast Fisheries Observer Program was concentrated in one area off the coast of Virginia. Because of the low level of sampling that was not distributed proportionately throughout the mid-Atlantic region observed mortality is considered unknown in 2002. The four year average (~~2000~~ 2001, and 2003~~, and~~ ~~2004~~2005) estimated mortality was applied as the best representative estimate.

f. Analysis of bycatch mortality attributed to the Northeast bottom trawl fishery has not been generated.

Other Mortality

Canada: In Canada, gray seals were hunted for several centuries by indigenous people and European settlers in the Gulf of St. Lawrence and along the Nova Scotia eastern shore, and were locally extirpated (Lavigueur and Hammill 1993). Between 1999-2003 the annual kill of gray seals by hunters in Canada was: 1999 (98), 2000 (342), 2001 (76) 2002 (126), and 2003 (6) (DFO 2003; Stenson unpublished data). 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 an annual (2006-2010) TAC of 2,100 gr~~e~~ay seals in the Gulf of St. Lawrence, and 8,300 on the Scotian Shelf. The hunting of grey seals will continue to be prohibited on Sable Island (http://www.dfo-mpo.gc.ca/seal-phoque/index_e.htm).

Canada also issues personal hunting licenses which allow~~s~~ the holder to take ~~6~~six ~~grey~~ gray seals annually (Lesage and Hammill 2001). Hunting is not permitted during the breeding season and some additional seasonal/spatial restrictions are in effect (Lesage and Hammill 2001).

U.S: Gray seals, like harbor seals, were hunted for bounty in New England waters until the late 1960~~'~~s. This hunt may have severely depleted this stock in U.S. waters (Rough 1995). Other sources of mortality include human interactions, storms, abandonment by the mother, disease, and predation. Mortalities caused by human interactions include boat strikes, fishing gear interactions, power plant entrainment, oil spill/exposure, harassment, and shooting. The Cape Cod stranding network has documented gray seals entangled in netting or plastic debris around the Cape Cod/Nantucket area, and in recent years have made successful disentanglement attempts.

From ~~1999~~2002~~2~~1-~~2004~~2005, ~~434~~274 gray seal stranding~~s~~ mortalities were recorded, extending from Maine to North Carolina (Table 3; NMFS unpublished data).~~.~~ Most ~~-~~stranding mortalities~~s~~ were in Massachusetts. ~~Twenty five~~Thirty four (~~5.8~~12.4%) of th~~e seals~~e total stranding mortalities ~~stranded during this period~~ showed signs of human interaction (2 in 2001, 6 in 2002, 7 in 2003, 16 in 2004 and 3 in 2005), with 20 having some indication of fishery interaction (1 in 2001, 3 in 2002, 5 in 2003, 11 in 2004 and 0 in 2005).

~~The total number of gray seal strandings from 2002 to 2004 are presented in Table 3.~~

Table 2. Gray seal (*Halichoerus grypus*) stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004[a]	2005[b]	Total
ME	2	2	2	3	5	14
NH	-	-	1	-	1	2
MA	20	32	58	33	30	173
RI	1	1	6	8	2	18
CT	-	-	-	2	-	2
NY	8	5	5	2	16	36
NJ	2	-	2	-	11	15
DE	-	-	-	1	4	5
MD	-	-	-	1	3	4
VA	-	-	1	2	1	4
NC	-	1	-	-	-	1
Total	33	41	75	52	73	274
Unspecified seals (all states)	37	35	27	33	19	151

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated

~~Table 3. Gray seal (*Halichoerus grypus*) reported strandings along the U.S. Atlantic coast (2002-2004).~~

~~State~~	~~2002~~	~~2003~~	~~2004~~[a]	~~Total~~
~~Maine~~	~~7~~	~~6~~	~~4~~	~~17~~
~~New Hampshire~~	~~0~~	~~1~~	~~0~~	~~1~~
~~Massachusetts~~	~~43~~	~~64~~	~~47~~	~~154~~
~~Rhode Island~~	~~3~~	~~7~~	~~8~~	~~18~~
~~Connecticut~~	~~0~~	~~0~~	~~2~~	~~2~~
~~New York~~	~~14~~	~~13~~	~~20~~	~~47~~
~~New Jersey~~	~~3~~	~~14~~	~~9~~	~~26~~
~~Delaware~~	~~0~~	~~1~~	~~3~~	~~4~~
~~Maryland~~	~~0~~	~~0~~	~~1~~	~~1~~
~~Virginia~~	~~0~~	~~2~~	~~4~~	~~6~~
~~North Carolina~~	~~1~~	~~0~~	~~2~~	~~3~~
~~Total~~	~~71~~	~~108~~	~~100~~	~~279~~

~~[a] During 2004, the Northeast region had 37 seal strandings where species could not be determined. In 2004, 10 seals had signs of human interaction.~~

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

STATUS OF STOCK

The status of the gray seal population relative to OSP in U.S. Atlantic EEZ waters is unknown, but the stock's abundance appears to be increasing in Canadian and U.S. waters. The species is not listed as threatened or endangered under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for this stock is low relative to the stock size in Canadian and U.S. waters and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is unknown, but believed to be very low relative to the total stock size; therefore, this is not a strategic stock.

REFERENCES

Anonymous. 1986. Seals and sealing in Canada. Rep. of the Royal Commission on Seals and Sealing, Vol. 1, 65 pp. Available from Canadian Government Publishing Centre, Ottawa, Canada.

Barlas, M. E. 1999. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) and gray seals (*Halichoerus grypus*) in southern New England, winter 1998- summer 1999. MA Thesis, Boston University, Graduate School of Arts and Sciences, Boston, MA. 52 pp.

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bisack, K. D. 1997. Harbor porpoise bycatch estimates in the New England multispecies sink gillnet fishery: 1994 and 1995. *Rep. int Whal. Commn.* 47:705-14.

Bonner, W. N. 1981. Grey seal *Halichoerus grypus Fabricus*, 1791. Pp. 111-144 *in:* S. H. Ridgway and R. J. Harrison (eds), Handbook of marine mammals, Vol. 2: Seals. *Academic Press*, London, 359 pp.

Boskovic, R., K. M. Kovacs, M. O. Hammill, and B. N. White. 1996. Geographic distribution of mitochondrial DNA haplotypes in grey seals (*Halichoerus grypus*). Can. J. Zool. 74:1787-1796.

Bowen, W.D., J. McMillan, and R. Mohn. 2003. Sustained exponential population growth of grey seals at Sable Island, Nova Scotia. ICES J. Mar. Sci. 60: 1265-1274.

Bowen, W.D, J.I. McMillan, and W. Blanchard. 2007. ~~2006~~. Reduced population growth of gray seals at Sable Island: Evidence from pup production and age of primiparity, Mar. Mamm. Sci.23:48-64.

Bravington, M.V. and K.D. Bisack. 1996. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-93. Rep. int Whal. Commn. 46:567-574.

DFO [Dept. of Fisheries and Oceans]. 2002. Atlantic seal hunt: 2002 management plan. Available from Canadian Department of Fisheries and Oceans, Ottawa, Ontario, Canada, K1A 0E6, Fisheries Resource Management – Atlantic. 39 pp.

DFO [Dept. of Fisheries and Oceans]. 2003. Atlantic seal hunt: 2003-2005 management plan. Available from Canadian Department of Fisheries and Oceans, Ottawa, Ontario, Canada, K1A 0E6, Fisheries Resource Management - Atlantic. 34 pp.

Davies, J. L. 1957. The geography of the gray seal. J. Mamm. 38:297-310.

deHart, P.A.P. 2002. The distribution and abundance of harbor seals (*Phoca vitulina concolor*) in the Woods Hole region. MA Thesis, Boston University, Graduate School of Arts and Sciences., Boston, MA. 88 pp.

Gilbert, J.R., G.T. Waring, K.M. Wynne, and N. Guldager, 2005. Changes in abundance and distribution of harbor seals in Maine, 1981-2001. Mar. Mamm. Sci. 21:519-535.

Hammill, M.O. 2005. Abundance of Northwest ~~Atlatnic~~Atlantic grey seals in the Gulf of St. Lawrence and along the Nova Scotia Eastern Shore. Canadian Department of Fisheries and Oceans. Research Document 2005/036 Available at: http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_036_e.htm 11 pp.

Hammill, M.O. and J.F. Gosselin. 2005. Pup production of non-Sable Island grey seals, in 2004. Research Document 2005/036 Available at: http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_033_e.htm 20 pp.

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

Laviguer, L. and M. O. Hammill. 1993. Distribution and seasonal movements of grey seals, *Halichoerus grypus*, born in the Gulf of St. Lawrence and eastern Nova Scotia shore. Can. Field-Nat. 107:329-340.

Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES C.M. 8/Q. 10 pp.

Lesage, V. and M.O. Hammill. 2001. The status of the grey seal, *Halichoerus grypus*, in the Northwest Atlantic. Can. Field-Nat. 115(4):653-662.

Mansfield, A.W. 1966. The grey seal in eastern Canadian waters. Can. Audubon Mag. 28:161-166.

Mohn, R. and W.D. Bowen. 1996. Grey seal predation on the eastern Scotian Shelf: Modeling the impact on Atlantic cod. Can. J. Aquat. Sci. 53:2722-2738.

Read, A. J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int Whal. Commn (Special Issue) 15:-133-147.

Rough, V. 1995. Gray seals in Nantucket Sound, Massachusetts, winter and spring, 1994. Final report to Marine Mammal Commission, Contract T10155615, 28 pp. NTIS Pub. PB95-191391.

Stobo, W. T. and K.C.T. Zwanenburg. 1990. Grey seal (*Halichoerus grypus*) pup production on Sable Island and estimates of recent production in the northwest Atlantic. Pp. 171-184 *in:* W. D. Bowen (ed), Population biology of sealworm (*Pseudoterranova decipiens*) in relation to its intermediate and seal hosts. Can. Bull. Fish. and Aq. Sci. 222.

Trzcinski, M.K., R. Mohn, and W.D. Bowen. 2005. Estimation of grey seal population size and trends at Sable Island. Canadian Department of Fisheries and Oceans. Research Document 2005/067 Available at: http://www.dfo-mpo.gc.ca/csas/Csas/Publications/ResDocs-DocRech/2005/2005_067_e.htm 10 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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

Zwanenberg, K.C.T. and W.D. Bowen. 1990. Population trends of the grey seal (*Halichoerus grypus*) in eastern Canada. Pp. 185-197 *in*: W.D. Bowen (ed.), Population Biology of Sealworm (*Pseudoterranova decipiens*) in Relation to its Intermediate and Seal Hosts. Can. Bull. Fish. and Aq. Sci. 222.

~~April 2006~~~~January~~April 2007

HARP SEAL (~~*Phoca*~~ *Phagophilus groenlandica*):
Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988).~~); however, in recent years, numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona *et al.* 1993; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000, B. Rubinstein, pers. comm., New England Aquarium). 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).~~ The world's harp seal population is divided into three separate stocks, each identified with a specific breeding site (Bonner 1990; Lavigne and Kovacs 1988). The largest stock is located off eastern Canada and is divided into two breeding herds which breed on the pack ice. The Front herd breeds off the coast of Newfoundland and Labrador, and the Gulf herd breeds near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). The second stock breeds 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 ~~the Soviet Union~~Russia~~,~~. ~~and the third stock breeds on the West Ice off eastern Greenland (Lavigne and Kovacs 1988).~~ The Front/Gulf stock is equivalent to western North Atlantic stock.

Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between mid-February and April. Adults then assemble north of their whelping patches to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western North Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. There they split into two groups, one moving into the Gulf and the other remaining off the coast of Newfoundland. The southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring.

In recent years, numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona *et al.* 1993; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000, B. Rubinstein, pers. comm., New England Aquarium). 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).
~~The extreme southern limit of the harp seal's habitat extends into the U.S. Atlantic Exclusive Economic Zone (EEZ) during winter and spring. Support for the increase in numbers and geographic distribution of harp seals in New England to mid-Atlantic waters is based primarily on strandings, and secondarily on fishery bycatch (McAlpine and Walker 1990; Rubinstein 1994).~~

POPULATION SIZE

~~The total population size of harp seals is unknown; however, three seasonal a~~Abundance estimates for the western North Atlantic stock are available which use a variety of methods including aerial surveys and mark-recapture (Table 1). ~~Generally, t~~These methods ~~include~~ involve surveying the whelping concentrations and estimating total population adult numbers from ~~modeling~~ pup production. ~~Harp seal pup production in the 1950's was estimated at 645,000 decreasing to 225,000 by 1970 (Sergeant 1975). Estimates began to increase at that time and have continued to rise through the late 1990s, reaching 478,000 in 1979 (Bowen and Sergeant 1983; Bowen and Sergeant 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 (CV=0.06) indicates that the increase in pup production observed throughout the 1990s has likely stopped (Stenson *et al.* 2005).~~

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), ~~applied a harp seal estimation model to the 1990 pup production and obtained an estimate of 3.1 million (range 2.7-3.5 million;~~ Stenson (1993~~). Using a revised population model, 1994 pup count data, and two assumptions regarding pup mortality rates~~), Shelton *et al.* (1996), and ~~estimated pup production and total population size for the period 1955-1994. The 1994 total population estimate was 4.8 million (95% CI= 4.1-5.5 million) harp seals (~~Warren *et al.* (1997). The revised 2000 population estimate was 5.5 million (95% CE= 4.5-6.4 million)

harp seals (Healey and Stenson 2000; DFO 2005) (Table 1).

Table 1. Summary of abundance estimates ~~(pups and total)~~ for western North Atlantic harp seals. Year and area covered during each abundance survey, resulting abundance estimate (N_{best}) and confidence interval~~coefficient of variation~~ (~~CV~~CI).			
Month/Year	Area	N_{best}	~~CV~~ CI
~~1999~~	~~Eastern Atlantic Canada-Labrador~~	~~998,000 pups~~	~~+/- 2000,000 (95% CI)~~
2000	Front and Gulf~~Eastern Atlantic Canada-Labrador~~	5.5 million	(95% CI 4.5-6.4 million)
~~2004~~	~~Eastern Atlantic Canada-Labrador~~	~~991,000 pups~~	~~(95% CI 0.9-1.1 million)~~
2004	Front and Gulf~~Eastern Atlantic Canada-Labrador~~	5.9 million	(95% CI 4.6-7.2 million)

Minimum population estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic harp seals is 5.9 million (SE = 660,000)(DFO 2005). The minimum population estimate based on the 2004 pup survey results is 5.3 million seals. ~~Present d~~Data are insufficient to calculate the minimum population estimate for U.S. waters. ~~It is estimated there are at least (5.9 million ± 1.3 million) harp seals in Canada (DFO 2005).~~

Current population trend

Harp seal pup production in the 1950's 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; Bowen and Sergeant 1985), 577,900 (CV=0.07) in 1990 (Stenson *et al.* 1993), 708,400 (CV=0.10) in 1994 (Stenson *et al*. 2002), and 998,000 (CV=0.10) in 1999 (Stenson *et al.* 2003). The 2004 estimate of 991,000 pups (CV=0.06) suggests that the increase in pup production observed throughout the 1990s may have abated (Stenson *et al*. 2005).

The population appears to be increasing in U.S. waters, judging from the increased number of stranded harp seals, but the magnitude of the suspected increase is unknown. In Canada~~, since 1996 the population has been stable (5.9 million ± 1.3 million) due to large harvests of young animals in recent years (Healey and Stenson 2000; DFO 2005). T~~the 2004 pup production estimate suggests that the increase in pup production observed throughout the 1990s has likely stopped (Stenson *et al*. 2005).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. ~~The best data are based on Canadian studies. The mean age of sexual maturity was 5.8 yrs in the mid-1950s, declining to 4.1 yrs in the early 1980s then increased to 5.3 yrs by the early 1990s and peaked at 5.7 years by 1995 (Sjare *et al.* 1996; Sjare and Stenson 2000; Sjare *et al* 2004). In 2001 the mean age was approximately 5.3 years (Sjare *et al*. 2004).~~

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size in U.S. waters is unknown. The maximum productivity rate is 0.12, the default value for pinnipeds. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) was set at 1.0 because it was believed that harp seals are within OSP. PBR for the western North Atlantic harp seal in U.S. waters is unknown. Applying the formula to the minimum population estimate for Canadian waters results in a "PBR" of ~~354~~321,000 harp seals. However, Johnston *et al.* (2000) suggests that catch statistics from the Canadian hunt

are negatively biased due to under reporting; therefore, an F_R of 0.5 may be appropriate. Using the lower F_R results in a "PBR" of ~~177~~160,000 harp seals. The Canadian model predicts replacement yields between 522,000 and 541,000 (Healey and Stenson 2000). The Canadian model predicts replacement yields between 522,000 and 541,000 (Healey and Stenson 2000). However, the PBR for the stock in US waters is unknown.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2000~~2001-~~2004~~ 2005 the total estimated annual human caused mortality and serious injury to harp seals was ~~406,691~~447,447. ~~Estimated annual human caused mortality in US waters is 86,~~This is derived from ~~two~~ three components: 1) an average catch of 447,365 seals from 2001-2005 by Canada (Table 2a); 2) ~~81~~ 73 harp seals (CV=0.~~29~~27) from the observed U.S. fisheries (Table 2~~),~~); and ~~2~~3) ~~5~~ 9 from average ~~2000~~2001-~~2004~~ 2005 stranding mortalities resulting from human interactions (NMFS unpublished data) Harp seal harvests are summarized in the table below.

~~The remaining mortality is derived from five components: 1) 257,280 from the 2000-2004 average commercial catches of northwest Atlantic harp seals by Canada (92,055 in 2000, 226,493 in 2001, 312,367 in 2002, 289,512 in 2003, and 365,971 in 2004) (Hammill and Stenson 2003, DFO 2003, DFO 2005; Stenson unpublished data); 2) 79,408 average Greenland subsistence catch (101,941 in 2000, 89,617 in 2001, 69,895 in 2002, 68,499 in 2003, and 67,064 in 2004 (Anonymous 2003, DFO 2005; Stenson unpublished data)), 3) 566 average catches in the Canadian Arctic (280 in 2000, 405 in 2001, 715 per year in 2002-2004) (Hammill and Stenson 2003; Stenson unpublished data), 4) 11,541 average bycatches in the Newfoundland lumpfish fishery (11,323 in 2000, 19,400 in 2001, 9,329 in 2002, 5,367 in 2003, and 12,290 in 2004 (DFO 2005; Stenson unpublished data)), and 5) 57,810 from 2000-2004 average struck and lost animals (animals that are killed but not recovered) (58,873 in 2000, 61,618 in 2001 and 157,495 in 2002, 53,285 in 2003, and 57,776 in 2004) (DFO 2005; Stenson unpublished data). The struck and lost component can be further broken down into struck and lost from the commercial harvest (17,825 from 2000-2004: 7,762 in 2000, 16,607 in 2001, and 22,190 in 2002, 18,678 in 2003, and 23,887 in 2004), and struck and lost from the Canadian Arctic and Greenland harvests (39,985 average from 2000-2004: 51,111 in 2000, 45,011 in 2001, and 35,305 in 2002, 34,607 in 2003 and 33,889 in 2004) (DFO 2005; Stenson unpublished data). 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). 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).~~

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

Fishery	**2001**	**2002**	**2003**	**2004**	**2005**	**Average**
Commercial catches[a]	226,493	312,367	289,512	365,971	329,829	**304,834**
Commercial catch struck and lost[b]	16,607	22,190	18,678	23,887	23,071	**20,887**
Greenland subsistence catch[c]	89,617	69,895	68,499	67,064	68,486	**72,712**
Canadian Arctic[d]	405	715	715	715	715[d]	**653**
Greenland and Canadian Arctic struck and lost[e]	45,011	35,305	34,607	33,889	34,600[e]	**36,682**
Newfoundland lumpfish[f]	19,400	9,329	5,367	12,290	11,597[f]	**11,597**
Total	**397,533**	**449,801**	**417,378**	**503,816**	**468,298**	**447,365**

a. Hammill and Stenson 2003, DFO 2003, DFO 2005; 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. ~~Anonymous~~ICES 2003, DFO 2005; Stenson unpublished data; 2002-2004 average used for 2005.

d. Hammill and Stenson 2003; Stenson unpublished data; 2002-2004 average used for 2005.

e. The Canadian Arctic and Greenland struck and lost rate is calculated assuming the rate is 50% for all age classes (DFO 2001; Stenson unpublished data); 2002-2004 average used for 2005..

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

Fishery Information

U.S.

Detailed fishery information is reported in the Appendix III.

Northeast Sink Gillnet:

Annual estimates of harp seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. There were ~~137 19~~140 harp seal mortalities observed in the Northeast sink gillnet fishery between 1990 and ~~2004~~2005. The bycatch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. One observed winter mortality was in waters south of Cape Cod. The stratification design used for this species is the same as that for harbor porpoise (Bravington and Bisack 1996). ~~Annual estimates of harp seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort.~~ Estimated annual mortalities (CV in parentheses) from this fishery ~~during 2000~~2001 ~~2004~~ 2005 were: 81 (0.78) in 1999, 24 (1.57) in 2000, ~~24 in 2000 (1.57),~~ 26 (1.04) in 2001 ~~(1.04)~~, 0 during 2002-2003, ~~and~~ 303 (0.30) in 2004, and 35 (0.68) in 2005 (Table 2b). There were also ~~were 5,~~ 8, 2, 2, ~~and~~ 9, and 14 unidentified seals observed during ~~2000~~ 2001 through ~~2004~~ 2005 respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2000~~2001-~~2004~~ 2005 was ~~71~~ 73 harp seals (CV=0.~~29~~27) (Table 2b). ~~The stratification design used for this species is the same as that for harbor porpoise (Bravington and Bisack 1996). The bycatch occurred principally in winter (January-May) and was mainly in waters between Cape Ann and New Hampshire. One observed winter mortality was in waters south of Cape Cod.~~

Mid-Atlantic Gillnet:

No harp seals were taken in observed trips during 1993-1997, and 1999-~~2004~~2005. One harp seal was observed taken in 1998. Observed effort from 1993-2004 was scattered between New York and North Carolina from 1 to 50 miles off the beach. All bycatches were documented during January to April. Using the observed takes, the estimated annual mortality (CV in parentheses) attributed to this fishery was 0 in 1995-1997, 17 in 1998 (1.02) and 0 in 1999-~~2004~~2005. In 2002, 65% of observer coverage was concentrated in one area and not distributed proportionally across the fishery. Therefore observed mortality is considered unknown in 2002. Average annual estimated fishery-related mortality attributable to this fishery during ~~2000~~2001-~~2004~~ 2005 was zero harp seals.

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 needs, rather than marine mammal management needs. No~~ Four mortalities were observed in the northeast bottom trawl fishery between ~~1991~~2001-and ~~2000~~2005~~, one mortality was observed in 2001, and zero mortalities were observed in 2002-2004~~. ~~Observer coverage, expressed as number of trips, was < 1% from 1998 to 2001, 2% in 2002, almost 3% in 2003 and over 4% in 2004 (Table 2).~~ The estimated annual fishery-related mortality and serious injury attributable to this fishery (CV in parentheses) was 0 between 1991 and 2000, 49 (CV=1.10) in 2001, and 0 between 2002 and 2004. ~~Average annual estimated fishery-related mortality attributable to this fishery between 2000 and 2004 was 10 harp seals (CV=1.10) (Table 2).~~ Estimates have not been generated for 2005.

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality[c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality
Northeast Sink Gillnet	~~00-04~~01-05	~~301~~unk	Obs. Data Weighout, Logbooks	.06, .04, .02, .03, .06, .07	~~3,~~ 1, 0, 0, 15, 3	~~24,~~ 26, 0, 0, 303, 35	~~1.57,~~ 1.04, 0, 0, .30, .68	~~71~~ 73 (0.~~29~~27)

Northeast Bottom Trawl	~~00~~01-~~04~~ 05	~~TBD~~unk	Obs. Data Weighout	~~.004,~~ .~~004~~01~~,~~ , .~~021~~03, .~~028~~ 04 .~~045~~05, tbd	~~0,~~ 1, 0, 0, 0, 3	~~0,~~ 49, 0, 0, 0, unk	~~0,~~ 1. 10, 0, 0, 0, unk	~~10 (1.10)~~unk
TOTAL								~~81~~ 73 (0.~~29~~27)

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

b. The observer coverages for the Northeast sink gillnet fishery and the mid-Atlantic coastal sink gillnet fisheries are ~~measured in~~ratios based on tons of fish landed. North Atlantic bottom trawl fishery coverages ~~is measured~~are ratios based o~~i~~n 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 - ~~2004~~2005, respectively, 2, 1, 0, 0, 4, 0 takes were observed in nets with pingers. In 2000 – ~~2004~~2005, respectively, 1, 0, 0, 0, 11, 3 takes were observed in nets without pingers.

d. Bycatch estimates attributed to the Northeast bottom trawl fishery have not been generated.

Other Mortality

U.S.: ~~From 1988 to 1993 strandings each year were under 50, approaching 100 animals in 1994, and exceeding 100 animals in 1995-1996 (Rubinstein 1994; B. Rubinstein, New England Aquarium, pers. comm.).~~ ~~From 1999 to 2004, 1,482 strandings were recorded (116 in 1999, 145 in 2000, 495 in 2001, 188 in 2002, 101 in 2003, and 332 in 2004) in all states between Maine and North Carolina (NMFS unpublished data).~~ From 2001 to 2005, 860 harp seal stranding mortalities were reported (Table 3; NMFS unpublished data). Factors contributing to ~~a dramatic increase~~the high number of stranding mortalities ~~in strandings~~ in 2001 are unknown (Harris *et al.* 2002). ~~Twenty-three~~ Forty-five (~~1.6~~5.2%) of the ~~stranded animals~~mortalities during this five-~~-~~year period showed signs of human interaction (10 in 2001, 5 in 2002, 2 in 2003 2 in 2004, and 26 in 2005), with 6 having some sign of fishery interaction (4 in 2001and 6 in 2005). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of harp seal stranding in the Gulf of Maine is consistent with the species seasonal migratory patterns in this region. ~~as a direct cause of mortality.~~ ~~Mortalities caused by human interaction include boat strikes, fishing gear interactions, power plant entrainment, oil spills, harassment, and shooting.~~

~~The total number of harp seal strandings in 2004 was 332, of which 7 were healthy and did not require rehabilitation. Sixteen animals were rehabilitated and released. The remaining animals were either found dead or died in rehabilitation.~~

Table 3. Harp seal (*Phoca groenlandica*) stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004	2005	Total
ME	49	11	7	30	24	121
NH	4				3	7
MA	168	57	29	91	65	410
RI	28	8	3	9	9	57
CT	7	8	1	2	3	21
NY	62	22	11	25	48	168
NJ	15	7		7	24	53
DE	1		1	1	2	5
MD	5				3	8
VA	1	2		3	4	10
Total	**340**	**115**	**52**	**168**	**185**	**860**
Unspecified	37	35	27	33	19	151

seals (all states)					

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated

~~Table 3. Harp seal (*Phoca groenlandica*) reported along the U.S. Atlantic coast (2002-2004).~~

~~State~~	~~2002~~	~~2003~~	~~2004[a]~~	~~Total~~
~~Maine~~	~~35~~	~~21~~	~~112~~	~~168~~
~~New Hampshire~~	~~1~~	~~1~~	~~2~~	~~4~~
~~Massachusetts~~	~~67~~	~~31~~	~~104~~	~~202~~
~~Rhode Island~~	~~10~~	~~6~~	~~14~~	~~30~~
~~Connecticut~~	~~12~~	~~1~~	~~2~~	~~15~~
~~New York~~	~~48~~	~~28~~	~~66~~	~~142~~
~~New Jersey~~	~~13~~	~~9~~	~~22~~	~~44~~
~~Delaware~~	~~0~~	~~1~~	~~5~~	~~6~~
~~Maryland~~	~~0~~	~~1~~	~~0~~	~~1~~
~~Virginia~~	~~1~~	~~0~~	~~4~~	~~5~~
~~North Carolina~~	~~1~~	~~2~~	~~1~~	~~4~~
~~Total~~	~~188~~	~~101~~	~~332~~	~~621~~

~~a. During 2004, one harp seal had signs of human interaction as the cause of mortality.~~

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

STATUS OF STOCK

The status of the harp seal stock, relative to OSP, in the U.S. Atlantic EEZ is unknown, but the stock's abundance appears to have stabilized~~population appears not to be increasing in Canadian 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 ~~believed to be~~ very low relative to the ~~population~~ stock size ~~in Canadian waters~~ and can be considered insignificant and approaching zero mortality and serious injury rate. The level of human-caused mortality and serious injury in the U.S. Atlantic EEZ is ~~believed to be very~~also low relative to the total stock size; therefore, this is not a strategic stock.

REFERENCES CITED

~~Anonymous. 2003. Report of the ICES/NAFO Working Group on Harp and Hooded Seals. 2-6 September 2003, Arkhangelsk, Russia. ICES CM 2004/ACFM::06. 57 pp.~~

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bravington, M.V. and K.D. Bisack. 1996. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-93. Rep. int Whal. Commn. 46:567-574.

Bonner, W.N. 1990. The natural history of seals. Facts on File, New York, 196 pp.

Bowen, W.D. and D.E. Sergeant. 1983. Mark-recapture estimates of harp seal pup (*Phoca groenlandica*) production in the northwest Atlantic. Can. J. Fish. Aquat. Sci. 40:-728-742.

Bowen, W.D. and D.E. Sergeant. 1985. A mark-recapture estimate of 1983 harp seal pup production in the Northwest Atlantic. NAFO SCR. Doc. 85/I/1.

CAFSAC. 1992. Update on population estimates of Harp seal in the Northwest Atlantic. Canadian Atlantic Fisheries Scientific Advisory Committee, CAFSAC Adv. Doc. 92/8.

DFO [Dept. Of Fisheries and Oceans]. 2000. Northwest Atlantic harp seals. DFO Science Stock Status Report E1-01. Available at http://www.dfo-mpo.gc.ca/csas/Csas/status/2000/.

DFO [Dept. Of Fisheries and Oceans]. 2001. Report on the Eminent Panel on Seal Management. Available from Canadian Department of Fisheries and Oceans, Ottawa, Ontario, Canada, K1A 0E6, Communication Branch. 145pp.

DFO [Dept. Of Fisheries and Oceans]. 2003. Atlantic Seal Hunt: 2003-2005 management plan. Available from Canadian Department of Fisheries and Oceans, Ottawa, Ontario, Canada, K1A 0E6, Fisheries Resource Management – Atlantic. 34 pp. DFO [Dept. Of Fisheries and Oceans]. 2005. Stock assessment of Northwest Atlantic harp seals (Pagophilus groenlandicus). DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/037. Available at http://www.dfo-mpo.gc.ca/csas.

Hammill, M.O. and G.B. Stenson. 2003. Harvest simulations for 2003-2006 harp seal management plan. Can. Sci. Advisory Sec. Res. Doc. 2003/068.

Harris, D.E. and S. Gupta. 2006. GIS-based analysis of ice-breeding seal strandings in the Gulf of Maine. Northeast. Nat.13: 403-420.

Harris, D.E., B. Lelli, and G. Jakush. 2002. Harp seal records from the southern Gulf of Maine: 1997-2001. Northeast~~ern~~ Nat.~~uralist~~ 9(3):331-340.

Healey, B.P.~~,~~ and G.B. Stenson. 2000. Estimating pup production and population size of the northwest Atlantic harp seal (*Phoca groenlandica*). Can. Stock Assess. Sec. Res. Doc. 2000/081.

ICES. 2003. Report of the ICES/NAFO Working Group on Harp and Hooded Seals. 2-6 September 2003, Arkhangelsk, Russia. ICES CM 2004/ACFM:06. 57 pp.

Johnston, D.W., P. Meisenheimer, and D.M. Lavigne. 2000. An evaluation of management objectives for Canada's commercial harp seal hunt, 1996-1998. Conserv. Biol. 14:~~-~~729-737.

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

Lacoste, K.N. and G.B. Stenson. 2000. Winter distribution of harp seals (*Phoca groenlandica*) off eastern Newfoundland and southern Labrador. Polar Biol. 23:~~-~~805-811.

Lavigne, D.M. and K.M. Kovacs. 1988. Harps and Hoods Ice Breeding Seals of the Northwest Atlantic. University of Waterloo Press, Waterloo, Ontario, Canada, 174 pp.

McAlpine, D.F. 1999. Increase in extralimital occurrences of ice-breeding seals in the northern Gulf of Maine region: more seals or fewer fish. Mar. Mammal Sci.~~,~~ 15:~~-~~906-911.

McAlpine~~–~~, D.F. and R.H. Walker. 1990. Extralimital records of the harp seal, *Phoca groenlandica*, from the western North Atlantic: a review. Mar. Mammal Sci. 6:243-247.

Roff, D.A. and W.D. Bowen. 1983. Population dynamics and management of the Northwest Atlantic harp seal. Can. J. Fish. Aquat. Sci. 40: 919-932.

Ronald, K. and P.J. Healey. 1981. Harp Seal. Pages 55-87 *in:* S. H. Ridgway and R. J. Harrison (eds), Handbook of marine mammals, Vol. 2: Seals. Academic Press, New York, 359 pp.

~~Rubinstein, B. 1994. An apparent shift in distribution of ice seals, *Phoca groenlandica*, *Cystophora cristata*, and *Phoca hispida*, toward the east coast of the United States. M.A. Thesis, Boston University, Boston, MA, 45 pp.~~

Sergeant, D.E. 1965. Migrations of harp seal *Pagophilus groenlandicus* (Erxleben) in the Northwest Atlantic. J. Fish. Res. Bd. Can. 22:433-464.

Sergeant, D.E. 1975. Estimating numbers of harp seals. Rapp. P. -v. Reun. Cons. int Explor. Mer. 169: 274-280.

Shelton, P.A., N.G. Caddigan and G.B. Stenson. 1992. Model estimates of harp seal population trajectories in the Northwest Atlantic. CAFSAC Res. Doc. 92/89, 23 pp.

Shelton, P.A., G.B. Stenson, B. Sjare, and W.G. Warren. 1996. Model estimates of harp seal numbers-at-age for the Northwest Atlantic. NAFO Sci. Coun. Studies 26:1-14.

Sjare, B., G.B. Stenson, and B. Healy. 2004. Changes in the reproductive parameters of female harp seals (*Pagophilus groenlandicus*) in the Northwest Atlantic. (DFO Can. Sci. Advis. Sec. Res. Doc. 2005/049. Available at http://www.dfo-mpo.gc.ca/csas

Sjare, B., G.B. Stenson and W.G. Warren. 1996. Summary of female harp seal reproductive parameters in the Northwest Atlantic. NAFO Sci. Coun. Studies 26:41-46.

Sjare, B. and G.B. Stenson. 2000. Recent estimates of reproductive rates for harp seals in the Northwest Atlantic. Can. Stock Assess. Sec. Res. Doc. 2000/077.

Stenson, G.B. 1993. The status of pinnipeds in the Newfoundland region. NAFO SCR Doc. 93/34.

Stenson, G.B. and B. Sjare. 1997. Seasonal distribution of harp seals, *Phoca groenlandica*, in the Northwest Atlantic. ICES C.M. 1997/CC:10 (Biology and Behavior II). 23 pp.

Stenson, G.B., M.O. Hammill, J. Lawson, J.F. Gosselin, and T. Haug. 2005. 2004 pup production of harp seals, *Pagophilus groenlandicus*, in the Northwest Atlantic. Available at: http://www.dfo-mpo.gc.ca./csas/ . 34 pp

Stenson, G.B., L.P. Rivest, M.O. Hammill, J.F. Gosselin, and B. Sjare. 2003. Estimating pup production of harp seals, *Pagophilus groenlandicus*, in the Northwest Atlantic. Mar. Mammal. Sci. 19(1):141-160.

Stenson, G.B., M.O. Hammill, M.C.S. Kingsley, B. Sjare, W.G. Warren, and R.A. Myers. 2002. Is there evidence of increased pup productioon in northwest Atlantic harp seals, *Pagophilus groenlandicus*? ICES J. Mar. Sci. 59:81-92.

Stenson, G.B., R.A. Myers, M.O. Hammill, I-H. Ni, W.G. Warren, and M.S. Kingsley. 1993. Pup production of harp seals, *Phoca groenlandica*, in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 50:2429-2439.

Stevick, P.T. and T.W. Fernald. 1998. Increase in extralimital records of harp seals in Maine. Northeast. Nat. 5(1)75-82.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

Warren, W.G., P.A. Shelton, and G.B. Stenson. 1997. Quantifying some of the major sources of uncertainty associated with estimates of harp seal prey consumption. Part 1: Uncertainty in the estimates of harp seal population size. J. Northwest Atl. Fish. Sci., 22:289-302.

~~April 2006~~ April 2007

HOODED SEAL (*Cystophora cristata*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The hooded seal occurs throughout much of the North Atlantic and Arctic Oceans (King 1983) preferring deeper water and occurring farther offshore than harp seals (Sergeant 1976a; Campbell 1987; Lavigne and Kovacs 1988; Stenson *et al.* 1996). The world's hooded seal population has been divided by ICES into three separate stocks, each identified with a specific breeding site (Lavigne and Kovacs 1988; Stenson *et al.* 1996): Northwest Atlantic, Greenland Sea ("West Ice"), and White Sea ("East Ice"). The Western North Atlantic stock (synonymous with the ICES Northwest Atlantic stock), whelps off the coast of eastern Canada and is divided into three whelping areas. The Front herd (largest) breeds off the coast of Newfoundland and Labrador, Gulf herd breeds in the Gulf of St. Lawrence, and the third area is in the Davis Strait.

Hooded seals are highly migratory and~~Hooded seals~~ ~~tend to~~may wander ~~far out of their range and have been seen~~ as far south as Puerto Rico (Mignucci-Giannoni and Odell 2001), with increased occurrences from Maine to Florida. These appearances usually occur between January and May in New England waters, and in summer and autumn off the southeast U.S. coast and in the Caribbean (McAlpine *et al.* 1999; Harris *et al.* 2001; Mignucci-Giannoni and Odell 2001). Although it is not known which stock these seals come from, it is known that during spring, the northwest Atlantic stock of hooded seals are at their southernmost point of migration in the Gulf of St. Lawrence. ~~The world's hooded seal population is divided into three separate stocks, each identified with a specific breeding site (Lavigne and Kovacs 1988; Stenson *et al.* 1996). One stock, which whelps off the coast of eastern Canada, is divided into two breeding herds (Front and Gulf) which breed on the pack ice. The Front herd (largest) breeds off the coast of Newfoundland and Labrador and the Gulf herd breeds in the Gulf of St. Lawrence. The second stock breeds in the Davis Strait, and the third stock occurs on the West Ice off eastern Greenland.~~

~~Hooded seals are highly migratory.~~ Hooded seals remain on the Newfoundland continental shelf during winter/spring (Stenson *et al.* 1996). Breeding occurs at about the same time in March for each stock. Three of 4 hooded seals stranded, satellite tagged, and released in the United States in 2004 migrated to the eastern edge of the Scotian Shelf and the two that were monitored until June ended up on the southeast tip of Greenland. The fourth traveled into the Gulf of St. Lawrence. (WHALENET at http://whale.wheelock.edu). Adults from all stocks ~~then~~ assemble in the Denmark Strait to molt between late June and August (King 1983; ~~Anonymous~~ ICES 1995), and following this, the seals disperse widely. Some move south and west around the southern tip of Greenland, and then north along the west coast of Greenland. Others move to the east and north between Greenland and Svalbard during late summer and early fall (Lavigne and Kovacs 1988). Little else is known about the activities of hooded seals during the rest of the year until they assemble again in February for breeding.

POPULATION SIZE

The number of hooded seals in the western North Atlantic is relatively well known and is derived from pup production estimates produced from~~unknown. Seasonal abundance estimates are available based on a variety of analytical methods based on commercial catch data, and also from aerial surveys. These methods often include surveying the~~ whelping pack surveys. ~~concentrations and modeling the pup production.~~ Several estimates of pup production at the Front are available. Hooded seal pup production between 1966 and 1977 was estimated at 25,000 - 32,000 annually (Benjaminsen and Oritsland 1975; Sergeant 1976b; Lett 1977; Winters and Bergflodt 1978; Stenson *et al.* 1996). Estimated pup production dropped to 26,000 hooded seal pups in 1978 (Winters and Bergflodt 1978). Pup production estimates began to increase after 1978, reaching 62,~~000~~ 400 (95% CI. 43,700 - 89,400) by 1984 (Bowen *et al.* 1987, ~~Anonymous~~ICES 2006). Bowen *et al.* (1987) also estimated pup production in the Davis Strait at ~~18,600~~19,000 (95% C.I. 14,000 - 23,000). A 1985 survey at the Front (Hay *et al.* 1985) produced an estimate of 61,400 (95% C.I. 16,500 - 119,450). Hammill *et al.* (1992) estimated the Front pup production ~~-~~to be ~~82,000~~83,100 (SE=12,~~636~~700) in 1990. Assuming a ratio of pups to total population of 1:5, pup production in the Gulf and Front herds would represent a total population of approximately 400,000-450,000 hooded seals (Stenson 1993). Based on the 1990 survey, Stenson *et al.* (1996) suggested that pup production may have increased at about 5% per year since 1984. However, because of exchange between the Front and the Davis Strait stocks, the possibility of a stable or slightly declining level of pup production ~~is~~ was also likely (Stenson 1993; Stenson *et al.* 1996). In 1998 and 1999, surveys were conducted to estimate pup production in the southern Gulf of St. Lawrence, which is the smallest component of the northwest Atlantic stock (~~Anonymous~~ ICES 2001). The estimate of 2,000 was similar to the previous published 1990 estimate (Hammill *et al.* 1992; ~~Anonymous~~ ICES 2001). Surveys of all three whelping areas in the Northwest Atlantic were carried out in 2005. Pup production at the Front was estimated to be 107,013 (SE = 7,558, CV = 7.1%) while 6,620 (SE = 1,700, CV = 25.8%) pups were estimated to have been born in the Gulf and 3,346 (SE = 2,237, CV = 66.8%) in Davis Strait. Total pup production in the northwest Atlantic was 116,900 (SE = 7,918, CV = 6.8%). Fitting

pup production estimates from all herds and making assumptions about numbers of hooded seals in the Davis Strait herd for years when this area was not included in the survey program, results in an estimate of total population in 2005 of 592,100 (SE=94,800; 95% C.I.= 404,400-779,800).

~~Pup production surveys were conducted FrontGulf in March 2004, and Front, Gulf and in Davis Strait during 2005 (Anonymous 2006). Results of these surveys are presented below in Table 1. Pup production estimates from the Front were fit to a population model incorporating production since the 1980's, resulting in an estimate of 108,200 (SE=24,500). Using this number, total population was estimated at 537,100 (SE=122,500). Fitting to pup production estimates from all herds and making assumptions about the Davis Strait herd, for which estimates are not available for all years, results in pup production estimates of 119,800 (SE=19,200), and an estimated total population of 592,100 (SE=94,800) (Anonymous 2006).There are no current estimates of pup production for the Davis Strait or the Front breeding groups. The stock has not been surveyed since 1990, but a pup survey was conducted in March 2005 (Stenson pers. comm.).~~

~~Table 1. Summary of pup production estimates for the western North Atlantic hooded seal. Year and area covered during each abundance survey, resulting abundance estimate (N_{best}) and standard error (SE).~~

~~Year~~	~~Area~~	~~N_{best}~~	~~SE~~
~~2004~~	~~Front~~	~~124,000~~	~~18,600~~
~~2004~~	~~Gulf~~	~~1,400~~	~~300~~
~~2005~~	~~Front~~	~~107,000~~	~~7,600~~
~~2005~~	~~Gulf~~	~~6,600~~	~~1,700~~
~~2005~~	~~Davis Strait~~	~~3,300~~	~~2,200~~

Minimum population estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for western North Atlantic hooded seals is 592,100 (SE = 94,800). The minimum population estimate based on the 2005 pup survey results is 512,000. Present data are insufficient to calculate the minimum population estimate for U.S. waters. ~~Since there are no recent comprehensive pup production counts it is not possible to assess current population size (Anonymous 2001). Recent Canadian surveys have resulted in minimum population estimates of 436,900 for the 'Front Only" population and 511,600 for 'All Areas' populations (Anonymous 2006).~~

Current population trend

Comparison with previous estimates suggests that pup production (and total population size) may have increased since the mid 1980s but the considerable uncertainty about the relationship among whelping areas makes it difficult to reliably assess the population trend..~~There are no current data to assess the status of the population in either Canadian or U.S. waters. Pup production is estimated to have increased since the mid 1980s. However, the lack of understanding of the relationship between whelping areas makes it hard to confidently quantify trends in population growth. (Anonymous 2006).~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. The most appropriate data are based on Canadian studies~~. The most recent comprehensive pup production survey (1990) is nearly 13 years old, which exceeds the GAMMS (Wade and Angliss 1997) criterion (e.g., >8 years) for reliable abundance data.~~

~~For purposes of this assessment~~, which assume~~,~~ the maximum net productivity rate ~~was assumed~~ to be 0.12 (Anonymous 2006). This value is based on theoretical modeling showing that pinniped populations may not grow at rates much greater than 12% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

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

512,000~~unknown~~. The maximum productivity rate is 0.12, the default value for pinnipeds. The recovery factor (F_R) for this stock is ~~0.5, the value for stocks with unknown population status~~ set at 0.75, the value for populations which are thought to be increasing. PBR for the western North Atlantic hooded seal stock is 15,360 but for~~in~~ U.S. waters is unknown. The Joint NAFO/ICES Harp and Hooded Seal Working Group applied the PBR formula to Canadian population estimates to obtain a harvest reference level of 19,650 and 23,025 hooded seals from the Front Only and All Areas, respectively (~~Anonymous,~~ICES 2006).

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

For the period ~~2000~~2001-~~2004~~2005, the total estimated human caused mortality and serious injury to hooded seals was ~~6,~~ 4,818~~139~~. This is derived from two components: 1) an average catch of 5,173~~6,114~~ seals from ~~2000~~2001-~~2004~~ 2005 (~~2000 = 5,988;~~ 2001= ~~6,414~~3,960; 2002 = ~~6,056~~[1] 7,341; 2003 = ~~6,056~~[1]~~,~~5,446, ~~and~~ 2004 = ~~6,056~~[1] 5,270, and 2005 = 3,846) average catches of Northwest Atlantic population of hooded seals by Canada and Greenland (~~Anonymous~~ICES 2006); and 2) 25 hooded seals (CV=0.82) from the observed U.S. fisheries (Table 1). Note that there is considerable intermixing between the Northwest Atlantic and West Ice stocks, so it is possible that Northwest Atlantic seals are taken by Greenland sealers.

Fishery Information

Detailed fishery information is reported in Appendix III.

U.S.

Northeast Sink Gillnet

The fishery has been observed in the Gulf of Maine and in southern New England. There were 2 hooded seal mortalities observed in the Northeast sink gillnet fishery between 1990 and ~~2004~~2005. The bycatch in 2001 occurred in summer (July-September). All bycatch was in waters between Cape Ann and New Hampshire. Annual estimates of hooded seal bycatch in the Northeast sink gillnet fishery reflect seasonal distribution of the species and of fishing effort. The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). Estimated annual mortalities (CV in parentheses) from this fishery during 1990-2003 were 0 in 1990-1994, 28 in 1995 (0.96), 0 in 1996-2000, 82 in 2001 (1.14), 0 in 2002-2003, ~~and~~ 43 (0.95) in 2004, and 0 in 2005. The 1995 bycatch includes 5 animals from the estimated number of unknown seals (based on observed mortalities of seals that could not be identified to species). The unknown seals were prorated, based on spatial/temporal patterns of bycatch of harbor seals, gray seals, harp seals, and hooded seals. There were ~~5,~~ 8, 2, 2, ~~and~~ 9, and 14 unidentified seals observed during ~~2000~~2001-~~2004~~2005, respectively. Since 1997, unidentified seals have not been prorated to a species. This is consistent with the treatment of other unidentified mammals that do not get prorated to a specific species. Average annual estimated fishery-related mortality and serious injury to this stock attributable to this fishery during ~~2000~~2001-~~2004~~ 2005 was 25 hooded seals (CV=0.82) (Table 1). ~~The stratification design used is the same as that for harbor porpoise (Bravington and Bisack 1996). The bycatch in 2001 occurred in summer (July-September). All bycatch was in waters between Cape Ann and New Hampshire.~~

CANADA

An unknown number of hooded seals have been taken in Newfoundland and Labrador groundfish gillnets (Read 1994).

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

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

Fishery	Years	Vessels	Data Type [a]	Observer Coverage [b]	Observed Mortality [c]	Estimated Mortality	Estimated CVs	Mean Annual Mortality

[1] ~~2000-2001 average Greenland catches~~

Northeast Sink Gillnet	~~00~~01-~~04~~ 05	~~301~~ unk	Obs. Data, Weighout, Logbooks	~~.06,~~ .04, 02, .03, .06~~-~~, ~~?~~.07	~~0,~~ 1, 0, 0, 1, 0	~~0,~~ 82, 0, 0, 43, 0	~~0,~~ 1.14, 0, 0, .95, 0	25 (0.82)
TOTAL								25 (0.82)

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

[b] The observer coverages for the Northeast sink gillnet fishery are ratios based on tons of fish landed.

[c] Only mortalities observed on marine mammal trips were used to estimate total hooded seal bycatch. See Bisack (1997) for "trip" type definitions. The one hooded seal mortality observed in 2001 was taken in a net equipped with pingers. The one hooded seal mortality observed in 2004 was taken in a net not equipped with pingers.

Other Mortality

In Atlantic Canada, hooded seals have been commercially hunted at the Front since the late 1800's. In 1974 total allowable catch (TAC) was set at 15,000, and reduced to 12,000 in 1983 and to 2,340 in 1984 (Stenson 1993; Anonymous 1998). From 1991 to 1992 the TAC was increased to 15,000. A TAC of 8,000 was set for 1993, and held at that level through 1997. From 1974 through 1982, the average catch was 12,800 animals, mainly pups. Since 1983 catches ranged from 33 in 1986 to 6,425 in 1991, with a mean catch of 1,001 between 1983 and 1995. ~~In~~ Catches peaked in 1996 (25,754) ~~catches~~ due to ~~(25,754) were more than three times the allowable quota (Anonymous 1998). The high catch was attributable to~~ good ice conditions and strong market demand (ICES 1998).~~.~~ Since 1996 catches have fallen markedly and during 2000-2004 averaged 170 animals per year (ICES 2006). ~~The TAC has remained at 10,000 since 1998 but catches have been very low (e.g., 10 (2000), 140 (2001), 150 (2002) and 151 (2003); DFO 2001; Anonymous 2003; Stenson, unpublished data). Greenland catches remained below 5,000 during the period 1954-1975, but increased to 5,000-7,000 and 6,300-9,900, respectively, during the periods 1976-1992 and 1993-1998 (Anonymous 2001).~~ A series of management regulations have been implemented for the Canadian harvest since 1960. For example, the taking of bluecoats was prohibited in 1993 and the TAC has been set at 10,000 seals per year since 1998 (ICES 2006~~hunting in the Gulf of St. Lawrence (below 50˚N) has been prohibited since 1965, no commercial hunting of hooded seals is permitted in the Davis Strait, and in 2000, the taking of bluebacks was prohibited (Anonymous 2001, DFO 2001~~).

In 1988-1993, strandings were fewer than 20 per year, and from 1994 to 1996 they increased to about 50 per year (Rubinstein 1994; Rubinstein, pers. comm.) From ~~2000~~ 2001 to ~~2004~~2005, 142 ~~207~~ hooded seal stranding mortalities~~s~~ were reported ~~(2000=30, 2001=86, 2002=30, 2003=20, and 2004=41),~~ in most states from Maine to ~~Virginia~~ North Carolina (Table ~~2~~3; NMFS unpublished data). ~~Three~~ Six (~~1.5~~4.2%) of the ~~seals stranded~~mortalities during this five year period showed signs of human -interaction ~~as a direct cause of mortality, (1 in 1999, (1~~ 2 in ~~2000~~2001, ~~and~~ -1 in ~~2003~~2004 and 3 in 2005), with 2 having some indication of fishery interaction (1 in 2004 and 1 in 2005). Extralimital strandings have also been reported off the southeast U.S., North Carolina to Florida, and in the Caribbean (McAlpine *et al.* 1999; Mignucci-Giannoni and Odell 2001; NMFS, unpublished data). Harris and Gupta (2006) analyzed NMFS 1996-2002 stranding data and suggest that the distribution of hooded seal stranding in the Gulf of Maine is consistent with the species seasonal migratory patterns in this region.

Table 3. Hooded seal (*Cystophora cristata*)stranding mortalities along the U.S. Atlantic coast (2001-2005)[a].

State	2001	2002	2003	2004[a]	2005[b]	Total
ME	21	8	5	6	8	48
NH	-	1	1	1	1	4
MA	22	8	3	9	11	53
RI	2	-	-	-	-	2

CT	1	-	-	-	-	1
NY	10	1	-	1	1	13
NJ	5	1	1	1	1	9
DE	1	1	-	2	-	4
MD	-	-	-	1	-	1
VA	1	-	-	-	1	2
NC	5	-	-	-	-	5
Total	68	20	10	21	23	142
Unspecified seals (all states)	37	35	27	33	19	151

a. Some of the data reported in this table differ from that reported in previous years. We have reviewed the records and made an effort to standardize reporting. Live releases and rehabbed animals have been eliminated

~~Table 2. Hooded seal (*Cystophora cristata*) reported strandings along the U.S. Atlantic coast (2002-2004).~~

~~State~~	~~2002~~	~~2003~~	~~2004~~[a]	~~Total~~
~~Maine~~	~~14~~	~~10~~	~~15~~	~~39~~
~~New Hampshire~~	~~1~~	~~1~~	~~2~~	~~4~~
~~Massachusetts~~	~~10~~	~~4~~	~~13~~	~~27~~
~~Rhode Island~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Connecticut~~	~~0~~	~~0~~	~~0~~	~~0~~
~~New York~~	~~2~~	~~2~~	~~5~~	~~9~~
~~New Jersey~~	~~2~~	~~2~~	~~2~~	~~6~~
~~Delaware~~	~~1~~	~~1~~	~~3~~	~~5~~
~~Maryland~~	~~0~~	~~0~~	~~1~~	~~1~~
~~Virginia~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Total~~	~~30~~	~~20~~	~~41~~	~~91~~

~~a. During 2004, the Northeast region had 37 seal strandings where species could not be determined.~~

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

STATUS OF STOCK

The status of hooded seals relative to OSP in U.S. Atlantic EEZ is unknown, but the stock's abundance~~population~~ appears to be increasing~~ in Canada~~. ~~They~~ The species ~~are~~ 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 ~~believed to be~~ very low relative to the ~~population~~ stock's size~~ in Canadian waters~~ and can be considered insignificant and approaching zero mortality and serious injury rate. ~~This is not a strategic stock because t~~ Because the level of human-caused mortality and serious injury is also low relative to overall stock size, this is not a strategic stock.
~~he level of human-caused mortality and serious injury is believed to be very low relative to overall stock size.~~

REFERENCES CITED

~~Anonymous. 1995. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 5-9 June 1995, Dartmouth, Nova Scotia Canada. NAFO SCS Doc. 95/16. Serial No. N2569. 40 pp.~~

~~Anonymous. 1998. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 28 August - 3 September 1997, Copenhagen, Denmark. ICES CM 1998/Assess:3. 35 pp.~~

~~Anonymous. 2001. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 2-6 October 2000, Copenhagen, Denmark. ICES CM 2001/ACFM:08. 40 pp.~~

~~Anonymous 2003. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 2-6 September 2003, Arkhanglesk, Russia. ICES CM 2004/ACFM:06 53 pp. 6:32 32Available at: http://www.ices.dk/reports/ACFM/2006/WGHARP/WGHARP06.pdf~~

Barlow, J., S.L. Swartz, T.C. Eagle, and P.R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background, and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Benjaminsen, T., and T. Oritsland. 1975. The survival of year-classes and estimates of production and sustainable yield of northwest Atlantic harp seals. Int. Comm. Northwest Atl. Fish. Res. Doc. 75/121.

Bowen, W.D., R.A. Myers, and K. Hay. 1987. Abundance estimation of a dispersed, dynamic population: Hooded seals (*Cystophora cristata*) in the Northwest Atlantic. Can. J. Fish. Aquat. Sci. 44:-282-295.

Bravington, M.V. and K.D. Bisack. 1996. Estimates of harbor porpoise bycatch in the Gulf of Maine sink gillnet fishery, 1990-93. Rep. int. Whal. Commn. 46:567-574.

Campbell, R.R. 1987. Status of the hooded seal, *Cystophora cristata*, in Canada. Can. Field.-Nat. 101:253-265.

DFO [Dept. of Fisheries and Oceans]. 2001. Atlantic Seal Hunt: 2001 management plan. Available from Canadian Department of Fisheries and Oceans, Ottawa, Ontario Canada, K1A OE6, Resource Management - Atlantic. 34 pp.

Hammill, M.O., G.B. Stenson, and R.A. Myers. 1992. Hooded seal (*Cystophora cristata*) pup production in the Gulf of St. Lawrence. Can. J. Fish. Aquat. Sci. 49:2546-2550.

Harris, D.E. and S. Gupta. 2006. GIS-based analysis of ice-breeding seal strandings in the Gulf of Maine. Northeast. Nat.13:403-420.

Harris, D.E., B. Lelli, G. Jakush, and G. Early. 2001. Hooded seal (*Cystophora cristata*) records from the southern Gulf of Maine. Northeast. Nat. 8:427-434.

Hay, K., G.B. Stenson, D. Wakeham, and R.A. Myers. 1985. Estimation of pup production of hooded seals (*Cystophora cristata*) at Newfoundland during March 1985. Can. Atl. Fish. Sci. Adv. Comm. 85/96.

ICES. 1995. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 5-9 June 1995, Dartmouth, Nova Scotia Canada. NAFO SCS Doc. 95/16. Serial No. N2569. 40 pp.

ICES. 1998. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 28 August - 3 September 1997, Copenhagen, Denmark. ICES CM 1998/Assess:3. 35 pp.

ICES. 2001. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 2-6 October 2000, Copenhagen, Denmark. ICES CM 2001/ACFM:08. 40 pp.

ICES. 2006. Report of the Joint ICES/NAFO Working Group on Harp and Hooded Seals. 12-16 June 2006, Copenhagen, Denmark. ICES CM 2006/ACFM:32 28 pp.
Available at: http://www.ices.dk/reports/ACFM/2006/WGHARP/WGHARP06.pdf

King, J.E. 1983. Seals of the World. Cornell University Press, Ithaca, NY, 240 pp.

Lavigne, D.M. and K.M. Kovacs. 1988. Harps and Hoods Ice Breeding Seals of the Northwest Atlantic. University of Waterloo Press, Waterloo, Ontario, Canada, 174 pp.

Lett, P.F. 1977. A model to determine stock size and management options for the Newfoundland hooded seal stock. Can. Atl. Fish. Sci. Adv. Comm. Res. Doc. 77/25.

Mignucci-Giannoni, A.A. and D.K. Odell. 2001. Tropical and subtropical records of hooded seals (*Cystophora cristata*) dispel the myth of extant Caribbean monk seals (*Monachus tropicalis*). Carib. Bull. Mar. Sci., 68:47-58.

McAlpine, D.F., P.T. Stevick, L.D. Murison, and S.D. Turnbull. 1999. Extralimital records of hooded seals (*Cystophora Cristata*) from the Bay of Fundy and northern Gulf of Maine. Northeastern Naturalist 6: 225-230.

Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. int. Whal. Commn (Special Issue) 15:133-147.

Rubinstein, B. 1994. An apparent shift in distribution of ice seals, *Phoca groenlandica*, *Cystophora cristata*, and *Phoca hispida*, toward the east coast of the United States. M.A. Thesis, Boston University, Boston, MA, 45 pp.

Sergeant, D.E. 1976a. History and present status of populations of harp and hooded seals. Biol. Conserv. 10:95-117.

Sergeant, D.E. 1976b. Research on hooded seals *Cystophora cristata* Erxleben in 1976. ICNAF Res. Doc. 76/X/126.

Stenson, G.B. 1993. The status of pinnipeds in the Newfoundland region. NAFO SCR Doc. 93/34.

Stenson, G.B., R.A. Myers, I-H. Ni and W.G. Warren. 1996. Pup production of hooded seals (*Cystophora cristata*) in the Northwest Atlantic. NAFO Sci. Coun. Studies 26:105-114.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, 93 pp. Available at: http://nmml.afsc.noaa.gov/library/gammsrep/gammsrep.htm.

Winters, G. H. and B. Bergflodt. 1978. Mortality and productivity of the Newfoundland hooded seal stock. ICNAF Res. Doc. 78/XI/91.

APPENDIX I. Estimated serious injury and mortality (SI&M) of Western North Atlantic marine mammals listed by U.S. observed fisheries for ~~2000~~2001-~~2004~~2005. Marine mammal species with zero (0) observed SI&M during ~~2000~~ 2001 to ~~2004~~ 2005 are not shown in this table.

(tbd = to be determined; n/a = not available; unk = unknown;JV = Joint Venture; TALFF = Total Allowable Level of Foreign Fishing; ~~SNE = Southern New England~~).

Category, Fishery (estimated # of vessels/persons), Species	Yrs. observed	% observer coverage	Est. SI by Year (CV)	Est. Mortality by Year (CV)	Mean Annual Mortality (CV)	PBR
CATEGORY I						
Gillnet Fisheries: Northeast ~~sink~~ gillnet (unk)						
Harbor porpoise - after Take Reduction Plan	~~2000~~2001-~~2004~~2005	~~.06,~~ .04, .02, .03,.06, .07		~~507 (.37),~~ 53(.97), 444 (.37), 592 (.33), 654(.36), 630(.23)	~~450~~ 475 (~~.18~~16)	~~747~~532 610
White sided dolphin	~~2000~~2001-~~2004~~2005	~~.06,~~ .04, .02, .03, .06, .07		~~69 (.70),~~ 26 (1.0), 26 (1.0), 30 (.74), 31 (.93), 14(.69), 59(.49)	~~24 (.43)~~	~~379~~509
Common dolphin	~~2000~~2001-~~2004~~2005	~~.06,~~ .04, .02, .03, .06, .07		~~146 (.97),~~ 0, 0, 0, 0, 26	5 (.8)~~29 (.97)~~	1,000
Risso's dolphin	~~2000~~2001-~~2004~~2005	~~.06,~~ .04, .02, .03, .06, .07		~~15(1.06),~~ 0, 0, 0, 0, 15 (.93)	3(~~1.06~~.93)	~~124~~129
Bottlenose dolphin (offshore)	~~1998~~2001-~~2002~~2005	~~.05, .06, .06,~~ .04, .02, .03, .06, .07		~~0, 0,132 (1.16),~~ 0, 0, 0, unk, unk	~~26~~ unk ~~(1.16)~~	~~714~~566
Harbor seal	2001-2005~~2000-2004~~	~~.06,~~ .04, .02, .03, .06, .07		~~917(.43),~~ 1,471 (.38), 787 (.32), 542 (.28), 792(.34), 719(.20)	~~902 (.18)~~862(.16)	5,493
Gray seal	2001-2005~~2000-2004~~	~~.06,~~ .04, .02, .03, .06, .07		~~193(.55),~~ 117(.59), 0(0), 242 (.47), 504(.34), 574(.44)	~~211 (.23)~~287(.23)	n/a
Harp seal	2001-2005~~2000-2004~~	~~.06,~~ .04, .02, .03, .06, .07		~~24(1.57),~~ 26(1.04), 0, 0, 303(.30), 35(.68)	~~71~~ 73 (~~.29~~27)	n/a
Hooded seal	2001-2005~~2000-2004~~	~~.06,~~ .04, .02, .03, .06, .07		~~0,~~ 82(1.14), 0, 0, 43(.95), 0	25(.82)	n/a
Gillnet Fisheries:US Mid-Atlantic gillnet (~~<655~~unk)						
Harbor porpoise - after Take Reduction Plan	~~2000~~2001-~~2004~~2005	~~.02,~~ .02, .01, .01, .02, .03		~~21 (.76),~~ 26 (.95), unk, 76 (1.13), 137(.91), 470(.23)	~~65 (.49)~~177(.40)	~~747~~610
Bottlenose dolphin (offshore)	~~1998-2002~~2001-2005	.02, .01, .01, .02, .03~~.05, .02, .02, .02, .01~~		~~4 (.70),~~unk, ~~-~~0, 0, ~~n/a~~unk, ~~n/a~~unk	~~1 (.70)~~unk	~~714~~566
[f]Bottlenose dolphin Southern NC	2001-2005~~1998-2002~~	~~.01, .03, .03, .02, <.01~~.02, <.01, 0, 0, 0	0, 0, unk, unk, unk	0, 0, unk, unk, unk~~0, 0, 0, 0, 0~~	~~0~~unk	~~9.9~~7.9
[f]Bottlenose dolphin Northern NC	2001-	.02, <.01, .01, .02,	0, 0, 0, 0, 0	~~17(.61), 13(.61), 26(.61),~~ 8(1.06), 8(1.06), 8(1.06),	~~14~~9(.~~33~~41)	20

	2005~~1998-2002~~	.01~~,01, .03, .03, .02, <.01~~		7(.82), 12(.82)		
[f]Bottlenose dolphin Northern migratory	2001-2005~~1998-2002~~	~~.02, .03, .03,~~ .02, .01, .03, .03, .05	0, 0, 0, 0, 0	~~37(.48), 19(.48), 30(.48),~~ 11(.35), 11(.35), 17(.35), 14(.35), 20(.35)	~~22~~15(.~~23~~16)	~~146~~73.1
[f]Bottlenose dolphin NC mixed	2001-2005~~1998-2002~~	~~.02, .02, .02,~~ .01, .01, .02, .03, .03	0, 0, 0, 0, 0	~~175(.46), 196(.46), 146(.46),~~ 67(.45), 50(.45), 23(.40), 30(.40), 18(.40)	~~127(.23)~~37(.22)	68
Harbor seal	2001-2005~~2000-2004~~	~~.02,~~ .02, .01, .01, .02, .03		~~0,~~ 0, unk, 0, 15(.86), 63(.67)	~~4~~ 20 (.~~86~~57)	5,493
Gray seal	2000-2004	~~.02,~~ .02, .01, .01, .02, .03		~~0,~~ 0, unk, 0, 69(.92), 0	17 (.92)	n/a
Longline Fisheries: Pelagic longline (excluding NED-E)[a]						
Risso's dolphin	2001-2005~~2000-2004~~	~~.04,~~ .04, .05, .09, .09, .06	~~23(1.0),~~ 45(.7), 8(1.0), 40(.63), 28(~~tbd~~.72), 3(1.0)	~~41 (1.0),~~ 24(1.0), 20(.86), 0, 0, 0	~~46~~ 34 (.~~37~~32)	~~124~~129
Long and short-finned pilot whale	2001-2005~~2000-2004~~	~~.04,~~ .04, .05, .09, .09, .06	~~109(1.0),~~ 50(.58), 52(.48), 21(.49), 74(.42), 212(.21)	~~24 (1.0),~~ 20 (1.0), 2 (1.0), 0, 0, 0	~~70 (.37)~~86 (.16)	249
Pygmy sperm whale[b]	2001-2005~~1999-2003~~	~~.~~ 04, .05, .09, .09, .06~~04, .04, .02, .04, .02~~	~~0,~~ 28(1.0), 0, 0, 0, 0	0, 0, 0, 0, 0	6(1.0)	3.7
Unidentified beaked whale	2001-2005	04, .05, .09, .09, .06	0, 0, 5.3(1.0), 0, 0	0, 0, 0, 0, 0	1(1.0)	22
Longline Fisheries: Pelagic longline (NED-E area only)[c]						
Risso's dolphin	2001-2003	1.0, 1.0, 1.0	4 (0), 3 (0), 0	0, 0, 1 (0)	3 (0)	~~124~~129
Mid-Atlantic Mid-Water Trawl – Including Pair Trawl ~~(Herring and Mackerel only)~~						
White-sided dolphin	2001-2005~~2000-2004~~	~~.08, 0, .008, .04, .12~~0, .003, .018, .064, .084	0, 0, 0, 0, 0	~~0~~unk, ~~0~~unk, ~~9.4~~51(.~~55~~.46), ~~73~~105(.~~55~~538), ~~31~~97(.~~55~~.76)	~~23~~84(.~~39~~34)	~~364~~509
Long and short-finned pilot whale	2001-2005	0, .003, .018, .064, .084	0, 0, 0, 0, 0	unk, unk, 3.9(.46), 8.1(.38), 7.5(.76)	7(.34)	249
CATEGORY II						
Trawl Fisheries:Gulf of Maine/Georges Bank herring mid-water trawl - JV and TALFF[d]						
Long and short-finned pilot whale (JV and TALFF)	2001	1.00[e]		11 (n/a)	11 (n/a)	249
White-sided dolphin (TALFF)	2001	1.00		2 (0)	2 (0)	509~~379~~
Trawl Fisheries:Northeast bottom trawl ~~[f]~~(unk)						

Harp seals	2001-2005~~2000-2004~~	~~.01,~~ .01, .03, .04, .05, .12		~~0,~~ 49(1.10), 0, 0, 0, unk	~~10 (1.10)~~unk	n/a
Harbor seals	2001-2005~~2000-2004~~	~~.01,~~ .01, .03, .04, .05, .12		~~0,~~ 0, unk, 0, 0, unk	unk	5,493
Long and short-finned pilot whale [g]	~~2000~~2001-~~2004~~2005	~~.01,~~ .01, .03, .04, .05, .12	0, 0, 0, 0, 0	21(.27), 22(.26), 21(.26), 15.29(.50), 15(.30)~~unk~~	19 (0.12)~~unk~~	249
Common Dolphin [g]	2001-2005	.01, .03, .04, .05, .12	0, 0, 0, 0, 0	30(.30), 26(.29), 26(.29), 26(.29), 32(.28)	28 (.13)	1,000
White-sided dolphin [g]	~~2000~~2001-~~2004~~2005	~~.01,~~ .01, .03, .04, .05, .12		161(.34), 170(.32), 216(.27), 200(.30), 213(.28)~~unk~~	192 (0.13)~~unk~~	~~379~~509
Minke whale	2001-2005~~2000-2004~~	~~.01,~~ .01, .03, .04, .05, .12		unk	unk	~~26~~19
Harbor Porpoise	2001-2005	.01, .03, .04, .05, .12		0.0.unk,0,~~0~~unk	unk	610
Mid-Atlantic Bottom ~~Trawl~~[g]Trawl						
White-sided dolphin [g]	~~2000~~2001-~~2004~~2005	.01, .01, .01, .~~01~~03, .03		27(.19), 25(.17), 31(.25), 26(.20), 38(.29)~~unk~~	~~unk~~29 (.11)	~~unk~~509
Long and short-finned pilot whale [g]	~~2000~~2001-~~2004~~2005	.01, .01, .01, .~~01~~03, .03	~~2~~0, 0, 0, 0, 0	39(.31), 38(.36), 31(.31), 35(.33), 31(.31)~~unk~~	38(.15)~~unk~~	249
Common Dolphin	2001-2005	.01, .01, .01, .03, .03	0, 0, 0, 0, 0	103(.27), 87(.27), 99(.28), 159(.30), 141(.29)	118 (.13)	1,000
Northeast Mid-Water Trawl Including Pair Trawl ~~(Herring and Mackerel only)~~						
Long and short-finned pilot whale	2001-2005~~2000-2004~~	~~.005,~~ .001, 0, .031, .~~14~~126, .199	0, 0, 0, 0,0	~~4.6(.74), 11(.74)~~unk, unk, ~~8.9~~1.9(.~~74~~56), ~~14~~1.4(.~~74~~58), ~~5.8~~1.1(.~~74~~68)	~~8.9~~1(.35)	249
White-sided dolphin	2001-2005~~2000-2004~~	.001, 0, .031, .126, .199~~.005, .001, 0, .03, .14~~	0, 0, 0,0 ,0	~~4.5((.74), 8.9(.74), 14(.44), 2.0(.74), 0.5(.5)~~unk, unk, 24(.56), 19(.58), 15(.58)	~~6.0~~19(.~~33~~35)	509~~379~~
Gillnet Fisheries:SE U.S. Atlantic shark gillnet (12)						
Bottlenose dolphin (coastal)	2001-2005~~2000-2004~~	C. Florida~~.15,~~ .42, .25, .09, .19, .26		~~2(1.0),~~ 4(0), 7(1.0), 13(.81), 0, 0	5(.~~49~~53)	n/a

NOTES: The estimated number of vessels/participants is expressed in terms of the number of active participants in the fishery, when possible. If this information is not available, the estimated number of vessels or persons licensed for a particular fishery is provided. Beginning with the 2001 Stock Assessment Report, Canadian records were incorporated into the mortality and serious injury rates to reflect the effective range of this stock.

a. ~~2000 mortality estimates were taken from Table 10 in Yeung (2001).~~

b. ~~Pygmy Sperm Whales - Twenty-eight seriously injured pygmy sperm whales were reported in 2000 in the pelagic longline fishery. The 2000 mortality estimates were taken from Table 10 in~~

~~Yeung 2001 (NMFS Miami Laboratory PRD 00/01-17). There have been no observed mortalities or serious injuries by NMFS Sea Samplers in the pelagic drift gillnet, pelagic longline, pelagic pair trawl, Northeast sink gillnet, mid-Atlantic gillnet, or Northeast bottom trawl fisheries.~~

~~c~~a. An experimental program to test effects of gear characteristics, environmental factors, and fishing practices on marine turtle bycatch rates in the Northeast Distant (NED-E) water component of the fishery was conducted from June 1, 2001 - December 31, 2003. Observer coverage was 100% during this experimental fishery. Summaries are provided for the pelagic longline EXCLUDING the NED-E area in one row and for ONLY the NED in the second row (Garrison, 2003; Garrison and Richard, 2004).

~~D~~b. During joint venture fishing operations, nets that are transferred from the domestic vessel to the foreign vessels for processing are observed on board the foreign vessel. There may be nets fished by domestic vessels that do not get transferred to a foreign vessel for processing and therefore would not be observed. During TALFF fishing operations all nets fished by the foreign vessel are observed.

~~e~~c. Ten vessels (3 foreign, 7 American) participated in the 2001 joint venture (JV) fishing operations and 2 of the foreign vessels participated in the 2001 Total Allowable Level of Foreign Fishing (TALFF) operations. Nets that are transferred from domestic to foreign vessels (JV) for processing are observed on board the foreign vessel. There may be nets fished by domestic vessels that do not get transferred to the foreign vessels and would therefore not be observed. During TALFF fishing operations, all the nets fished by a foreign fishing vessel are observed.

~~f~~d. Coastal Bottlenose Dolphins -These are “management units” of the coastal morphotype of bottlenose dolphin along the U.S. Atlantic coast. Annual estimated mortality/serious injury and PBR are by management unit.

~~g~~e. A new method was used to develop preliminary estimates of mortality for the Mid-Atlantic and Northeast trawl fisheries for pilot whales, common dolphin and white-sided dolphin during 2000-2005. They are a product of bycatch rates predicted by covariates in a model framework and effort reported by commercial fishermen on mandatory vessel logbooks. This method differs from the previous method used to estimate mortality in these fisheries prior to 2000. Therefore, the estimates reported prior to 2000 can not be compared to estimates during 2000-2004. ~~Mortality estimation attributed to the Northeast and mid-Atlantic bottom trawl fishery is in progress.~~

Appendix II. Summary of the confirmed human-caused mortality and serious injury ("SI")[a] events involving baleen whales along the Gulf of Mexico coast, U.S. East coast and adjacent Canadian Maritimes, ~~2000~~ 2001 - ~~2004~~2005, with number of events attributed to entanglements or vessel collisions by year.

Stock	Mean annual mortality and SI rate (and PBR)	Entanglements			Vessel Collisions		
		Annual rate (US waters / Canadian waters / other waters)	Confirmed mortalities (~~2000,~~ 2001, 2002, 2003, 2004, 2005)	Confirmed SI's (~~2000,~~ 2001, 2002, 2003, 2004, 2005)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (~~2000,~~ 2001, 2002, 2003, 2004, 2005)	Confirmed SI's
Northern right whale	**~~2.8~~3.2** (0)	**~~1.6~~1.4** (0.~~6~~ 4 / 1.0/ 0)	**3** (~~0,~~ 1, 1, 0, 1, 0)	**~~5~~ 4** (~~1,~~ 1, 2, 1, 0, 0)	**~~1.2~~1.8** (1.~~0~~6/ 0.2)	**~~6~~ 8** (~~0,~~ 2, 1, 1, 2, 2)	**~~0~~1 (0, 0, 0, 0, 1)**
Gulf of Maine humpback whale[b]	**~~3.0~~4.2** (1.~~3~~1)	**2.~~4~~ 8**(~~1.8~~ 2.4/ 0.~~6~~ 4 / 0)	**~~5~~ 8** (~~0, 1~~3, ~~2~~3, 1, 1, 0)	**~~8~~6** (~~3,~~ 0, 1, ~~3~~4, 1, 0)	**~~0.6~~1.4** (~~0.6~~1.4 / 0)	**~~3~~ 7** (~~0, 2~~3, ~~1~~2, ~~0~~1, ~~0~~1, 0)	**0**
Western North Atlantic fin whale[c]	**~~1.8~~2.4** (4.~~7~~0)	**0.8** (0.~~4~~ 6 / 0.~~2~~ / 0.2)	**3** (~~0,~~ 1, 1, 0, 1, 0)	**1**(~~0,~~ 0, 0, 0, 1, 0)	**1.~~0~~ 6** (~~.8~~1.2 / ~~.2~~0.4)	**~~5~~ 8** (~~1,~~ 2, 0, 0, 2, 4)	**0**
Nova Scotian sei whale[d]	**0.4** ~~(–)~~(0.3)	**0**	**0**	**0**	**0.4** (0.4 / 0)	**2** (~~0,~~ 1, 0, 1, 0, 0)	**0**
Western North Atlantic blue whale[d]	**0** (–)	**0**	**0**	**0**	**0**	**0**	**0**
Canadian East Coast minke whale	**2.~~8~~[e] 6**[e] (~~26~~19)	**2.~~6~~2**[e] (2.~~6~~[e] 2[e] / 0 / 0)	**~~12~~ 11** (~~1,~~ 2, 2, 5, 2, 0)	**~~1~~ (1, 0, 0, 0, 0)0**	**0.~~2~~4**	**~~1~~ 2** (~~0,~~ 0, 0, 0, 1, 1)	**0**
Western North Atlantic Brydes whale	**0.2** (0.3)	**0.2** (0.2 / 0 / 0)	**1** (~~0,~~ 0, 0, 1, 0, 0)	**0**	**0**	**0**	**0**

a. It is 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. Several factors must 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. For the purposes of this report, discussion is primarily limited to those records considered confirmed human-caused mortalities or serious injuries.
b. Includes only events involving confirmed members of the Gulf of Maine feeding stock.
c. Includes an entanglement mortality found off Bermuda in 2001.
d. Stock abundance estimates outdated; no PBR established ~~for these stocks~~.
e. Plus a pending bycatch estimate from the Northeast bottom trawl fishery.

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 is published in the Federal Register, vol. 71, No. 162, 2006. Each part of this appendix contains three sections: I) data sources used to document marine mammal mortality/entanglements and commercial fishing effort trip locations, II) fishery descriptions for Category I, II and III fisheries that have documented interactions with marine mammals and their historical level of observer coverage, and III) historical fishery descriptions.

Part A. Description of U.S Atlantic Commercial Fisheries

I. Data Sources

Items 1-5 describe sources of marine mammal mortality, serious injury or entanglement data; items 6-8 describe the sources of commercial fishing effort data used to summarize different components of each fishery (i.e. active number of permit holders, total effort, temporal and spatial distribution) and generate maps depicting the location and amount of fishing effort.

1. Northeast Region Fisheries Observer Program

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 (NEFOB) 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 Drift Gillnet Observer Program that observes the U.S. Southeast 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. They also sample other types of shark gillnet gear. The third program is the Southeastern Shrimp Otter Trawl Fishery Observer Program. This is a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program is funding and project dependent, therefore observer coverage is not necessarily randomly allocated across the fishery. The total level of observer coverage for this program is <<1% of the total fishery effort. In each Observer Program, the observers record information on the total target species catch, the number and type of interactions with protected species (including both marine mammals and sea turtles), and biological information on species caught.

3. Regional Marine Mammal Stranding Networks

The Northeast and Southeast Region Stranding Networks are components of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and

coordinate effective responses to unusual mortality events (Becker, *et al.* 1994). Since 1997, the Northeast Region Marine Mammal Stranding Network has been collecting and storing data on marine mammal strandings and entanglements that occur between the states of Maine and Virginia. The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the Atlantic coast from North Carolina to Florida, along the U.S. Gulf of Mexico coast from Florida through Texas, and in the U.S. Virgin Islands and Puerto Rico. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement, collect data on stranded animals that include: species; event date and location; details of the event (i.e., signs of human interaction) and determination on cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

4. Marine Mammal Authorization Program

Commercial fishing vessels engaging in Category I or II fisheries are required to register under the Marine Mammal Authorization Program (MMAP) in order to lawfully capture a marine mammal incidental to fishing operations. All vessel owners, regardless of the category of fishery they are operating in, are required to report all incidental injuries and mortalities of marine mammals that have occurred as a result of fishing operations (NMFS-OPR, 2003). Events are reported by fishermen on Mortality/Injury forms then submitted to and maintained by the NMFS Office of Protected Resources. The data reported include: captain and vessel demographics; gear type and target species; date, time and location of event; type of interaction; animal species; mortality or injury code; and number of interactions.

5. Other Data Sources for Protected Species Interactions/Entanglements/Ship Strikes

In addition to the above, data on fishery interactions/entanglements and vessel collisions with large cetaceans are reported from a variety of other sources including the New England Aquarium (Boston, MA); Provincetown Center for Coastal Studies (Provincetown, MA); U.S. Coast Guard; whale watch vessels; and Canadian Department of Fisheries and Oceans (DFO). These data, photographs, etc. are maintained by the Protected Species Branch at the Northeast Fisheries Science Center (NEFSC) and the SEFSC.

6. Northeast Region Vessel Trip Reports

The Northeast Region Vessel Trip Report Data Collection System is a mandatory, but self-reported, commercial fishing effort database (Wigley, *et al.* 1998). The data collected include: species kept and discarded; gear types used; trip location; trip departure and landing dates; port; and vessel and gear characteristics. The reporting of these data is mandatory only for vessels fishing under a federal permit. Vessels fishing under a federal permit are required to report in the Vessel Trip Report even when they are fishing within state waters.

7. Southeast Region Fisheries Logbook System

The Fisheries Logbook System (FLS) is maintained at the SEFSC and manages data submitted from mandatory Fishing Vessel Logbook Programs under several FMPs. In 1986 a comprehensive logbook program was initiated for the Large Pelagics Longline Fishery and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

8. Northeast Region Dealer Reported Data

The Northeast Region Dealer Database houses trip level fishery statistics on fish species landed by market category, vessel ID, permit number, port location and date of landing, and gear type utilized. The data are collected by both federally permitted seafood dealers and NMFS port agents. Data are considered to represent a census of both vessels actively fishing with a federal permit and total fish landings. It also includes vessels that fish with a state permit (excluding the state of North Carolina) that land a federally managed species. Some states submit the same trip level data to the Northeast Region, but contrary to the data submitted by federally permitted seafood dealers, the trip level data reported by individual states does not include unique vessel and permit information. Therefore, the estimated number of active permit holders reported within this appendix should be considered a minimum estimate. It is

important to note that dealers were previously required to report weekly in a dealer call in system. However, in recent years the NER regional dealer reporting system has instituted a daily electronic reporting system. Although the initial reports generate from this new system did experience some initial reporting problems, these problems have been addressed and the new daily electronic reporting system is providing better real time information to managers.

II. U.S Atlantic Commercial Fisheries

Northeast Sink Gillnet (text includes descriptions of Northeast anchored float and Northeast drift gillnets)

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Windowpane Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, and Skate spp.

Number of Permit Holders: Approximately 2,850 state and Federal permit holders~~To Be Determined~~

Number of Active Permit Holders: ~~In 2002 there were 361active federal permits reported in the Northeast Region (ME-CT) Dealer Reported~~To be determined. ~~Landings Database.~~

Total Effort: Total metric tons of fish landed from 1998 to ~~2004~~ 2005 were 22,933, 18,681, 14,487, 14, 634, 15,201, 17,680~~and~~, 19,080, and 15.390 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. ~~Total days absent from port, or days at sea, are yet to be determined. Figures documenting approximate gillnet trip locations are not yet available.~~

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 ~~2000~~ 2001 to ~~2004~~ 2005 respectively.

Gear Characteristics: The Northeast Sink Gillnet Fishery is dominated by a bottom-tending (sink) net. Less than 1% of the fishery utilizes a ~~drift~~ gillnet that ~~(~~either is anchored floating or drift (i.e. Northeast anchored float and Northeast drift gillnet fisheries). Monofilament twine is the dominant material used with stretched mesh sizes ranging from 6 to 12 inches. String lengths range from 600 to 10,500 feet long. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Northeast Sink Gillnet Fishery has been defined as a category I fishery, and both the Northeast anchored float and Northeast drift gillnet fisheries as category II fisheries, in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). This gear is managed by several federal and state FMPs that range North and East of the 72 degree 30 min line. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648); Monkfish (FR 68(81), 50 CFR Part 648); Spiny Dogfish (FR 65(7), 50 CFR Part 648); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648); Atlantic Bluefish (FR 68(91), 50 CFR Part 648); and Northeast Skate Complex (FR 68(160), 50 CFR part 648). 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 1990-2004, estimated observer coverage (number of trips observed/total commercial trips reported) was 1%, 6%, 7%, 5%, 7%, 5%, 4%, 6%, 5%, 6%, 6%, 4%, 2%, 3%, ~~and~~ 6%, and 7% respectively.

Comments: Effort patterns in this fishery are heavily influenced by pinger requirements, marine mammal time/area closures, fish time/area closures, and gear restrictions due to fish conservation measures, the ALWTRP, and the Harbor

Porpoise Take Reduction Plan (HPTRP).

Protected Species Interactions: Documented interaction with Harbor Porpoise, White-sided Dolphin, Harbor Seal, Gray Seal, Harp Seal, Hooded Seal, Long-finned Pilot Whale, Offshore Bottlenose Dolphin, Risso's Dolphin, and Common Dolphin. Not mentioned here are possible interactions with sea turtles and sea birds.

Bay of Fundy Sink Gillnet

Target Species: Atlantic cod and other groundfish.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: To Be Determined

Total Effort: To Be Determined

Temporal and Spatial Distribution: In Canadian waters the Gillnet Fishery occurs during the summer and early autumn months mostly in the western portion of the Bay of Fundy.

Gear Characteristics: Typical gillnet strings are 300 m long (three 100 m panels), 4 m deep, with stretched mesh size of 15 cm, strand diameter of 0.57-0.60mm, and are usually set at a depth of about 100 m for 24 hours.

Management and Regulations: To Be Determined

Observer Coverage: During the period 1994 to 2001, the estimated observer coverage of the Grand Manan portion of the sink gillnet fishery was 0.49, 0.89, 0.8, 0.8, 0.24, 0.11, 0.41, and 0.56. The fishery was not observed during 2002 and 2003. There is a proposal to observe the fishery during 2004.

Comments: Marine mammals in Canadian waters are regulated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). DFO Maritimes Region has developed a Harbour Porpoise Conservation Strategy that has set a maximum take of 110 Harbor Porpoise per year in the Bay of Fundy. Bycatch mitigation measures include acoustic pingers and nylon barium-sulphate netting that target cetacean and sea bird bycatch reduction goals, and fishery effort restrictions that target fish management goals.

Protected Species Interactions: Documented interactions with Harbor Porpoise and sea birds.

Mid-Atlantic Gillnet

Target Species: Monkfish, Spiny and Smooth Dogfish, Bluefish, Weakfish, Menhaden, Spot, Croaker, Striped Bass, Coastal Sharks, Spanish Mackerel, King Mackerel, American Shad, Black Drum, and Skate spp.

Number of Permit Holders: Approximately 7,000 state and Federal permit holders.~~To Be Determined~~

Number of Active Permit Holders: To Be Determined.

Total Effort: Total metric tons of fish landed from 1998 to ~~2004~~ 2005 were 15,494, 19,130, 16,333, 14,855, 13,389, 13,~~107and~~ 107, 15,124, and 12, 994 respectively (NMFS). Data on total quantity of gear fished (i.e. number of sets) have not been reported consistently among commercial gillnet fishermen on vessel logbooks, therefore will not be reported here. During 1998 it was estimated that 302 full- and part-time sink gillnet vessels and an undetermined number of drift gillnet vessels participated in this fishery. This is the number of unique vessels in the Commercial Landings Database (Weighout) that reported catch from this fishery during 1998 from the states of Connecticut to North Carolina. This does not include a small percentage of records where the vessel number was missing. Figures documenting approximate gillnet trip locations are not yet available.

Temporal and Spatial Distribution: This fishery operates year-round, extending from New York to North Carolina. It's comprised of a combination of small vessels that target a variety of fish species. This fishery can be prosecuted right off

the beach (6 feet) or in nearshore coastal waters to offshore waters (250 feet). Figures 6-10 document the distribution of sets and marine mammal interactions observed from ~~2000~~ 2001 to ~~2004~~ 2005 respectively.

Gear Characteristics: The Mid-Atlantic Gillnet Fishery utilizes both drift and sink gillnets. These nets are most frequently attached to the bottom, although unanchored drift or sink nets are also utilized to target specific species. Monofilament twine is the dominant material used with stretched mesh sizes ranging from 2.5 to 12 inches. String lengths range from 150 to 8400 feet long. The mesh size and string length vary by the primary fish species targeted for catch.

Management and Regulations: The Mid-Atlantic Gillnet Fishery has been defined as a Category I fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229. This gear is managed by several federal FMPs and Inter-State Fishery Management Plans (ISFMP's) managed by the Atlantic States Marine Fisheries Commission (ASMFC). This fishery ranges South and East of the 72 degree 30 min. line. The relevant FMPs include, but may not be limited to: Atlantic Bluefish (FR 68(91), 50 CFR Part 648); Weakfish (FR 68(191), 50 CFR 697); Shad and River Herring (ASMFC ISFMP 2002); Striped Bass (FR68(202), 50 CFR part 697); Spanish Mackerel (FR 65(92), 50 CFR 622); Monkfish (FR 68(81), 50 CFR Part 648); Spiny Dogfish (FR 65(7), 50 CFR Part 648); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648); Northeast Skate Complex (FR 68(160), 50 CFR part 648); 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-~~2004~~2005, the estimated observer coverage was 5%, 4%, 3%, 5%, 2%, 2%, 2%, 1%, 1%, ~~and~~ 2% and 3% respectively.

Comments: Effort patterns in this fishery are heavily influenced by marine mammal time/area closures, gear restrictions due to fish conservation measures, the ALWTRP, and the HPTRP and Bottlenose Dolphin Take Reduction Plan (BDTRP).

Protected Species Interactions: Documented interaction with Harbor Porpoise, White-sided Dolphin, Harbor Seal, Gray Seal, Harp Seal, Coastal Bottlenose Dolphin, Offshore Bottlenose Dolphin, Common Dolphin, and Long-Finned and Short-Finned Pilot Whale. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Bottom Trawl

Target Species: Include, but are not limited to: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny and Smooth Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, Scup, Black Sea Bass, Skate spp, Atlantic Mackerel, *Loligo* Squid, *Illex* Squid, and Atlantic Butterfish.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: To Be Determined

Mixed Groundfish Bottom Trawl Total Effort: Total effort, measured in trips, for the Mixed Groundfish Trawl from 1998 to 2004 was 27,521, 26,525, 24,362, 27,890, 28,103, 25,725 and 22,303, respectively (NMFS). The number of days absent from port, or days at sea, is yet to be determined. Figures documenting approximate trawl trip locations are not yet available.

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 2004 were 373, 278, 262, 102, 175, 310, 238, and 231, respectively (NMFS). Total effort, measured in trips, for the *Illex* Squid Fishery from 1998 to 2004 were 412, 141, 108, 51, 39, 103, and 445, respectively (NMFS). Total effort, measured in trips, for the *Loligo* Squid Fishery from 1998 to 2004 were 1,048, 495, 529, 413, 3,585, 1,848, and 1,124, 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. Figures documenting approximate trawl trip locations are not yet available.

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 2000 to 2004 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 100m isobath), mainly by small-mesh otter trawlers, when the Squid are distributed in continental shelf and slope waters during the summer months (June-September) (Clark 1998).

***Loligo* Squid**

The U.S. domestic fishery for *Loligo* Squid (*Loligo pealeii*) occurs mainly in Southern New England and mid-Atlantic waters. Fishery patterns reflect *Loligo* seasonal distribution, therefore most effort is directed offshore near the edge of the continental shelf during the fall and winter months (October-March) and inshore during the spring and summer months (April-September) (Clark 1998).

Atlantic Mackerel

The U.S. domestic fishery for Atlantic Mackerel (*Scomber scombrus*) occurs primarily in the Southern New England and mid-Atlantic waters between the months of January and May (Clark 1998). An Atlantic Mackerel Trawl Fishery also occurs in the Gulf of Maine during the summer and fall months (May-December) (Clark 1998).

Atlantic Butterfish

Atlantic Butterfish (*Peprilus triacanthus*) undergo a northerly inshore migration during the summer months, a southerly offshore migration during the winter months, and are mainly caught as bycatch to the directed Squid and Mackerel Fisheries. Fishery Observers suggest that a significant amount of Atlantic Butterfish discarding occurs at sea.

Gear Characteristics: The Mixed Groundfish Bottom Trawl Fishery gear characteristics have not yet been determined or summarized. The *Illex* and *Loligo* Squid Fisheries are dominated by small-mesh otter trawls, but substantial landings of *Loligo* Squid are also taken by inshore pound nets and fish traps during the spring and summer months (Clark 1998). The Atlantic Mackerel Fishery is prosecuted by both mid-water (pelagic) and bottom trawls.

Management and Regulations: The Mid-Atlantic Bottom Trawl Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). There are at least 2 distinct components to this fishery. One is the mixed groundfish bottom trawl fishery. It is managed by several federal and state FMPs that range from Massachusetts to North Carolina. The relevant FMPs include, but may not be limited to, Monkfish (FR 68(81), 50 CFR Part 648); Spiny Dogfish (FR 65(7), 50 CFR Part 648); Summer Flounder, Scup, and Black Sea Bass (FR 68(1), 50 CFR part 648); and Northeast Skate Complex (FR 68(160), 50 CFR part 648). The second major component is the squid, mackerel, butterfish fishery. This component is managed by the federal Squid, Mackerel, Butterfish FMP. The *Illex* and *Loligo* Squid Fisheries are managed by moratorium permits, gear and area restrictions, quotas, and trip limits. The Atlantic Mackerel and Atlantic Butterfish Fisheries are managed by an annual quota system.

Observer Coverage: During the period 1996-2004, estimated observer coverage (measured in trips) for the Mixed Groundfish Bottom Trawl Fishery was 0.24%, 0.22%, 0.15%, 0.14%,1%, 1%, 1%, 1%, and 3%, respectively.

During the period 1996-2004, estimated observer coverage (trips) in the *Illex* Fishery was 3.7%, 6.21%, 0.97%, 2.84%, 11.11%, 0.00%, 0.00%, 8.74% and 5.07%, respectively. During the period 1996-2004, estimated observer coverage (trips) of the *Loligo* Fishery was 0.37%, 1.07%, 0.72%, 0.69%, 0.61%, 0.95%, 0.42%, 0.65% and 5.07%, respectively. During the period 1997-2004, estimated observer coverage (trips) of the domestic Atlantic Mackerel Fishery was 0.81%, 0.00%, 1.14%, 4.90%, 3.43%, 0.97%, 5.04% and 18.61%, respectively. Mandatory 100% observer coverage is required on any Joint Venture (JV) fishing operation. The most recent Atlantic Mackerel JV fishing activity occurred in 1998 and 2002 where 152 and 62 transfers from USA vessels were observed respectively. Only the net transfer operations from the USA vessel to the foreign processing vessel are observed. The actual net towing and hauling operations conducted on the USA vessel are not observed.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of scup. The GRAs are spread out in time and space along the edge of the Southern New England and Mid-Atlantic Continental Shelf Region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic

Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. Access to the GRAs to harvest non-exempt species (*Loligo* Squid, Black Sea Bass, and Silver Hake) can be granted by a special permit. For detailed information regarding GRAs refer to (FR 70(2), (50 CFR Part 648.122 parts A and B)).

Protected Species Interactions: Documented interaction with White-sided Dolphin, Common Dolphin, Long-finned Pilot Whale, Short-finned Pilot Whale, Harbor Seal, Gray Seal, and Harp Seal. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Bottom Trawl

Target Species: Atlantic Cod, Haddock, Pollock, Yellowtail Flounder, Winter Flounder, Witch Flounder, American Plaice, Atlantic Halibut, Redfish, Windowpane Flounder, Summer Flounder, Spiny Dogfish, Monkfish, Silver Hake, Red Hake, White Hake, Ocean Pout, and Skate spp.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: In 2002 there were 803 active federal permits reported in the Northeast Region Dealer Reported Landings Database.

Total Effort: Total effort, measured in trips, for the North Atlantic Bottom Trawl Fishery from 1998 to 2004 was 13,263, 10,795, 12,625, 12,384, 12,711, 11,577 and 10,354, respectively (NMFS). An average mean of 970 (CV=0.04) vessels (full- and part time) participated annually in the fishery during 1989-1993. The number of days absent from port, or days at sea, is yet to be determined. Figures documenting approximate trawl trip locations are not yet available.

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 2000 to 2004 respectively .

Gear Characteristics: To Be Determined

Management and Regulations: The North Atlantic Bottom Trawl Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). This gear is managed by several federal and state FMPs that range from Maine to Connecticut. The relevant FMPs include, but may not be limited to: the Northeast Multi-species (FR 67, CFR Part 648); Monkfish (FR 68(81), 50 CFR Part 648); Spiny Dogfish (FR 65(7), 50 CFR Part 648); Summer Flounder, Scup and Black Sea Bass (FR 68(1), 50 CFR part 648); Atlantic Bluefish (FR 68(91), 50 CFR Part 648); and Northeast Skate Complex (FR 68(160), 50 CFR part 648). These fisheries are primarily managed by TACs; individual trip limits (i.e., quotas); effort caps (i.e., limited number of days at sea per vessel); time and area closures; and gear restrictions.

Observer Coverage: During the period 1994-2004, estimated observer coverage (measured in trips) was 0.4%, 1.1%, 0.2%, 0.2%, 0.1%, 0.3%, 1%, 1%, 3%, 4%, and 5%, respectively.

Vessels in the Northeast bottom Trawl Fishery, a Category II fishery under the MMPA, were observed in order to meet fishery management needs rather than monitoring for bycatch of marine mammals.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: Documented interaction with White-sided Dolphin, Common Dolphin, Harbor Seal, and Harp Seal. Not mentioned here are possible interactions with sea turtles and sea birds.

Northeast Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Herring and miscellaneous pelagic species.

Gear Characteristics: Historically, the Atlantic Herring resource was harvested by the Distant Water Fleet (DWF) until the fishery collapsed in the late 1970's. There has been no DWF since then. A domestic fleet has been harvesting the Atlantic Herring resource utilizing both fixed and mobile gears. Only a small percentage of the resource is currently harvested by fixed gear due to a combination of reduced availability and less use of fixed gear (Clark 1998). The majority of the resource is currently harvested by domestic mid-water (pelagic) trawls (single and paired).

Management and Regulations: The Northeast Mid-Water Trawl Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229). Atlantic herring are managed jointly by the MAFMC and ASMFC as one migratory stock complex. There has been a domestic resurgence in a directed fishery on the adult stock due to the recovery of the adult stock biomass.

Temporal and Spatial Distribution: The current fishery occurs during the summer months when the resource is distributed throughout the Gulf of Maine and Georges Bank regions. The stock continues on a southerly migration into mid-Atlantic waters during the winter months. Figures 21-25 document the distribution of tows and marine mammal interactions observed from 2000 to 2004 respectively.

Total Effort: Total effort, measured in trips, for the Northeast Mid-Water Trawl Fishery (across all gear types) from 1997 to 2004 was578, 289, 553, 1,312, 2,404, 1,736, 2,158, and 1,564, respectively (NMFS).

Observer Coverage: During the period 1997-2004, estimated observer coverage (trips) was 0.00%, 0.00%, 0.73%, 0.46%, 0.06%, 0.00% , 2.25% and 11.48%, respectively. A U.S. JV Mid-Water (pelagic) Trawl Fishery was conducted on Georges Bank from August to December 2001. A total allowable landings of foreign fishery (TALFF) was also granted during the same time period. Ten vessels (3 foreign and 7 American), fishing both single and paired mid-water trawls, participated in the 2001 Atlantic Herring JV Fishery. Two out of the three foreign vessels also participated in the 2001 TALFF and fished with paired mid-water trawls. The NMFS maintained 74% observer coverage (243 hauls) on the JV transfers and 100% observer coverage (114 hauls) on the foreign vessels granted a TALFF.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B)

Protected Species Interactions: Documented interaction with White-sided Dolphin and Long-finned Pilot Whale. There were no marine mammal takes observed from the domestic Mid-Water Trawl Fishery trips during the period 1997-2002. Not mentioned here are possible interactions with sea turtles and sea birds.

Mid-Atlantic Mid-Water Trawl Fishery (includes pair trawls)

Target Species: Atlantic Mackerel, Chub Mackerel and other miscellaneous pelagic species.

Gear Characteristics: To be determined.

Management and Regulations: The Mid-Atlantic Mid-Water Trawl Fishery has been defined as a Category I fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

Temporal and Spatial Distribution: To be determined. Figures 26-30 document the distribution of tows and marine mammal interactions observed from 2000 to 2004 respectively.

Total Effort:. Total effort, measured in trips, for the mid-Atlantic Mid-Water Trawl Fishery (across all gear types) from

1997 to 2004 was 331, 223, 374, 166, 408, 261, 428, and 360, respectively (NMFS).

Observer Coverage:. During the period 1997-2004, estimated observer coverage (trips) was 0.00%, 0.00%, 1.01%, 8.43%, 0.00%, 0.77% , 3.5% and 12.16%, respectively.

Comments: Mobile Gear Restricted Areas (GRAs) were put in place for fishery management purposes in November 2000. The intent of the GRAs is to reduce bycatch of Scup. The GRAs are spread out in time and space along the edge of the Southern New England and mid-Atlantic continental shelf region (between 100 and 1000 meters). These seasonal closures are targeted at trawl gear with small-mesh sizes (<4.5 inches inside mesh measurement). The Atlantic Herring and Atlantic Mackerel Trawl Fisheries are exempt from the GRAs. For detailed information regarding GRAs refer to (50 CFR Part 648.122 parts A and B).

Protected Species Interactions: . Documented interaction with White sided dolphins and Pilot Whale spp. Not mentioned here are possible interactions with sea turtles and sea birds.

Bay of Fundy Herring Weir

Target Species: Atlantic Herring

Number of Permit Holders: According to Canadian DFO officials, for 1998 there were 225 licenses for herring weirs on the New Brunswick and Nova Scotia sides of the Bay of Fundy (60 from Grand Manan Island, 95 from Deer and Campobello Islands, 30 from Passamaquoddy Bay, 35 from the East Charlotte area, and 5 from the Saint John area). The number of licenses has been fairly consistent since 1985 (Ed Trippel, pers. comm.)

Number of Active Permit Holders: In 2002 around Grand Manan Island, the only area surveyed for active weirs, there were 22 active weirs. In 2003 the number of active weirs included: 20 around Grand Manan Island, 9 around the Wolves Islands, 10 around Campobello Island, 2 at Deer Island, and 43 in Passamaquoddy Bay and the western Bay of Fundy. The numbers in the eastern Bay of Fundy are unknown, but some do exist.

Total Effort: Effort is difficult to measure. Weirs may or may not have twine (i.e., be actively fishing) on them in a given year and the amount of time the twine is up varies from year to year. Most weirs tend to fish (i.e., have twine on them) during July, August, and September. Some fishermen keep their twine on longer, into October and November, if it is a good year or there haven't been any storms providing incentive to take the twine down. Effort cannot simply be measured by multiplying the number of weirs with twine times the average number of fishing days (this will provide a very generous estimation of effort) because if a weir fills up with fish the fisherman will pull up the drop (close the net at the mouth) which prevents loss of fish, but also means no new fish can get in, therefore the weir is not actively fishing during that period.

Temporal and Spatial Distribution: In Canadian waters, the Herring Weir Fishery occurs from May to October along the southwestern shore of the Bay of Fundy, and is scattered along the coasts of western Nova Scotia.

Gear Characteristics: Weirs are large, heart-shaped structures (roughly 100 feet across) consisting of long wooden stakes (50-80 feet) pounded 3-6 feet into the sea floor and surrounded by a mesh net (the "twine") of about ¾ inch stretch mesh. Weirs are typically located within 100-400 feet of shore. The twine runs from the sea floor to the surface, and the only opening (the "mouth") is positioned close to shore. Herring swimming along the shore at night, encounter a fence (net of the same twine from sea floor to surface) that runs from the weir to the shoreline and directs the fish into the weir. At dawn, the weir fisherman tends the weir and if Herring are present, he/she may close off the weir until the fish can be harvested. Harvesting takes place when the tidal current is the slackest, usually just before low tide. A large net ("seine") is deployed inside the weir, and, much like a purse seine, it is drawn up to the surface so that the fish become concentrated. They are then pumped out with a vacuum hose into the waiting carrier for transport to the processing plant.

Management and Regulations: To Be Determined

Observer Coverage: From mid-July to early September, on a daily basis, scientists from the Grand Manan Whale & Seabird Research Station check only the weirs around Grand Manan Island for the presence of cetaceans.

Comments: Marine mammals occasionally swim into weirs, in which they can breathe and move about. Marine mammals are vulnerable during the harvesting/seining process where they can become tangled in the seine and suffocate if care is not taken to remove them from the net or to remove them from the weir prior to the onset of the seining process. Small marine mammals, like porpoises, can be removed from the net, lifted into small boats, and taken out of the weir for release without interrupting the seining process. Larger marine mammals, such as whales, must be removed from the weir either through the creation of a large enough escape hole in the back of the weir (taking down the twine and removing some poles) or sometimes by sweeping them out with a specialized mammal net, although this approach carries with it a few more risks to the animal than the "escape hole" technique.

Through the cooperation of weir fishermen and the Grand Manan Whale & Seabird Research Station, weir-associated mortality of cetaceans is relatively low. Over 91% of all entrapped porpoises, dolphins and whales are successfully released from weirs around Grand Manan Island. Thus the total number of entrapments (which can vary annually from 6 to 312) is in no way reflective or indicative of cetacean mortality caused by this fishery.

Protected Species Interactions: Documented interactions with Harbor Porpoise and Minke Whales. Right Whales are also vulnerable to entrapment, though very rarely. The last two Minke whales in a Grand Manan weir were safely released, unharmed, through the partial disassembly of the weir.

Gulf Of Maine Atlantic Herring Purse Seine Fishery

Target Species: Atlantic Herring.

Number of Permit Holders: To Be Determined

Number of Active Permit Holders: The Atlantic Herring FMP distinguishes between vessels catching herring incidentally while pursuing other species and those targeting herring by defining vessels that average less than 1 metric tons of herring caught per trip (in all areas) as incidental herring vessels. In 2002-2004 there were 7, 6, and 4 active federal permits reported in the Northeast Region Dealer Reported Landings Database.

Gear Characteristics: The purse seine is a deep nylon mesh net with floats on the top and lead weights on the bottom. Rings are fastened at intervals to the lead line and a purse line runs completely around the net through the rings (www.gma.org, Gulf of Maine Research Institute, GOMRI). One end of the net remains in the vessel and the other end is attached to a power skiff or "bug boat" that is deployed from the stern of the vessel and remains in place while the vessel encircles a school of fish with the net. Then the net is pursed and brought back aboard the vessel through a hydraulic power block. Purse seines vary in size according to the size of the vessel and the depth to be fished. Most purse seines used in the New England Herring Fishery range from 30 to 50 meters deep (100-165 ft) (NMFS 2005). Purse seining is a year round pursuit in the Gulf of Maine, but is most active in the summer when herring are more abundant in coastal waters and are mostly utilized at night, when herring are feeding near the surface. This fishing technique is less successful when fish remain in deeper water and when they do not form "tight" schools.

Management and Regulations: The Gulf Of Maine Atlantic Herring Purse Seine Fishery has been defined as a Category III fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).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) and the Northeast Multi-species (FR 67, CFR Part 648). 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 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 31-33 document the distribution of sets and marine mammal interactions observed from 2000 to 2004, respectively.

Total Effort: Total metric tons of fish landed from 1998 to 2004 were 24,256, 39,866, 29,609, 20,691, 20,096, 17,939, and 19,958 (2004 totals are provisional data), respectively (NMFS, Unpbl.). Total effort, measured in trips, for the Gulf of Maine Atlantic Herring Purse Seine Fishery from 2002 to 2004 was 343, 339, and 276 respectively (NMFS, Unpbl.). Figures documenting approximate purse seine trip fishing locations are not yet available.

Observer Coverage: During the period 1994 to 2002, estimated observer coverage (number of trips observed/total commercial trips reported) was 0% and 2003 to 2004 observer coverage, respectively, was 0.34%, and 9.8%. The coverage in 2004 may be considered a 'pilot' program, as sampling priorities and data collection methods were refined over the course of the year.

Comments:

Protected Species Interactions: Documented interactions with Harbor Seals, Gray Seals, and unidentified seals.

Northeast/Mid-Atlantic American Lobster Trap/Pot

There are three distinctly identified stock areas for the American lobster: 1) Gulf of Maine, 2) Southern New England, and 3) Georges Bank. In 2005, there were 3,266 vessels holding licenses to harvest lobsters in federal waters, 2,674 vessels licensed to use lobster pot gear in state waters, and approximately 1,030 licenses to use bottom trawls or dredge gear to harvest lobsters. In 2003, there were 11,522 vessels from Maine to North Carolina holding licenses. Lobsters are taken primarily by traps, with about 2-3% of the harvest being taken by mobile gear (trawlers and dredges). About 80% of lobsters were harvested from state waters. The offshore fishery in federal waters has developed in the past 15 years, largely due to technological improvements in equipment and lower competition in the offshore areas. In January 1997, NMFS changed the classification of the Gulf of Maine and Mid-Atlantic Lobster Pot Fisheries from Category III to Category I (1997 List of Fisheries 62 FR 33, January 2, 1997) based on examination of 1990 to 1994 stranding and entanglement records of large whales (including Right, Humpback and Minke whales). For the American Lobster fishery, where the majority of landings are taken from state waters, the Atlantic States Marine Fisheries Commission (ASMFC) has a primary regulatory role. 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 the EEZ. The EEZ fishery is operating under the federal American Lobster regulations (50 CFR 697). Both the EEZ and state fishery are operating under Federal regulations from the ALWTRP (50 CFR 229.32). ~~This fishery is operating under regulations from the ALWTRP (50 CFR 229.32) and the federal American Lobster FMP (50 CFR 697).~~ Documented interaction with minke whales were reported in this fishery.

Atlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline

Target Species: Large pelagic fish species including: Swordfish, Yellowfin Tuna, Bigeye Tuna, Bluefin Tuna, Albacore Tuna, Dolphin Fish, Shortfin Mako Shark, and a variety of other shark species.

Number of Permit Holders: < 200

Number of Active Permit Holders: The number of 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 1999, the mean number of vessels reporting effort to the FLS for the entire Atlantic including the Gulf of Mexico was 292. This declined to an annual average of 158 for the period between 2000 and 2004. Not including the Gulf of Mexico, an average of 85 vessels reported fishing effort in the Atlantic Ocean each year between 2000 and 2004. ~~Fifty-eight~~Sixty vessels reported pelagic longline effort in the Atlantic during ~~2004~~2005. 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 FLS between 1995 and 1999 was 9,819 sets (5.88 million hooks). Between 2000 and 2004, a mean of 5,126 sets (3.43 million hooks) was reported each year. During ~~2004~~2005, the total reported fishing effort in the Atlantic Ocean component of the fishery was 4,~~270~~ 098 sets and ~~3.14~~2.97 million hooks (~~Garrison~~ Fairfield-Walsh and Garrison 2006~~2005~~).

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 ~~2004~~2005, the majority of fishing effort in the Atlantic was reported in the Mid-Atlantic Bight (Virginia to New Jersey, ~~1,185~~ 1,246 sets) and the South Atlantic Bight (Georgia to North Carolina, ~~989~~ 7113 sets) fishing areas (Fairfield-Walsh and Garrison 2006~~Garrison 2005~~).

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. Hooks may be of the straight shank "J" type hook or circle shaped hooks and the hook end may be offset from the shank. A variety of bait types are used depending on the target species, but most typically include whole, frozen squid or fish baits such as sardine or mackerel. A combination of different hook and bait types may be used on a single set. 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 (71 FR 267, 50 CFR Part 229). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP, 50 CFR Part 635). The fishery has also been the focus of management actions relating to bycatch of billfish. Amendment One to the Atlantic Billfish FMP also pertains to the Large Pelagics Longline Fishery and is consistent with the regulations in the HMS FMP. This fishery is also regulated under the Endangered Species Act resulting from frequent interactions with sea turtle species including both Loggerhead and Leatherback Turtles in the Atlantic and Gulf of Mexico. A Biological Opinion issued by the NMFS Southeast Regional Office in June 2004 mandated the use of circle hooks throughout the fishery, mandated the use of de-hooking and disentanglement gear by fishermen to reduce the mortality of captured sea turtles, reopened the Northeast Distant Water fishing area, and mandated increased reporting and monitoring of the fishery.

Observer Coverage: The Pelagic Longline Observer Program (POP) is a mandatory observer program managed by the SEFSC that has been in place since 1992. Observers are placed upon randomly selected vessels with total observer effort allocated on a geographic basis proportional to the total amount of fishing effort reported by the fleet. The target observer coverage level was 5% of reported sets through 2001, and was elevated to 8% of total sets in 2002. Between 2000 and ~~2004~~2005, observer coverage as a percentage of reported sets in the Atlantic component of the fishery was 4%, 4%, 4%, 7%, ~~and~~ 9%, and 6%. The observer coverage during ~~2004~~ 2005 was ~~8.9~~6.4% of reported sets; however, coverage was often >10% in some areas and seasons (Fairfield-Walsh and Garrison 2006~~Garrison 2005~~). These values do not include the experimental portion of the fishery in the NED area, which was 100% of sets during 2001-~~2002~~2003. Observed longline sets and marine mammal interactions are shown for ~~2000~~2001-~~2004~~ 2005 in Figures LPG1 through LPG5.

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 Northeast Distant Water (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 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 2003a, Garrison 2005, Fairfield-Walsh and Garrison 2006). The pelagic longline take reduction team was convened during 2005 to develop approaches to reduce the serious injury of pilot whales in the mid-Atlantic, and the resulting take reduction plan is currently being implemented by NOAA Fisheries.

Protected Species Interactions: Documented interactions with Minke Whale, Risso's Dolphin, Long-finned Pilot Whale, Short-finned Pilot Whale, Common Dolphin, Atlantic Spotted Dolphin, Pantropical Spotted Dolphin, Striped Dolphin, Offshore Bottlenose Dolphin, Pygmy Sperm Whale, and Harbor Porpoise. 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: 6

Number of Active Permit Holders: 6

Total Effort: During the period from 2000 to 2004, the fishing effort reported to the FLS by vessels operating in the Shark Gillnet Fishery averaged 241 sets annually. The total reported effort has been generally declining in the last three years. The total reported fishing effort by the six vessels operating in the fleet was ~~212~~ 170 sets during ~~2004~~2005. However, there is direct evidence of under-reporting as some observed sets were not reported to the FLS system. In addition, these vessels also prosecute other fisheries, and it is not possible to distinguish between trips targeting sharks from those targeting other finfish. The total fishing effort in this fleet therefore remains uncertain (Garrison 2003b).

Temporal and Spatial Distribution: The Shark Drift Gillnet Fleet operates in the coastal waters of Florida and Georgia. During the period from 15 November to 31 March, shark drift gillnet fishing effort is restricted to waters south of 27°51'N latitude under the provisions of the ALWTRP. Fishing for sharks with strikenet gear is exempt from the close period and area if special provisions are met. One vessel operates in waters off Key West, Florida during winter months. During the remainder of the year, the fishery effort is concentrated in waters off Cape Canaveral, Florida and southern Georgia (Carlson and Baremore 2002).

Gear Characteristics: The Shark Gillnet Fishery is characterized by large-mesh (5-10 inches) nets that are typically greater than 1500 feet long. The fleet has traditionally employed long, night-time drift sets with durations greater than 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 and generally have very low bycatch of non-target species (Carlson and Baremore 2002). Approximately 50% of the fishing effort observed during the last several years was strike sets. Strike sets are used primarily during the winter "right whale" season (J. Carlson, SEFSC, Panama City, pers. comm.)

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 (71 FR 162, 50 CFR Part 229). The directed fishery effort is managed under an amendment to the HMS FMP (50 CFR Part 635, 66 FR 17370 March 30, 2001) that mandates observer coverage outside of the season, defined by the ALWTRP, at levels sufficient to achieve precise

estimates (coefficient of variation < 0.3) of marine mammal and sea turtle bycatch. The fishery is also managed under the ALWTRP (50 CFR Part 229.32), which includes seasonal restriction of driftnet fishing effort to below 27degrees 51 min. North latitude during 15 November – 31 March, special provisions for strikenet gear North of 27 degrees-51 min. during this time period, and 100% observer coverage during this period South to 26 degrees-46.5 min. N latitude. 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 in the last few years. The overall observer coverage of the drift component of the fishery from 2000 to 2004 was 20%, 38%, 33%, 9%, and 15%. However, given the uncertainties surrounding the level of reported effort in the FLS, these estimates of observer coverage are highly uncertain. The Shark Drift Gillnet Observer Program attempted to cover 100% of shark gillnet trips by the fleet during 2002-~~2004~~ 2005 (Carlson and Baremore 2002, Carlson and Betha 2006, Garrison 2003b). The locations of observed strike and drift sets and marine mammal interactions in the shark gillnet fishery are shown in Figures LPG6-LPG10.

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 distinguish trips targeting sharks from those targeting other fish species, and it is not possible to distinguish strike sets from drift 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.

Atlantic Blue Crab Trap/Pot

The Blue Crab Trap/Pot Fishery is broadly distributed in estuarine and nearshore coastal waters throughout the mid and south Atlantic. The fishery is estimated to have >16,000 participants deploying gear on a year-round basis. Pots are baited with fish or poultry and are typically set in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. In recent years, reports of strandings with evidence of interactions between Bottlenose Dolphins and both recreational and commercial Crab Pot Fisheries have been increasing in the Southeast region (McFee and 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. The fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

Mid-Atlantic Haul/Beach Seine

A Beach Seine Fishery operates along northern North Carolina beaches targeting Striped Bass, Mullet, Spot, Weakfish, Sea Trout, and Bluefish. The fishery operates on the Outer Banks of North Carolina primarily in the spring (April-June) and fall (October-December). It uses two primary gear types: a “beach anchored gill net” and a “beach seine”. Both systems utilize a small net anchored to the beach. Although the “beach anchored gillnet” is functionally utilized in the same manner as the “beach seine” they are mono-filament gillnets and are technically a component of the category I mid-Atlantic Gillnet fishery. The beach seine system uses a bunt and a wash net that are attached to the beach and are in the surf (Steve et al. 2001). The North Carolina Beach Seine Fishery has been observed since April 7, 1998 by the NMFS Fisheries Sampling Program (Observer Program) based at the NEFSC. Through 2001, there were 101 sets observed during the winter season (Nov-Apr) and 65 sets observed during the summer season (May-Oct). There were no sets observed during the summer of 2001. This fishery has observed interactions with Coastal Bottlenose Dolphin. The fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229) and has management actions under the Bottlenose Dolphin Take Reduction Plan (71 FR162, 50 CFR Part 223 and 229).

North Carolina Long Haul Seine

The Long Haul Seine is an estuarine fishery operating in North Carolina waters with 10-15 participants statewide. The seine consists of a 1000-1200 yard long net pulled by two boats for distances of 1-2 nautical miles (Steve *et al.*, 2001). The fishery targets Weakfish, Spot, and Croaker and operates in Pamlico and Core sounds and tributaries. The fishery operates primarily between June and October. Occasional interactions with Coastal Bottlenose Dolphins have been reported. The fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

North Carolina Roe Mullet Stop Net

The Stop Net Fishery is unique to Bogue Banks, North Carolina and is currently operated by two crews including approximately 20 fishers each (Steve *et al*. 2001). 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 (Steve *et al.* 2001). Interactions between this fishery and Coastal Bottlenose Dolphins have been reported; however, the total number of interactions has not been estimated. The fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

Virginia Pound Net

Pound Nets are a stationary gear fished in nearshore coastal and estuarine waters of Virginia. The gear consists of a large mesh lead posted perpendicular to the shoreline extending outward to the corral, or "heart", where the catch accumulates. Target species included Weakfish, Spot, and Croaker. The NEFOB began observing effort in this fishery in 2001. In 2004 and 2005 an experimental fishery was conducted in an area of the Chesapeake bay that was closed to commercial fishing effort from May to July for sea turtle conservation measures. Occasional interactions with Coastal Bottlenose Dolphins have been observed while monitoring for sea turtle interactions in both the commercial and experimental fisheries. In some cases it is not clear whether pound nets were the cause of death due to entanglement in other gear (monofilament twine). Data from the Chesapeake Bay suggest that the likelihood of Bottlenose Dolphin entanglement in pound net leads may be affected by the mesh size of the lead net (Bellmund *et al.* 1997), but the information is not conclusive. Stranded Bottlenose Dolphins have also shown evidence of interactions with pound nets. The fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

Mid-Atlantic Menhaden Purse Seine

Between 1994 and 1997, two fleets of 9-10 vessels each operated out of two processing facilities in Reedville Beach, Virginia and one fleet of 2-6 vessels operated out of a Beaufort, North Carolina processing facility. Most of the sets occurred within three miles of shore during this time. Since 1998, only one plant has been operational in Virginia with a total fleet of 10 vessels, and the fleet in Beaufort has been reduced to two vessels. The majority of the effort occurs off North Carolina from November through January, moving northward during warmer months to southern New England. Occasional interactions with Coastal Bottlenose Dolphins have been recorded historically in this fishery. However, there is no observer coverage in this fishery, and the level of incidental interactions with marine mammals is undocumented. The Mid-Atlantic Menhaden Purse Seine Fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

Southeastern U.S. Atlantic Shrimp Trawl

The Shrimp Trawl Fishery operates from North Carolina through northern Florida virtually year-round, moving seasonally up and down the coast. A recent estimate of fishing effort based upon state dealer trip reports included approximately 23,000 shrimping trips (Epperly *et al.* 2002). The gear consists of relatively fine-meshed trawls typically fished in a paired fashion on either side of a fishing vessel. Effort occurs in both estuarine and nearshore coastal waters. The Shrimp Trawl Fishery has long been the focus of management actions associated with significant bycatch of both fish species and sea turtles. Observer coverage is typically very sparse and non-systematic. Occasional interactions with Bottlenose Dolphins have been observed, and there is infrequent evidence of interactions from stranded animals. The Shrimp Trawl fishery has been defined as a Category III fishery in the 2006 List of Fisheries (71 FR162, 50 CFR Part 229).

III. Historical Fishery Descriptions

Atlantic Foreign Mackerel

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

Pelagic Drift Gillnet

In 1996 and 1997, NMFS issued management regulations which prohibited the operation of this fishery in 1997. The fishery operated during 1998. Then, in January 1999 NMFS issued a Final Rule to prohibit the use of drift net gear in the North Atlantic Swordfish Fishery (50 CFR Part 630). In 1986, NMFS established a mandatory self-reported fisheries information system for Large Pelagic Fisheries. Data files are maintained at the SEFSC. The estimated total number of hauls in the Atlantic Pelagic Drift Gillnet Fishery increased from 714 in 1989 to 1,144 in 1990; thereafter, with the introduction of quotas, effort was severely reduced. The estimated number of hauls from 1991 to 1996 was 233, 243, 232, 197, 164, and 149 respectively. Fifty-nine different vessels participated in this fishery at one time or another between 1989 and 1993. In 1994 to 1998 there were 11, 12, 10, 0, and 11 vessels, respectively, in the fishery. Observer coverage, expressed as percent of sets observed, was 8% in 1989, 6% in 1990, 20% in 1991, 40% in 1992, 42% in 1993, 87% in 1994, 99% in 1995, 64% in 1996, no fishery in 1997, and 99% coverage during 1998. Observer coverage dropped during 1996 because some vessels were deemed too small or unsafe by the contractor that provided observer coverage to NMFS. Fishing effort was concentrated along the southern edge of Georges Bank and off Cape Hatteras, North Carolina. Examination of the species composition of the catch and locations of the fishery throughout the year suggest that the Drift Gillnet Fishery was stratified into two strata: a southern, or winter, stratum and a northern, or summer, stratum. Documented interactions with North Atlantic right whales, humpback whales, sperm whales, pilot whale spp., Mesoplodon spp., rissos dolphins, common dolphins, striped dolphins and white sided dolphins were reported in this fishery.

Atlantic Tuna Purse Seine

The Tuna Purse Seine Fishery occurring between Cape Cod, Massachusetts and Cape Hatteras, North Carolina is directed at small and medium Bluefin and Skipjack Tuna for the canning industry, while the fishery north of Cape Cod, Massachusetts is directed at large medium and giant Bluefin Tuna These two fisheries are entirely separate from other Atlantic Tuna Purse Seine Fisheries. Spotter aircraft are used to locate fish schools. The official start date, set by regulation, is August 15. Individual Vessel Quotas (IVQs) and a limited access system prevent a derby fishery situation. Catch rates for large medium and giant Tuna are high and consequently, the season usually only lasts a few weeks. The 1996 regulations allocated 250MT (5 IVQs) with a minimum of 90% giants and 10% large mediums.

Limited observer data is available for the Atlantic Tuna Purse Seine Fishery. Out of 45 total trips made in 1996, 43 trips (95.6%) were observed. Forty-four sets were made on the 43 observed trips and all sets were observed. A total of 136 days were covered. No trips were observed during 1997 through 1999. Two trips (seven hauls) were observed in October 2000 in the Great South Channel Region. Four trips were observed in September 2001. No marine mammals were observed taken during these trips. Documented interactions with pilot whale spp. were reported in this fishery.

Atlantic Tuna Pelagic Pair Trawl

The Pelagic Pair Trawl Fishery operated as an experimental fishery from 1991 to 1995, with an estimated 171 hauls in 1991, 536 in 1992, 586 in 1993, 407 in 1994, and 440 in 1995. This fishery ceased operations in 1996 when NMFS rejected a petition to consider pair trawl gear as an authorized gear type in the Atlantic Tuna Fishery. The fishery operated from August to November in 1991, from June to November in 1992, from June to October in 1993 (Northridge 1996), and from mid-summer to December in 1994 and 1995. Sea sampling began in October of 1992 (Gerrior et al. 1994) where 48 sets (9% of the total) were sampled. In 1993, 102 hauls (17% of the total) were sampled. In 1994 and 1995, 52% (212) and 55% (238), respectively, of the sets were observed. Nineteen vessels have operated in this fishery. The fishery operated in the area between 35°N to 41°N and 69°W to 72°W. Approximately 50% of the total effort was within a one degree square at 39°N, 72°W, around Hudson Canyon, from 1991 to 1993. Examination of the 1991-1993 locations and species composition of the bycatch, showed little seasonal change for the six months of operation and did not warrant any seasonal or areal stratification of this fishery (Northridge 1996). During the 1994 and 1995 Experimental Pelagic Pair Trawl Fishing Seasons, fishing gear experiments were conducted to collect data on environmental parameters, gear behavior, and gear handling practices to evaluate factors affecting catch and bycatch (Goudey 1995, 1996), but the results were inconclusive. Documented interactions with pilot whale spp., rissos dolphin and common dolphins were reported in this fishery.

Part B. Description of U.S. Gulf of Mexico Fisheries

I. Data Sources

Items 1 and 2 describe sources of marine mammal mortality, serious injury or entanglement data, and item 3 describes the source of commercial fishing effort data used to generate maps depicting the location and amount of fishing effort and the numbers of active permit holders. In general, commercial fisheries in the Gulf of Mexico have had little directed observer coverage and the level of fishing effort for most fisheries that may interact with marine mammals is either not reported or highly uncertain. With the exception of the Large Pelagics Longline Fishery, no incidental take estimates are possible for Gulf of Mexico commercial fisheries.

1. Southeast Region Fishery Observer Programs

Two fishery observer programs are managed by the SEFSC that observe commercial fishery activity in the U.S. Gulf of Mexico. The Pelagic Longline Observer Program (POP) administers a mandatory observer program for the U.S. Atlantic Large Pelagics Longline Fishery. The program has been in place since 1992, and randomly allocates observer effort by eleven geographic fishing areas proportional to total reported effort in each area and quarter. Observer coverage levels are mandated under the Highly Migratory Species FMP (HMS FMP, 50 CFR Part 635). The second is the Southeastern Shrimp Otter Trawl Fishery Observer Program. This is a voluntary program administered by SEFSC in cooperation with the Gulf and South Atlantic Fisheries Foundation. The program is funding and project dependent, and therefore observer coverage is not necessarily randomly allocated across the fishery. The total level of observer coverage for this program is <<1% of the total fishery effort. In each Observer Program the observers record information on the total target species catch, the number and type of interactions with protected species including both marine mammals and sea turtles, and biological information on species caught.

2. Regional Marine Mammal Stranding Networks

The Southeast Regional Stranding Network is a component of the Marine Mammal Health and Stranding Response Program (MMHSRP). The goals of the MMHSRP are to facilitate collection and dissemination of data, assess health trends in marine mammals, correlate health with other biological and environmental parameters, and coordinate effective responses to unusual mortality events (Becker *et al.* 1994). The Southeast Region Strandings Program is responsible for data collection and stranding response coordination along the U.S. Gulf of Mexico coast from Florida through Texas. Prior to 1997, stranding and entanglement data were maintained by the New England Aquarium and the National Museum of Natural History, Washington, D.C. Volunteer participants, acting under a letter of agreement with NOAA Fisheries, collect data on stranded animals that include: species; event date and location; details of the event including evidence of human interactions; determinations of the cause of death; animal disposition; morphology; and biological samples. Collected data are reported to the appropriate Regional Stranding Network Coordinator and are maintained in regional and national databases.

3. Southeast Region Fisheries Logbook System

The FLS is maintained at the SEFSC and manages data submitted from mandatory fishing vessel logbook programs under several FMPs. In 1986, a comprehensive logbook program was initiated for the Large Pelagics Longline Fisheries, and this reporting became mandatory in 1992. Logbook reporting has also been initiated since the early 1990s for a number of other fisheries including: Reef Fish Fisheries; Snapper-Grouper Complex Fisheries; federally managed Shark Fisheries; and King and Spanish Mackerel Fisheries. In each case, vessel captains are required to submit information on the fishing location, the amount and type of fishing gear used, the total amount of fishing effort (e.g., gear sets) during a given trip, the total weight and composition of the catch, and the disposition of the catch during each unit of effort (e.g., kept, released alive, released dead). FLS data are used to estimate the total amount of fishing effort in the fishery and thus expand bycatch rate estimates from observer data to estimates of the total incidental take of marine mammal species in a given fishery.

II. Gulf of Mexico Commercial Fisheries

Atlantic Ocean, Caribbean, Gulf of Mexico Large Pelagics Longline

Target Species: Large pelagic fish species including: Swordfish, Yellowfin Tuna, Bigeye Tuna, Bluefin Tuna, Albacore Tuna, Dolphin Fish, Shortfin Mako Shark, and a variety of other shark species.

Number of Permit Holders: < 200

Number of Active Permit Holders: The number of active fishing vessels in the pelagic longline fishery has been declining since a peak number of 361 vessels reporting longline effort during 1995. Over the period between 1995 and 1999, the mean number of vessels reporting effort to the FLS for the entire Atlantic including the Gulf of Mexico was 292. This declined to an annual average of 158 for the period between 2000 and 2004. For the Gulf of Mexico, an average of 74 vessels reported fishing effort each year from 2000-2004. The total number of fishing vessels reporting effort in the Gulf of Mexico during ~~2004~~ 2005 was ~~69~~60, 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 increased since 1992 and has ranged between 2.5 and 4.1 million hooks. The mean effort reported to the FLS between 1995 and 1999 was 4,499 sets and 3.25 million hooks. During ~~2004~~2005, the total reported fishing effort in the Gulf of Mexico component of the fishery was ~~5,410~~3,785 sets and ~~4.08~~2.94 million hooks (Fairfield-Walsh and Garrison ~~2005~~2006). This reflects a significant decrease over previous years due to the effects of Hurricanes Katrina and Rita on the Gulf fleet.

Temporal and Spatial Distribution: Fishing effort occurs year round and operates in waters both inside and outside the U.S. EEZ throughout Atlantic, Caribbean and Gulf of Mexico waters. The Gulf of Mexico component of the fleet operates both in continental shelf and deep continental slope waters from Florida to Texas.

Gear Characteristics: The pelagic longline gear consists of a mainline of >700-lb test monofilament typically ranging between 10 and 45 miles long. At regular intervals along the mainline, bullet-shaped floats are suspended and long sections of the gear are marked by “high-flyers” or radio beacons. Suspended from the mainline are long gangion lines of 200 to 400-lb test monofilament that are typically 100 to 200 feet in length. Fishing depths are most typically between 40 and 120 feet. Hooks of various sizes are attached by a steel swivel leader. Hooks may be of the straight shank “J” type hook or circle shaped hooks and the hook end may be offset from the shank. A variety of bait types are used depending on the target species, but most typically include whole, frozen squid or fish baits such as sardine or mackerel. A combination of different hook and bait types may be used on a single set. 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 (68 FR 41725, 50 CFR Part 229). The directed fishery is managed under the FMP for Atlantic Tunas, Swordfish, and Sharks (Highly Migratory Species FMP, 50 CFR Part 635). The fishery has also been the focus of management actions relating to bycatch of billfish. Amendment One to the Atlantic Billfish FMP also pertains to the Large Pelagics Longline Fishery and is consistent with the regulations in the Highly Migratory Species FMP. This fishery is also regulated under the Endangered Species Act resulting from frequent interactions with endangered sea turtle species including both Loggerhead and Leatherback Turtles in the Atlantic and Gulf of Mexico. A Biological Opinion issued by the NMFS Southeast Regional Office in June 2004 mandated the use of circle hooks throughout the fishery, mandated the use of de-hooking and disentanglement gear by fishermen to reduce the mortality of captured sea turtles, and mandated increased reporting and monitoring of the fishery.

Observer Coverage: The Pelagic Longline Observer Program (POP) is a mandatory observer program managed by the SEFSC that has been in place since 1992. Observers are placed upon randomly selected vessels with total observer effort allocated on a geographic basis proportional to the total amount of fishing effort reported by the fleet. The target observer coverage level was 5% of reported sets through 2001, and was elevated to 8% of total sets in 2002. Between 2000 and ~~2004~~2005, observer coverage of reported sets in the Gulf of Mexico component of the fishery was 4%, 4%,3%, 5%, , 5% and ~~5~~7%. Observer coverage in the Gulf of Mexico during ~~2004~~ 2005 was ~~4.9~~7.4% of reported sets; however, coverage was as high as ~~6.6~~9.0% in some seasons (Fairfield-Walsh and Garrison ~~2005~~2006). Observed longline sets and marine mammal interactions in the Gulf of Mexico are shown for ~~2000~~2001-~~2004~~ 2005 in Figures LPG11 through LPG15. Only one marine mammal interaction, with an unidentified dolphin, has been observed during this period.

Comments: This fishery has been the subject of numerous management actions over the last four years associated with bycatch of both billfish and sea turtles. These changes have resulted in a reduction of overall fishery effort and in the behaviors of the fishery. The most significant change was the closure of the Northeast Distant Water Area off the Canadian Grand Banks and near the Azores as of June 1, 2001 (50 CFR Part 635). In the Gulf of Mexico, a year round closure was implemented in two areas in DeSoto Canyon (NMFS, 2003). Additionally, a ban on the use of live fish bait was initiated in 1999 due to concerns over billfish bycatch. The June 2004 has resulted in a significant change in the gear and fishing practices of this fishery that will likely impact marine mammal bycatch. The majority of interactions with marine mammals in this fishery in the Gulf of Mexico have been with Risso's Dolphin (Garrison 2003a); however, there have been very few interactions with marine mammals observed in the last five years.

Protected Species Interactions: Gulf of Mexico stocks of Risso's Dolphin, Pantropical Spotted Dolphin, Atlantic Spotted Dolphin, and Offshore Bottlenose Dolphin.

Gulf of Mexico Shrimp Trawl

The Shrimp Trawl Fishery operates along the Gulf coast of the U.S. virtually year round. Hundreds of thousands of fishing trips are reported annually in the Gulf of Mexico with effort occurring in estuarine, nearshore coastal, and offshore continental shelf waters (Epperly *et al.* 2002). The gear consists of relatively fine-meshed trawls typically fished in a paired fashion on either side of a fishing vessel. Observer coverage is typically very sparse and is not systematic. The Shrimp Trawl Fishery has long been the focus of management actions associated with significant bycatch of both fish species and sea turtles. Occasional interactions with Bottlenose Dolphins have been observed in the Atlantic component of this fishery, and there is infrequent evidence of interactions from stranded animals. The Shrimp Trawl Fishery is listed as a Category III fishery in the 2006 List of Fisheries (71 FR 162, 50 CFR Part 229).

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 (68 FR 41725). 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 with crab pots appear to generally involve a Dolphin becoming wrapped in the buoy line. The total number of these interactions and associated mortality

rates has not been documented. The fishery has been defined as a Category III fishery in the 2006 List of Fisheries (71 FR 162, 50 CFR Part 229).

Gulf of Mexico Menhaden Fishery

This fishery operates in coastal waters along the Gulf coast, with the majority of fishing effort concentrated off Louisiana. 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, interactions with Coastal Bottlenose Dolphins have been reported historically in Louisiana and for the similar Atlantic Menhaden Fishery. The fishery has been defined as a Category II fishery in the 2006 List of Fisheries (71 FR 162, 50 CFR Part 229).

Gulf of Mexico Gillnet Fisheries

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. These fisheries, for the most part, operate year around. They are state-controlled and licensed, and vary widely in intensity and target species. No marine mammal mortalities associated with Gillnet Fisheries have been reported in these states, but stranding data suggest that marine mammal interactions with gillnets do occur, causing mortality and serious injury. There are no effort or observer data available for these fisheries. The Gulf of Mexico Gillnet Fisheries are listed as Category II fisheries in the 2006 List of Fisheries (71 FR 162, 50 CFR Part 229).

Literature Cited

Becker P.R., Wilkinson D., Lillestolen T. 1994. Marine Mammal Health and Stranding Response Program: Program Development Plan. NOAA Tech. Mem. NMFS-OPR-94-2. U.S. Dep. Of Commerce, Washington D.C. 35pp.

Bellmund, S.A., Musick, J.A., Klinger, R.C., Byles, R.A., Keinath, J.A., and Barnard, D.E. 1997. Ecology of Sea Turtles in Virginia. Final Report to National Marine Fisheries Service Northeast Region. Contract number NA80FAC-00004. Virginia Institute of Marine Science, Gloucester Point, Virginia.

Burdett, L.G. and W.E. McFee. 2004. Bycatch of bottlenose dolphins in South Carolina, USA, and an evaluation of the Atlantic blue crab fishery categorisation. Journal of Cetacean Research and Management 6: 231-240.

Carlson, J. and I. Baremore. 2002. The directed shark gillnet fishery: Right whale season, 2002. Available from NOAA Fisheries, Southeast Fisheries Science Center, Panama City, FL. SFD Contribution PCB-02/13.

Carlson, J,K. and D.M. Betha. 2006. The directed shark gillnet fishery: Catch and Bycatch 2005. National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City Lab Contribution #06-01.

Clark, S.H. 1998. Status of Fishery Resources off the Northeastern United States for 1998. NOAA Tech. Mem. NMFS-NE-115. 160 pp.

Epperly, S.L., L.P. Garrison, T. Henwood, W. Hoggard, J. Mitchell, J. Nance, J. Poffenberger, C. Sasso, E. Scott-Denton, and C. Yeung. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of southeast U.S. waters and the Gulf of Mexico. NOAA Tech. Mem. NMFS-SEFSC-490. 88 pp.

Fairfield-Walsh, C. and L.P. Garrison. 2006. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2005. NOAA Technical Memorandum NMFS-SEFSC-539, 52 p.

Garrison, L.P. 2005. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2004. NOAA Tech. Mem. NMFS-SEFSC-531, 57 pp.

Garrison, L.P. 2003a. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2001-2002. NOAA Tech. Mem. NOAA FISHERIES-SEFSC-515, 52 p.

Garrison, L.P. 2003b. Protected species interactions with the directed shark gillnet fishery off Florida and Georgia from 1999-2002. NMFS/SEFSC Internal report. Available from: Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Gerrior, P., A.S. Williams and D.J. Christensen. 1994. Observations of the 1992 pelagic pair trawl fishery in the Northwest Atlantic. Mar. Fish. Rev. 56(3): 24-27.

Goudy, C.A. 1995. The 1994 experimental pair trawl fishery for tuna in the Northwest Atlantic. MITSWG 95-6, Massachusetts Institute of Technology, Sea Grant, Cambridge, MA. 10 pp.

Goudy, C.A. 1996. The 1995 experimental pair trawl fishery for tuna in the Northwest Atlantic. MITSG 96-17,

Massachusetts Institute of Technology, Sea Grant, Cambridge, MA. 13 pp.
McFee, W. E. and W. Brooks, Jr. 1998. Fact finding meeting of marine mammal entanglement I in the crab pot fishery: a summary. U.S. Fish and Wildlife Service. Unpublished Report.
NMFS [National Marine Fisheries Service]. 2003. Guide for complying with the regulations for Atlantic tunas, swordfish, sharks, and billfish. September 2003. http://www.nmfs.noaa.gov/sfa/hms/2003_ComplianceGuide.pdf
NMFS-OPR [National Marine Fisheries Service-Office of Protected Resources]. 2003. Marine Mammal Authorization Program [http://www.nmfs.noaa.gov/prot_res/PR2/Fisheries_Interactions/MMAP.html]; accessed on 11/05/2003.
NMFS-NEFSC [National Marine Fisheries Service-Northeast Fisheries Science Center]. 2003. Fishery Sampling Branch [http://www.nefsc.noaa.gov/nefsc/directorate/divisions/femad/fishsamp.html]; accessed on 11/05/2003.
Northridge, S. 1996. Estimation of cetacean mortality in the U.S. Atlantic swordfish and tuna drift gillnet and pair trawl fisheries. Final report, Contract No. 40ENNF500160, to the NMFS, Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543
Smith, J.W., E.A. Hall, N.A. McNeil, and W.B. O'Bier. 2002. The distribution of purse-seine sets and catches in the Gulf Menhaden fishery in the Northern Gulf of Mexico, 1994-1998. Gulf of Mexico Science 20: 12-24.
Steve, C., J. Gearhart, D. Borggaard, L. Sabo and A.A. Hohn. 2001. Characterization of North Carolina Commercial Fisheries with Occasional Interactions with Marine Mammals. NOAA Tech. Mem. NMFS-SEFSC-458. 60 pp.
Wigley, S., Terceiro M., Delong A., Sosebee K. 1998. Proration of 1994-96 USA Commercial Landings of Atlantic Cod, Haddock and Yellowtail Flounder to Unit Stock Areas. NOAA, NMFS, NEFSC [Northeast Fisheries Science Center] Ref. Doc. 98-02, Woods Hole, Massachusetts

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). 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).

There has been speculation, based on year-round occurrence of strandings, opportunistic sightings and whaling catches, that sperm whales in the Gulf of Mexico may constitute a distinct stock (Schmidly 1981). 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~~have been collected during Minerals Management Service led field studies (2000-2005). Preliminary analyses of data (unpublished annual reports and presentations at review meetings) indicate Gulf of Mexico sperm whales are smaller in size and likely exhibit distinct genetic and acoustic traits relative to other sperm whale populations. When published, results will likely support Schmidly (1981).~~.~~

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. Limited studies are currently being conducted to address this issue and its impact, if any, on this and other marine species. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of sperm whales for all surveys combined was 530 (CV=0.31) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

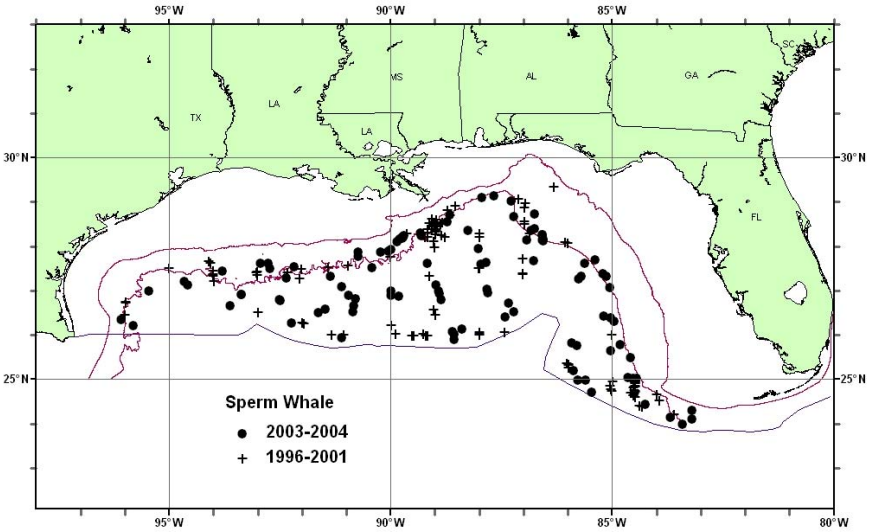


Figure 1. *Distribution of sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted line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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate. The estimate of abundance for sperm whales in oceanic waters, pooled from 1996 to 2001, is 1,349 (CV=0.23) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic

cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for sperm whales in oceanic waters, pooled from 2003 to 2004, was 1,665 (CV=0.20) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for sperm whales is 1,~~349~~665 (CV=0.2~~3~~0). The minimum population estimate for the northern Gulf of Mexico is 1,~~114~~409 sperm whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,665 (CV=0.20) and that for 1996-2001 of 1,349 (CV=0.29) ~~and that for 1991-1994 of 530 (CV=0.31)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is relatively low. These estimates are 2-3 times larger than that for 1991-1994 of 530 (CV=0.31). The 2003-2004 estimates were based on less negatively biased estimates of sperm whale group size and may account for part of the difference. Nevertheless, ~~these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of sperm whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~these temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of sperm whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is 1,~~114~~409 ~~(CV=0.23)~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.1 because the sperm whale is an endangered species. PBR for the northern Gulf of Mexico sperm whale is 2.~~2~~8.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a sperm whale during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006). 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.

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 1700's to the early 1900's (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).

Fisheries Information

The level of past or current, direct, human-caused mortality of sperm whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to sperm whales by this fishery.

Other Mortality

No sperm whale strandings were documented during 2004-2005. A total of 9 sperm whale strandings were documented in the northern Gulf of Mexico during 1999-2003 (Table 1). There was no evidence of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Sperm whale (*Physeter macrocephalus*) strandings along the U.S. Gulf of Mexico coast, 1999-2003. No sperm whale strandings were documented during 2004-2005.

~~State~~TATE	**1999**	**2000**	**2001**	**2002**	**2003**	**TOTAL**
Alabama	0	0	0	0	0	0
Florida	1	2	1	1	1	6
Louisiana	1	0	0	0	1	2
Mississippi	0	0	0	0	0	0
Texas	0	1	0	0	0	1
T~~otal~~OTAL	2	3	1	1	2	9

STATUS OF STOCK

The status of sperm whales in the northern Gulf of Mexico, relative to OSP, is unknown. This species is listed as endangered under the Endangered Species Act (ESA). There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because the sperm whale is listed as an endangered species under the ESA.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central

and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State University Press, Baton Rouge, 565 pp.

~~Mate, B. 2002. Satellite-monitored radio-tagging of a sperm whale in the Gulf of Mexico (unpublished). Report to the Southeast Fisheries Science Center, 3209 Frederic Street, Pascagoula, MS 39567. 5 pp.~~

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K .D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K., W. Hoggard, C. Roden, R. Lohoefener, C. Rogers and B. Taggart. 1994. Cetaceans on the upper continental slope in the north-central Gulf of Mexico. Fish. Bull. 92: 773-786.

~~Mullin, K .D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.~~

~~Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.~~

Petersen, J. C. and W. Hoggard. 1996. First sperm whale (*Physeter macrocephalus*) record in Mississippi. Gulf Research Reports 9(3):215-217.

Rice, D. W. 1989. Sperm whale, *Physeter macrocephalus* Linnaeus, 1758. pp. 177-233. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: river dolphins and the larger toothed whales. Academic Press, London, 442 pp.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

Townsend, C. H. 1935. The distribution of certain whales as shown by logbook records of American whale ships. Zoologica 19: 1-50.

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

Whitehead, H. 2002. Estimates of the current global population size and historical trajectory for sperm whales. Mar. Ecol. Prog. Ser. 242: 295-304.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bryde's whales are distributed worldwide in tropical and sub-tropical waters. In the western Atlantic Ocean, Bryde's whales are reported from off the southeastern United States and the southern West Indies to Cabo Frio, Brazil (Leatherwood and Reeves 1983). Most of the sighting records of Bryde's whales in the Gulf of Mexico are from NMFS abundance surveys that were conducted during the spring (Figure 1; Hansen *et al.* 1995; Hansen *et al.* 1996; Mullin and Hoggard 2000; Mullin and Fulling 2004). However, there are stranding records from throughout the year (Würsig *et al.* 2000).

It has been postulated that the Bryde's whales found in the Gulf of Mexico may represent a resident stock (Schmidly 1981; Leatherwood and Reeves 1983), but there is no information on stock differentiation. The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data.

From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Bryde's whales for all surveys combined from 1991 through 1994 was 35 (CV=1.10) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

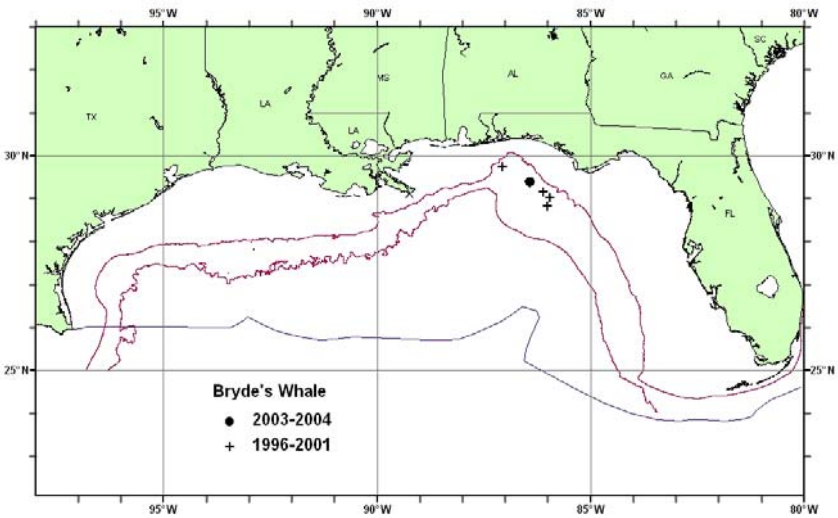


Figure 1. *Distribution of Bryde's whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for Bryde's whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 40 (CV=0.61) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are

deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Bryde's whales in oceanic waters, pooled from 2003 to 2004, was 15 (CV=1.98) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Bryde's whales is ~~40~~15 (CV=~~0.61~~1.98). The minimum population estimate for the northern Gulf of Mexico is ~~2~~5 Bryde's whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 15 (1.98) and that for 1996-2001 of 40 (CV=0.61)~~ and that for 1991-1994 of 35 (CV=1.09)~~ are not significantly different (P>0.05) from each other~~, and are/are not significantly different from the 2003-2004 estimate of 15 (CV=1.98),~~ but due to the imprecision of the estimates, the power to detect a difference is low.

The abundance estimate for 1991-1994 was 35 (CV=1.09). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Bryde's whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~ These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Bryde's whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~2~~5. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Bryde's whale is 0.~~3~~1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of Bryde's whales during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Bryde's whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Bryde's whales by this fishery.

Other Mortality

There were no reported strandings of Bryde's whales in the Gulf of Mexico during 1999-200~~3~~5.

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

does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of Bryde's whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Northeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Würsig, B., T. A. Jefferson and D. J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. Texas A&M University Press, College Station.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Cuvier's beaked whales are distributed throughout the world's oceans except for the polar regions (Leatherwood and Reeves 1983; Heyning 1989). Strandings have occurred in all months along the east coast of the U.S. (Schmidly 1981) and throughout the year in the Gulf of Mexico (Würsig *et al.* 2000). Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico (Hansen *et al.* 1996; Mullin and Hoggard 2000). Some of the aerial survey sightings may have included Cuvier's beaked whale, but identification of beaked whale species from aerial surveys is problematic.

Strandings of Cuvier's beaked whales along the west coast of North America, based on skull characteristics, are thought to represent members of a panmictic population (Mitchell 1968), but there is no information on stock differentiation in the Gulf of Mexico and nearby waters. In the absence of adequate information on stock structure, a species' range within an ocean should be divided into defensible management units, and such management units include distinct oceanographic regions (Wade and Angliss 1997). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Cuvier's beaked whales for all surveys combined was 30 (CV=0.50). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

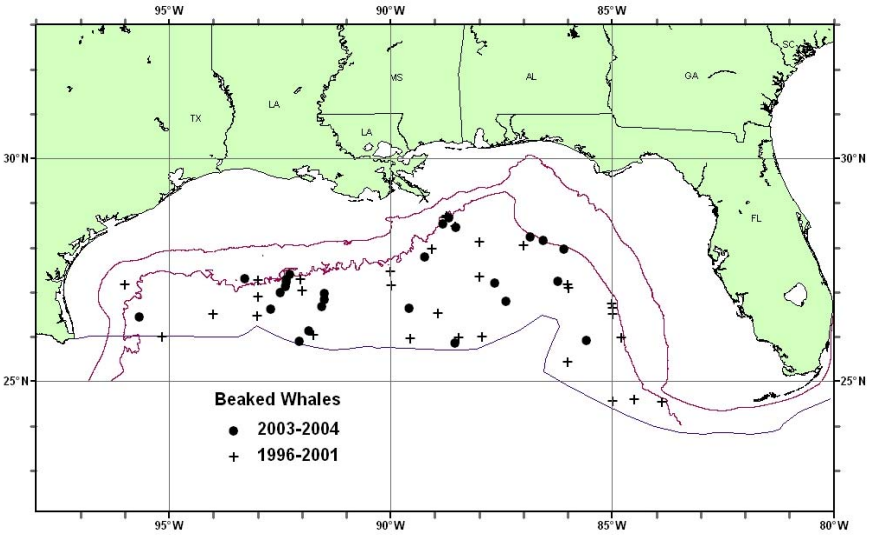


Figure 1. *Distribution of ~~Cuvier's~~ beaked whale sightings from SEFSC shipboard spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for Cuvier's beaked whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 95 (CV=0.47) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~. The estimated abundance of Cuvier's beaked whales ~~is~~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 ~~is~~was 146 (CV=0.46), which may also ~~-~~include an unknown number of *Mesoplodon* spp.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Cuvier's beaked whales in oceanic waters, pooled from 2003 to 2004, was 65 (CV=0.67) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may also include an unknown number of *Mesoplodon* spp.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Cuvier's beaked whales is ~~95~~65 (CV=0.~~4~~67~~7~~). ~~-~~The minimum population estimate for the northern Gulf of Mexico is ~~65~~39 Cuvier's beaked whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 65 (CV=0.67) and that for 1996-2001 of 95 (CV=0.47) ~~and that for 1991-1994 of 30 (CV=0.50)~~ 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 30 (CV=0.50). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Cuvier's beaked whale dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Cuvier's beaked whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size for the Cuvier's beaked whale is ~~65~~39 ~~(CV=0.47)~~. 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.~~7~~4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Cuvier's beaked whale during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Cuvier's beaked whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Cuvier's beaked whales by this fishery.

Other Mortality

Cuvier's beaked whales were taken occasionally in a small, directed fishery for cetaceans that operated out of the Lesser Antilles (Caldwell and Caldwell 1971). There w~~ere~~as ~~no~~one reported strandin~~gs~~g of Cuvier's beaked whale~~s~~ in the Gulf of Mexico during 1999-200~~3~~5. One Cuvier's beaked whale stranded in Texas in October 2004. There was no indication of human interactions for this stranded animal. Two unidentified beaked whales mass stranded in Florida in December 1999. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 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 acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Evans and England 2001; Balcomb and Claridge 2001; Cox *et al*.~~, in review~~ 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~~of~~ ~~6~~5 of the dead beaked whales and reveal~~ed~~ed 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*.~~, in review~~ 2006).

STATUS OF STOCK

The status of Cuvier's beaked whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because of evidence of human induced mortality and serious injury associated with acoustic activities.

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.

REFERENCES

Balcomb, K. C. III and D. E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. *Bahamas J. Sci*. 2: 2-12.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Caldwell, D. K. and M. C. Caldwell. 1971. Beaked whales, *Ziphius cavirostris*, in the Bahamas. *Florida Acad. Sci. Q. J.* 34: 157-160.

Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. C. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. 2006. Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7(3): 177-187.

~~Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. (in review) Report of a workshop to understand the impacts of anthropogenic sound on beaked whales. Submitted to J. Cetacean Res. Manage. 33 pp. Available from: U.S. Marine Mammal Commission, 4340 East-West Highway, Rm. 905, Bethesda, MD 20814.~~

Evans, D. L. and G. R. England. 2001. Joint interim report - Bahamas Marine Mammal Stranding - event of 15-16 March 2000. U.S. Department of Commerce; Secretary of the Navy, vi + 59 pp. Available at: http://www.nmfs.noaa.gov/pr/acoustics/acoustics_reports.htm.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic

pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392:29.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Heyning, J. E. 1989. Cuvier's beaked whale *Ziphius cavirostris* G. Cuvier, 1923. pp. 289-308. *In*: S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London. 442 pp.

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

Mitchell, E. 1968. Northeast Pacific stranding distribution and seasonality of Cuvier's beaked whale, *Ziphius cavirostris*. Can. J. Zool. 46: 265-279.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Simmonds, M. P. and L. F. Lopez-Jurado. 1991. Whales and the military. Nature 351: 448.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Würsig, B., T. A. Jefferson and D. J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. Texas A&M University Press, College Station.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Three species of *Mesoplodon* are known to occur in the Gulf of Mexico, based on stranding or sighting data (Hansen *et al.* 1995; Würsig *et al.* 2000). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*) and Sowerby's beaked whale (*M. bidens*). Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only 1 known stranding of this species (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). Identification of *Mesoplodon* to species in the Gulf of Mexico is very difficult, and in many cases, *Mesoplodon* and Cuvier's beaked whale (*Ziphius cavirostris*) cannot be distinguished; therefore, sightings of beaked whales (Family Ziphiidae) are identified as *Mesoplodon* sp., Cuvier's beaked whale, or unidentified Ziphiidae.

Blainville's beaked whales appear to be widely but sparsely distributed in temperate and tropical waters of the world's oceans (Leatherwood *et al.* 1976; Leatherwood and Reeves 1983). Strandings have occurred along the northwestern Atlantic coast from Florida to Nova Scotia (Schmidly 1981), and there have been 4 documented strandings and 2 sightings of this species in the northern Gulf of Mexico (Hansen *et al.* 1995; Würsig *et al.* 2000). Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of undifferentiated beaked whales (*Mesoplodon*~~-~~ spp. and unidentified Ziphiidae) for all surveys combined was 117 (CV=0.38) (Hansen *et al.* 1995). Hansen *et al.* (1995) did not estimate the abundance of *Mesoplodon* spp. ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

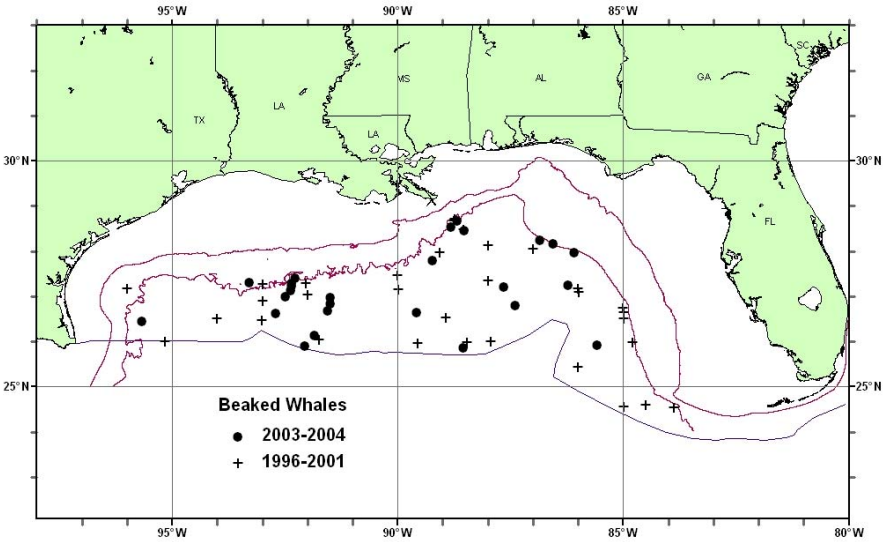


Figure 1. *Distribution of beaked whale sightings* ~~*(Mesoplodon spp.)*~~ *from SEFSC spring vessel surveys during 1996-2001 and from* ~~*sp*~~*summer 2003*~~*ring*~~ *and spring 2004*~~*summer*~~ *surveys*~~ *during 2003-2004*~~. *All the on-effort sightings are shown, though not all were used to estimate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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any

given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 1996 to 2001, ~~is~~was 106 (CV=0.41) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for these species in the northern Gulf of Mexico~~. This ~~is~~was a combined estimate for Gervais' beaked whale and Blainville's beaked whale. The estimate for the same time period for unidentified Ziphiidae ~~is~~was 146 (CV=0.46) which may also include an unknown number of Cuvier's beaked whales.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 2003 to 2004, was 57 (CV=1.40) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico. This is a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may also include an unknown number of Cuvier's beaked whales.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for *Mesoplodon* spp. is ~~106~~57 (CV=~~0.41~~1.40). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is ~~76~~24.

Current Population Trend

~~There are insufficient data to determine the population trends for this species.~~There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Mesoplodon* spp. for 2003-2004 of 57 (CV=1.40) and that for 1996-2001 of 106 (CV=0.41) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~ These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Mesoplodon* spp. is ~~76~~24. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico *Mesoplodon* spp. is 0.~~8~~2. It is not possible to determine the PBR for only Blainville's beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a beaked whale during 1998-200~~3~~5 (Yeung 1999; Yeung

2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of beaked whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Blainville's or other beaked whales by this fishery.

Other Mortality

There were no strandings of *Mesoplodon* spp. or unidentified beaked whales during 2004-2005. There were 2 reported stranding events of beaked whales in the Gulf of Mexico during 1999-2003. Two unidentified beaked whales mass stranded in Florida in December 1999, and 1 unidentified *Mesoplodon* stranded in Florida in January 2003. There was no evidence of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 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 acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (NMFS 2001; Balcomb and Claridge 2001; Cox *et al.*~~, in review~~ 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~~of~~ ~~6~~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.*~~, in review~~ 2006).

STATUS OF STOCK

The status of Blainville's beaked whales or other beaked whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities. Also, the continuing inability to distinguish between species of *Mesoplodon* raises concerns about the possibility of mortalities of one stock or the other exceeding 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.

REFERENCES

Balcomb, K. C. III and D. E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2: 2-12.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bonde, R. K. and T. J. O'Shea. 1989. Sowerby's beaked whale (*Mesoplodon bidens*) in the Gulf of Mexico. J. Mammal. 70: 447-449.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, 432 pp.

Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser~~p~~, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. C. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. 20~~05/~~06. Understanding the impacts of anthropogenic sound on beaked whales. ~~Submitted to~~ J. Cetacean Res. Manage. ~~33 pp. Available from: U.S. Marine Mammal Commission, 4340 East-West Highway, Rm. 905, Bethesda, MD 20814~~7(3): 177-187.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392: 29.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. NOAA Tech. Rep. NMFS CIRC-396, 176 pp.

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

Mead, J. G. 1989. Beaked whales of the genus Mesoplodon. pp. 349-430. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London, 442 pp.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

NMFS [National Marine Fisheries Service]. 2001. Joint interim report - Bahamas marine mammal stranding event of 15-16 March 2000. Available from: National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD 20910.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Simmonds, M. P. and L. F. Lopez-Jurado. 1991. Whales and the military. Nature 351:448.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Würsig, B., T. A. Jefferson and D. J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. Texas A&M University Press, College Station.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Three species of *Mesoplodon* are known to occur in the Gulf of Mexico, based on stranding or sighting data (Hansen *et al.* 1995; Würsig *et al.* 2000). These are Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*)~~,~~ and Sowerby's beaked whale (*M. bidens*). Sowerby's beaked whale in the Gulf of Mexico is considered extralimital because there is only 1 known stranding of this species (Bonde and O'Shea 1989) and because it normally occurs in northern temperate waters of the North Atlantic (Mead 1989). Identification of *Mesoplodon* to species in the Gulf of Mexico is very difficult, and in many cases, *Mesoplodon* and Cuvier's beaked whale (*Ziphius cavirostris*) cannot be distinguished; therefore, sightings of beaked whales (Family Ziphiidae) are identified as *Mesoplodon* sp., Cuvier's beaked whale, or unidentified Ziphiidae.

Gervais' beaked whales appear to be widely but sparsely distributed in temperate and tropical waters of the world's oceans (Leatherwood *et al.* 1976; Leatherwood and Reeves 1983). Strandings have occurred along the northwestern Atlantic coast from Florida to Nova Scotia (Schmidly 1981), and there have been 16 documented strandings in the Gulf of Mexico (Würsig *et al.* 2000). Beaked whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of undifferentiated beaked whales (*Ziphius* and *Mesoplodon* spp.) for all surveys combined was 117 (CV=0.38) (Hansen *et al.* 1995). ~~Hansen *et al.* (1995) did not estimate the abundance of *Mesoplodon* spp. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

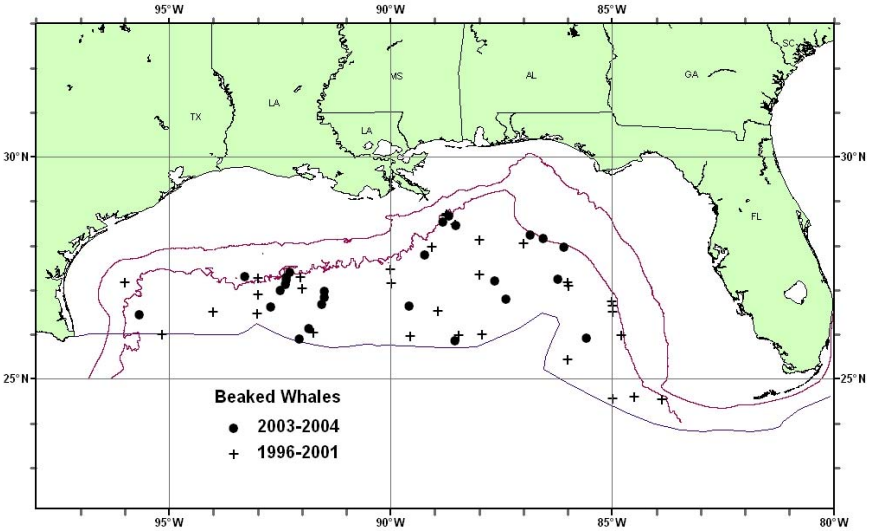


Figure 1. *Distribution of beaked whale sightings ~~(Mesoplodon spp.)~~ from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 1996 to 2001, ~~is~~was 106 (CV=0.41) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for these species in the northern Gulf of~~

~~Mexico~~. This ~~is~~ was a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate for the same time period for unidentified Ziphiidae ~~is~~was 146 (CV=0.46), which may also include an unknown number of Cuvier's beaked whales.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extend of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for *Mesoplodon* spp. in oceanic waters, pooled from 2003 to 2004, was 57 (CV=1.40) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico. This is a combined estimate for Blainville's beaked whale and Gervais' beaked whale. The estimate for the same time period for unidentified Ziphiidae was 337 (CV=0.40), which may also include an unknown number of Cuvier's beaked whales.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for *Mesoplodon* spp. is ~~106~~57 (CV = ~~0.41~~1.40). The minimum population estimate for *Mesoplodon* spp. in the northern Gulf of Mexico is ~~76~~24.

Current Population Trend

~~There are insufficient data to determine the population trends for this species.~~There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Mesoplodon* spp. for 2003-2004 of 57 (CV=1.40) and that for 1996-2001 of 106 (CV=0.41) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Mesoplodon* abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for *Mesoplodon* spp. is ~~76~~24. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico *Mesoplodon* spp. is 0.~~8~~2. It is not possible to determine the PBR for only Gervais' beaked whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a beaked whale during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of beaked whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico.

There were no reports of mortality or serious injury to Gervais' or other beaked whales by this fishery.

Other Mortality

There were no strandings of *Mesoplodon* spp. or unidentified beaked whales during 2004-2005. There were 2 reported stranding events of beaked whales in the Gulf of Mexico during 1999-2003. Two unidentified beaked whales mass stranded in Florida in December 1999, and 1 unidentified *Mesoplodon* stranded in Florida in January 2003. There was no evidence of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Several unusual mass strandings of beaked whales in North Atlantic marine environments have been associated with military naval activities. During the mid- to late 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 acoustic sonar tests conducted by the North Atlantic Treaty Organization (Frantzis 1998). In March 2000, 14 beaked whales live stranded in the Bahamas; 6 beaked whales (5 Cuvier's and 1 Blainville's) died (Evans and England 2001; Balcomb and Claridge 2001; Cox *et al*.~~, in review~~ 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 ~~6~~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*.~~, in review~~ 2006).

STATUS OF STOCK

The status of Gervais' beaked whales or other beaked whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is a strategic stock because of uncertainty regarding stock size and evidence of human induced mortality and serious injury associated with acoustic activities. Also, the continuing inability to distinguish between species of *Mesoplodon* raises concerns about the possibility of mortalities of one stock or the other exceeding 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.

REFERENCES

Balcomb, K. C. III and D. E. Claridge. 2001. A mass stranding of cetaceans caused by naval sonar in the Bahamas. Bahamas J. Sci. 2: 2-12.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bonde, R. K. and T. J. O'Shea. 1989. Sowerby's beaked whale (*Mesoplodon bidens*) in the Gulf of Mexico. J. Mammal. 70: 447-449.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

~~Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. (in review). Report of a workshop to understand the impacts of anthropogenic sound on beaked whales. Submitted to J. Cetacean Res. Manage. 33 pp. Available from: U.S. Marine Mammal Commission, 4340 East-West Highway, Rm. 905, Bethesda, MD 20814.~~

Cox, T. M., T. J. Ragen, A. J. Read, E. Vos, R. W. Baird, K. Balcomb, J. Barlow, J. Caldwell, T. Cranford, L. Crum, A. D'Amico, G. D'Spain, A. Fernandez, J. Finneran, R. Gentry, W. Gerth, F. Gulland, J. Hildebrand, D. Houser, T. Hullar, P. D. Jepson, D. Ketten, C. D. MacLeod, P. Miller, S. Moore, D. C. Mountain, D. Palka, P. Ponganis, S. Rommel, T. Rowles, B. Taylor, P. Tyack, D. Wartzok, R. Gisiner, J. Mead, and L. Benner. 2006.

Understanding the impacts of anthropogenic sound on beaked whales. J. Cetacean Res. Manage. 7(3): 177-187.

Evans, D.L. and G. R. England. 2001. Joint interim report - Bahamas Marine Mammal Stranding - event of 15-16 March 2000. U.S. Department of Commerce; Secretary of the Navy, vi + 59 pp. Available at: http://www.nmfs.noaa.gov/pr/acoustics/acoustics_reports.htm.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Frantzis, A. 1998. Does acoustic testing strand whales? Nature 392: 29.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Leatherwood, S., D. K. Caldwell and H. E. Winn. 1976. Whales, dolphins, and porpoises of the western North Atlantic. NOAA Tech. Rep. NMFS CIRC-396, 176 pp.

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

Mead, J. G. 1989. Beaked whales of the genus Mesoplodon. pp. 349-430. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, London, 442 pp.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Schmidly, D. J. 1981. Marine mammals of the southeastern United States and the Gulf of Mexico. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, DC, FWS/OBS-80/41, 165 pp.

Simmonds, M. P. and L. F. Lopez-Jurado. 1991. Whales and the military. Nature 351: 448.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Würsig, B., T. A. Jefferson and D. J. Schmidly. 2000. The marine mammals of the Gulf of Mexico. Texas A&M University Press, College Station.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Gulf of Mexico continental shelf bottlenose dolphin stock inhabits waters from 20 to 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 (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998). The continental shelf stock probably consists of a mixture of both the coastal and offshore ecotypes. The offshore and nearshore ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 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 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.

The bottlenose dolphins inhabiting waters <20m deep in the U.S. Gulf are believed to constitute 36 inshore or coastal stocks. An oceanic stock is provisionally defined for bottlenose dolphins inhabiting waters >200m. Both inshore and coastal stocks and the oceanic stock are separate from the continental shelf stock. However, the continental shelf stock may overlap with coastal stocks and the oceanic stock in some areas and may be genetically indistinguishable from those stocks. ~~Analysis of biopsy samples obtained from bottlenose dolphins in the shelf region is scheduled for 2005-06.~~ However, studies have shown significant genetic differentiation between inshore stocks and coastal/continental shelf stocks (Sellas *et al.* 200~~2~~5).

Based on research currently being conducted on bottlenose dolphins in the Gulf of Mexico, as well as the western North Atlantic Ocean, the structure of these stocks is uncertain, but appears to be complex. The multi-disciplinary research programs conducted over the last 3.5 decades (e.g., Wells 1994) have begun to shed light on the structure of some of the stocks of bottlenose dolphins, though additional analyses are needed before stock structures can be elaborated on in the Gulf of Mexico. As research is completed, it may be necessary to revise stocks of bottlenose dolphins in the Gulf of Mexico.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. Data were collected from 1998 to 2001 during fall plankton surveys conducted from NOAA ships *Oregon II* (1998, 1999) and *Gordon Gunter* (2000, 2001). Tracklines, which were perpendicular to the bathymetry, covered shelf waters from the 20m to the 200m isobaths (Figure 1, Table 1; Fulling *et al.* 2003). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both areas.

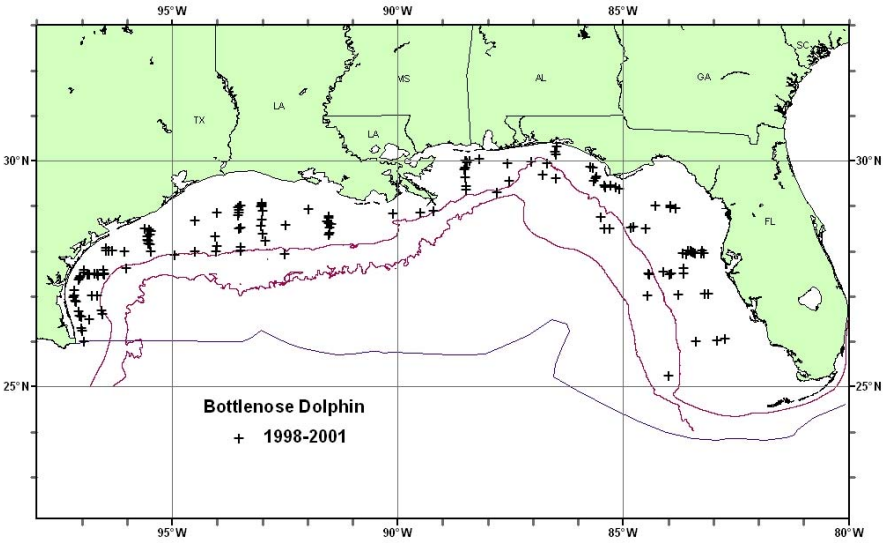


Figure 1. *Distribution of bottlenose dolphin sightings from SEFSC fall vessel surveys during 1998-2001. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted line shows the~~ offshore extent of the U.S.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

The best abundance estimate of bottlenose dolphins, pooled from 199~~8~~9 through 2001, for continental shelf vessel surveys was 2~~5,320~~1,531 (CV=0.2~~6~~8) (see Fulling *et al.* 2003). This estimate is considered the best because these surveys have the most complete coverage of the species' habitat.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for bottlenose dolphins is 2~~5,320~~1,531 (CV=0.2~~6~~8). The minimum population estimate for the northern Gulf of Mexico is ~~20,414~~17,084 bottlenose dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate from the 199~~8~~9-2001 ship survey of 2~~5,320~~1,531 (CV=0.2~~6~~8) 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 9.3km past the 18m (10fm) curve to 9.3km past 183m (100fm) 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 are not always easily distinguished from bottlenose dolphins, so it is possible that some groups were misidentified during aerial surveys leading to bias in the relative abundance of each species.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a "recovery" factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~20,414~~17,084 ~~(CV=0.26~~). The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico continental shelf bottlenose dolphin is ~~204~~170.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There are no observed cases of human-caused mortality and serious injury in this stock; however, based on an observed non-lethal take in U.S. Atlantic waters in 1993 in the pelagic longline fishery, this stock may be subject to incidental take resulting in serious injury or mortality. Fishery interactions have been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico (SEFSC unpublished logbook data), and annual fishery-related mortality and serious injury to bottlenose dolphins was estimated to be 2.8 per year (CV=0.74) during 1992-1993. This could include bottlenose dolphins from the oceanic stock. There has been no reported fishing-related mortality of bottlenose dolphins during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004~~).~~; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of bottlenose dolphins in the northern Gulf of Mexico is unknown; however, interactions between bottlenose dolphins and fisheries have been observed in the northern Gulf of Mexico. There have been no reports of incidental mortality or injury associated with the shrimp trawl fishery in this area. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no observed incidental takes or releases of bottlenose dolphins in the Gulf of Mexico from 1997 to 2001. 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 have been no reports of either serious injury or mortality to bottlenose dolphins (NMFS unpublished data).

STATUS OF STOCK

The status of bottlenose dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Blaylock, R. A. and W. Hoggard. 1994. Preliminary estimates of bottlenose dolphin abundance in southern U.S. Atlantic and Gulf of Mexico continental shelf waters. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-356, 10 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Burn, D. and G. P. Scott. 1988. Synopsis of available information on marine mammals-fisheries interactions in the southeastern United States: preliminary report. NMFS/SEFC, Miami Laboratory, Coastal Resources Division, Contribution ML-CRG-87/88-26, 37 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101:923-932.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Gitschlag, G. R. and B. A. Herczeg. 1994. Sea turtle observations at explosive removals of energy structures. Mar. Fish. Rev. 56(2): 1-8.

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

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' populations of the bottlenose dolphin. Proc. R. Soc. Lond. B 265: 1177-1183.

LeDuc, R. G. and B. E. Curry. 1998. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Rep. int. Whal. Commn. 47: 393.

~~Sellas, A. B. 2002. Population structure and group relatedness of bottlenose dolphins (*Tursiops truncatus*) in the coastal Gulf of Mexico using mitochondrial DNA and nuclear microsatellite markers. Masters Thesis from University of California, Santa Cruz.~~Sellas, A. B., R. S. Wells and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6: 715-728.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19(3): 502-514.

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

Wells, R. S. 1994. Determination of bottlenose dolphin stock discreteness: Application of a combined behavioral and genetic approach. pp. 16-20. *In:* K. R. Wang, P. M. Payne and V.G. Thayer (compilers) Coastal Stock(s) of Atlantic Bottlenose Dolphin: Status Review and Management. Proceedings and Recommendations from a

Workshop held in Beaufort, NC, 13-14 September 1993. NOAA Tech. Memo. NMFS-OPR-4, 120 pp.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins inhabit coastal waters throughout the northern Gulf of Mexico (Mullin *et al.* 1990). Northern Gulf of Mexico coastal waters have been divided for management purposes into 3 bottlenose dolphin stocks: eastern, northern and western. As a working hypothesis, it is assumed that the dolphins occupying habitats with dissimilar climactic, coastal and oceanographic characteristics might be restricted in their movements between habitats, and thus constitute separate stocks. Coastal waters are defined as those from shore, barrier islands, or presumed bay boundaries to the 20m isobath (Figure 1). The eastern coastal bottlenose dolphin stock area extends from 84° W longitude to Key West, Florida; the northern coastal bottlenose dolphin stock area from 84° W longitude to the Mississippi River Delta; and the western coastal bottlenose dolphin stock area from the Mississippi River Delta to the Texas-Mexico border. The eastern coastal stock area is temperate to subtropical in climate, is bordered by a mixture of coastal marshes, sand beaches, marsh and mangrove islands, and has an intermediate level of freshwater input. The northern coastal stock area is characterized by a temperate climate, barrier islands, sand beaches, coastal marshes and marsh islands, and has a relatively high level of fresh water input. The western coastal stock area is characterized by an arid to temperate climate, sand beaches in southern Texas, extensive coastal marshes in northern Texas and Louisiana, and low to high levels of fresh water input.

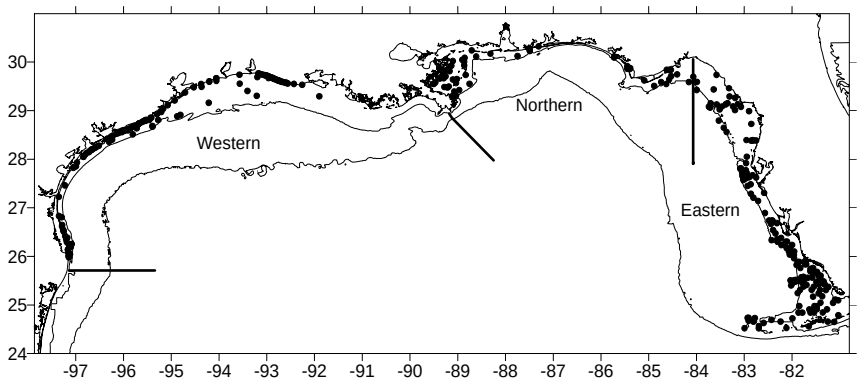


Figure 1. Locations of bottlenose dolphin groups sighted in coastal waters during aerial surveys in 1992-1994. The 20 and 200m isobaths are shown.

Portions of the coastal stocks may co-occur with the northern Gulf of Mexico continental shelf stock and bay, sound and estuary stocks, and the western coastal stock is trans-boundary with Mexico. The seaward boundary for coastal stocks, the 20m isobath, generally corresponds to survey strata (Scott ~~*et al.*~~ 1990; Blaylock and Hoggard 1994; Fulling *et al.* 2003), and thus represents a management boundary rather than an ecological boundary. Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998), and both could potentially occur in coastal waters. The offshore and coastal ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 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. However, because the continental shelf is much wider in the Gulf, results from the Atlantic may not apply. ~~About 180 genetic samples are available to help assess whether the continental shelf and coastal stocks should be separated, and if so, where. Analysis of these samples is scheduled for 2005-06.~~ Research on coastal stocks is limited. Sellas *et al.* (200~~2~~5) ~~found significant genetic differentiation between Sarasota Bay resident dolphins and those occurring primarily in adjacent Gulf coastal waters.~~ examined population subdivision among Sarasota Bay, Tampa Bay, Charlotte Harbor, Matagorda Bay, 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 estuarine stocks from those occurring in adjacent Gulf coastal waters. ~~–~~Fazioli ~~*and Wells*~~ *et al.* (~~1999~~2006) conducted photo-identification surveys of coastal waters off Tampa Bay, Sarasota Bay, and Charlotte Harbor/Pine Island Sound over 14 months. They found coastal waters were inhabited by both 'inshore' and 'Gulf' dolphins but that the 2 types used coastal waters differently. Dolphins from the inshore communities were observed occasionally in Gulf near-shore waters adjacent to their inshore range, whereas 'Gulf' dolphins were found primarily in open Gulf of Mexico waters with some displaying seasonal variations in their use of the study area. The 'Gulf' dolphins did not show a preference for waters near passes as was seen for 'inshore' dolphins, but moved throughout the study area and made greater use of waters offshore of waters used by 'inshore' dolphins. During winter months abundance of 'Gulf' groups decreased while

abundance for 'inshore' groups increased. Seasonal movements of identified individuals and abundance indices suggest that part of the 'Gulf" dolphin community moves out of the study area during winter, but their destination is unknown. ~~While they found a mixture of ranging patterns (seasonal residency, transience), they did find some dolphins displayed many of the community structure characteristics of inshore dolphins. Similar finding were reported by Quintana-Rizzo and Wells (2001) for coastal waters of Cedar Key, Florida.~~ 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 ~~1995~~2002).

POPULATION SIZE

Population size has not been estimated for the 3 coastal stocks for more than 8 years and therefore the current population size is unknown for each (Wade and Angliss 1997). Previous estimates of abundance were derived using distance sampling analysis (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) with sighting data collected during aerial line-transect surveys conducted during autumn from 1992-1994 (Blaylock and Hoggard 1994; NMFS unpublished data). Systematic sampling transects, placed randomly with respect to the bottlenose dolphin distribution, extended orthogonally from shore out to approximately 9km past the 18m isobath. Approximately 5% of the total survey area was visually searched. Previous bottlenose dolphin abundance estimates for each stock based on the 1991-1994 surveys are listed in Table 1.

Table 1. Previous bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV), and minimum population estimate (N_{MIN}) for northern Gulf of Mexico coastal bottlenose dolphin stocks. Because they are based on data collected more than 8 years ago, all estimates are currently considered unknown. PBR - Potential Biological Removal, UNK - unknown.

Gulf of Mexico Stock Area	**N_{BEST}**	**CV**	**N_{MIN}**	**PBR**	**Year**
Eastern	9,912	0.12	~~8,963~~UNK	UNK	1994
Northern	4,191	0.21	~~3,518~~UNK	UNK	1993
Western	3,499	0.21	~~2,938~~UNK	UNK	1992

Minimum Population Estimate

The current minimum population size for each stock is unknown. ~~The previous minimum population estimates for each stock based on the 1992-1994 surveys are listed in Table 1.~~ The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997).

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is currently unknown for each stock. PBR is the product of minimum population size, one-half the maximum productivity rate and a "recovery" factor (Wade and Angliss 1997). The "recovery" factor, which accounts for endangered, depleted and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stocks are of unknown status.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

A total of 1,~~377~~404 bottlenose dolphins were found stranded in the northern Gulf of Mexico from ~~1999~~2001 through 200~~3~~5 (Table 2) (NMFS unpublished data). Of these, 7~~3~~6 ~~or 5%~~ 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 recreational and commercial fishing gear (Wells and Scott 1994; Wells *et al.* 1998; Gorzelany 1998), and some are struck by recreational and commercial vessels (Wells and Scott 1997).

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

interaction, and the condition of the carcass if badly decomposed can inhibit the interpretation of cause of death.

The Gulf of Mexico menhaden fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken.

Feeding or provisioning, and swimming with wild bottlenose dolphins have been documented in Florida, particularly near Panama City Beach in the Panhandle, and near Sarasota Bay (Cunningham-Smith *et al.* 2006). Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, Samuels and Bejder (2004) observed a high rate of uncontrolled provisioning near Panama City beach in 1998. The effects of swim-with activities on dolphins and their legality under the MMPA are less clear and are currently under review. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning.

Table 2. Bottlenose dolphin strandings in the U.S. Gulf of Mexico (West Florida to Texas) from 2001 to 2005. Data are from the Southeast Marine Mammal Stranding Database (SESUS). Percent of animals with human interactions were calculated based on animals which were determined as "yes" or "no" for human interactions. Animals that were "CBD" (could not be determined) were excluded from % with human interactions calculations.

S~~tate~~TATE		**2001**	**2002**	**2003**	**2004**	**2005**	**TOTAL**
Florida							
	No. Stranded	57	82 [a]	64 [d]	162	135	500
	No. Human Interactions	2	6	7	4	4	23
	No. CBD	26	44	34	63	84	251
	% With Human Interactions	6%	16%	23%	4%	8%	9%
Alabama							
	No. Stranded	17	12	7	18	19	73
	No. Human Interactions	2	0	1	0	0	3
	No. CBD	8	9	4	18	15	54
	% With Human Interactions	22%	0%	33%	CBD	0%	16%
Mississippi							
	No. Stranded	22	21[b]	37 [e]	27	11	118
	No. Human Interactions	0	0	0	1	0	1
	No. CBD	8	6	29	13	6	62
	% With Human Interactions	0%	0%	0%	7%	0%	2%
Louisiana							
	No. Stranded	0	2	33 [f]	26	22	83
	No. Human Interactions	-	0	0	2	1	3
	No. CBD	-	2	29	24	15	70
	% With Human Interactions	-	CBD	0%	100%	14%	23%
Texas							
	No. Stranded	116	154 [c]	154 [g]	110	96	630
	No. Human Interactions	6	15	10	12	3	46
	No. CBD	5	57	101	41	17	221
	% With Human Interactions	5%	15%	19%	17%	4%	11%

TOTAL~~Totals~~							
	No. Stranded	212	271	295	343	283	1404
	No. Human Interactions	10	21	18	19	8	76
	No. CBD	47	118	197	159	137	658
	% With Human Interactions	6%	14%	18%	10%	5%	10%

a Florida mass stranding of 2 animals in December 2002
b Mississippi mass stranding of 2 animals in March 2002
c Texas mass strandings (2 animals in January 2002, 2 animals in March 2002)
d Florida mass stranding of 2 animals in May 2003
e Mississippi mass stranding of 2 animals in April 2003
f Louisiana mass stranding of 3 animals in July 2003
g Texas mass stranding of 5 animals in March 2003

Fisheries Information

The commercial fisheries which potentially could interact with coastal stocks in the northern Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden and gillnet fisheries (Appendix I). Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. The blue crab fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery. There ~~is~~are no observer program data for the menhaden fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury.

Other Mortality

The nearshore habitat occupied by these 3 stocks is adjacent to areas of high human population and in some areas, such as ~~the~~ Tampa Bay, Florida; Galveston, Texas; and Mobile, Alabama, is highly industrialized. Concentrations of anthropogenic chemicals such PCB's and DDT and its metabolites vary from site to site, and can reach levels of concern for bottlenose dolphin health and reproduction in the southeastern U.S. (Schwacke *et al.* 2002). PCB concentrations in 3 stranded dolphins sampled from the eastern coastal stock area ranged from 16-46Φg/g wet weight. Two stranded dolphins from the northern coastal stock area had the highest levels of DDT derivatives of any of the bottlenose dolphin liver samples analyzed in conjunction with a 1990 mortality investigation conducted by NMFS (Varanasi *et al.* 1992). The significance of these findings is unclear, but there is some evidence that increased exposure to anthropogenic compounds may reduce immune function in bottlenose dolphins (Lahvis *et al.* 1995). 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 ~~1~~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.

Since 1990, there have been ~~6~~8 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). In March and April 1992, 111 bottlenose dolphins stranded in Texas; about 9 times the average number. Seven of 34 live-captured bottlenose dolphins (20%) in 1992 from Matagorda Bay, Texas, tested positive for previous exposure to cetacean morbillivirus and it is possible that other stocks have been exposed to the morbillivirus (Duignan *et al.* 1996).

~~In 1992, NOAA Fisheries' Working Group on Unusual Marine Mortality Events was formalized and developed protocols to declare Unusual Mortality Events (UME) and respond to them. Since 1992, 4 UMEs involving bottlenose dolphins have been investigated in the northern Gulf of Mexico. In 1993-1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). In 1996 a UME was declared for bottlenose dolphins in Mississippi and while the cause was not determined, *Karenia brevis* (red tide) was suspected. Between August 1999 and February 2000, at least 120 bottlenose~~

~~dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 107 bottlenose dolphins stranded dead (NMFS 2004).~~

In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an usual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 6 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. In 1993-1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb 1994). From February through April 2004, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. In 1996 a UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. Between August 1999 and February 2000, at least 120 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 107 bottlenose dolphins stranded dead (NMFS 2004). 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. From July to December 2005, a total of 79 bottlenose dolphins stranded. The multi-species UME extended into 2006, and proposed dates for UME closure are in review. Finally, a separate 2005-2006 UME was declared in the Florida panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom. Between September 2005 and September 2006, 98 bottlenose dolphin strandings occurred (plus 1 stranding of a striped dolphin, *Stenella coeruleoalba*). In September 2006 the event was officially declared over.

STATUS OF STOCK

The status of each stock relative to OSP is not known and population trends cannot be determined due to insufficient data. This species is not listed as threatened or endangered under the Endangered Species Act. The total known human-related mortality and serious injury for each stock cannot be assessed relative to PBR because the PBR is unknown for each stock, and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. Each is a strategic stock because the known level of human-related mortality or serious injury relative to PBR is unknown. Also, there is no systematic monitoring of all fisheries that may take these stocks. Insufficient information is available to determine whether the total fishery mortality and serious injury for coastal bottlenose dolphin stocks is insignificant and approaching zero mortality and serious injury rate. The potential impact, if any, of coastal pollution may be an issue for this species in portions of its habitat, though little is known on this to date.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and a Summary of the 1995 Assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Beier, A. G. 2001. Occurrence, distribution, and movement patterns of outer coastline bottlenose dolphins off Galveston, Texas. Master's thesis from Texas A&M University, 97 pp.

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

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

Cunningham-Smith, P., D. E. Colbert, R. S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. Aquat. Mamm. 32(3):346-356.

Duignan, P. J., C. House, D. K. Odell, R. S. Wells, L. Hansen, M. T. Walsh, D. J. St. Aubin, B. K. Rima and J. R. Geraci. 1996. Morbillivirus infection in bottlenose dolphin: evidence for recurrent epizootics in the Western Atlantic and Gulf of Mexico. Mar. Mamm. Sci. 12(4): 499-515.

Fazioli, K. L., S. Hofmann and R. S. Wells. ~~1999~~2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 32(2): 212-222.~~Stock structure of coastal bottlenose dolphins, *Tursiops truncatus*, near Sarasota, Florida. Final Contract Report to the National Marine Fisheries Service, Southeast Fisheries Science Center, Contract No. 40-WCNF701806.~~

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Gorzelany, J. F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to

ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3): 614-6167.

Hansen, L. J. (ed). 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21.

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

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' populations of bottlenose dolphins. Proc. R. Soc. Lond., Ser. B: Biol. Sci. 265: 1177-1183.

Laake, J. L., S. T. Buckland, D. R. Anderson and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins, 72 pp.

Lahvis, G. P., R. S. Wells, D. W. Kuehl, J. L. Stewart, H. L. Rhinehart and C. S. Via. 1995. Decreased lymphocyte responses in free-ranging bottlenose dolphins (*Tursiops truncatus*) are associated with increased concentrations of PCB's and DDT in peripheral blood. Environ. Health Perspect. 103: 67-72.

LeDuc, R. G. and B. E. Curry. 1998. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Rep. Int. Whal. Commn. 47: 393.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. pp. 4-5. *In:* R. A. Blaylock, B. Mase and D. K. Odell (eds.) Strandings, Vol. 2, No. 3, SEFSC Miami Laboratory, Miami, Florida, 7 pp.

Lipscomb, T. P. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J. Wildl. Dis. 30(4): 572-576.

Lynn, S. K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G. Mex. Sci. 20(1): 25-37.

McFee, W. E. and W. Brooks Jr. 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: A summary. U.S. Fish and Wildlife Service unpublished report. Available from:

Mullin, K. D., R. R. Lohoefener, W. Hoggard, C. L. Roden and C. M Rogers. 1990. Abundance of bottlenose dolphins, *Tursiops truncatus*, in the coastal Gulf of Mexico. Northeast Gulf Sci. 11(2): 113-122.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

NMFS. 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. 35 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

~~NMFS [National Marine Fisheries Service]. 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. 35 pp.~~

~~Quintana-Rizzo, E. and R. S. Wells. 2001. Resighting and association patterns of bottlenose dolphins (*Tursiops truncatus*) in the Cedar Keys, Florida: Insight into social organization. Can. J. Zool. 79: 447-456.~~

Rabalais, N. N., R. E. Turner and W. J. Wiseman, Jr. 1999. Hypoxia in the northern Gulf of Mexico: Linkage with the Mississippi River. pp. 297-322. *In:* H. Kumpf, K. Steidinger and K. Sherman (eds.) The Gulf of Mexico large marine ecosystem. Blackwell Science, Oxford, UK.

Reynolds, J. E., III. 1985. Evaluation of the nature and magnitude of interactions between bottlenose dolphins, *Tursiops truncatus*, and fisheries and other human activities in coastal areas of the southeastern United States. National Technical Information Service PB86-162203, U.S. Department of Commerce, Springfield, VA 22161.

Samuels, A. and L. Bejder. 2004. Chronic interactions between human and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. J. Cetacean Res. Manage. 6: 69-77.

~~Sellas, A. B. 2002. Population structure and group relatedness of bottlenose dolphins (Tursiops truncatus) in the coastal Gulf of Mexico using mitochondrial DNA and nuclear microsatellite markers. Master's thesis from University of California, Santa Cruz.~~

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the Southeast United States coast. Environ. Toxicol. Chem. 21: 2752–2764.

Scott, G. P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. pp. 623-639. *In:* S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA, 653 pp.

Sellas, A. B., R. S. Wells and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6: 715-728.

Smith, J. W., E. A. Hall, N. A. McNeil and W. B. O'Bier. 2002. The distribution of purse-seine sets and catches in the Gulf Menhaden fishery in the Northern Gulf of Mexico, 1994-1998. G. Mex. Sci. 20: 12-24.

Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19(3): 502-514.

Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark and S. L. Chan. 1992. pp. 56-86. *In:*

L. J. Hansen (ed.) Report on Investigation of 1990 Gulf of Mexico Bottlenose Dolphin Strandings, Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.

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

Wells, R. S. and M. D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. p. 629. *In:* W. F. Perrin, G. P. Donovan and J. Barlow (eds.) Gillnets and cetaceans. Rep. Int. Whal. Commn., Special Issue 15.

Wells, R. S. and M. D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 13(3): 475-480.

Wells, R. S., S. Hofmann and T.L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3):647-650.

~~Würsig, B. and S. K. Lynn. 1996. Movements, site fidelity, and respiration patterns of bottlenose dolphins on the central Texas coast. NOAA Tech. Memo. NMFS-SEFSC 383, 43 pp.~~

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Thirty-eight stocks have been provisionally identified for Gulf of Mexico bottlenose dolphins (Waring *et al.* 2001). Gulf of Mexico inshore habitat has been separated into 33 bay, sound and estuarine stocks. Three northern Gulf of Mexico coastal stocks include nearshore waters from the shore to the 20 m isobath. The continental shelf stock encompasses waters from 20 to 200m deep. The Gulf of Mexico oceanic stock encompasses the waters from the 200 m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ; Figure 1).

Both "coastal/nearshore" and "offshore" ecotypes of bottlenose dolphins (Hersh and Duffield 1990) occur in the Gulf of Mexico (LeDuc and Curry 1998) but the distribution of each is not known. The offshore and nearshore ecotypes are genetically distinct using both mitochondrial and nuclear markers (Hoelzel *et al.* 1998). In the northwestern Atlantic Ocean, Torres *et al.* (2003) found a statistically significant break in the distribution of the ecotypes at 34km from shore. The offshore ecotype was found exclusively seaward of 34 km and in waters deeper than 34m. The continental shelf is much wider in the Gulf of Mexico and these results may not apply.

Based on research currently being conducted on bottlenose dolphins in the Gulf of Mexico, as well as the western North Atlantic Ocean, the structure of these stocks is uncertain, but appears to be complex. The multi-disciplinary research programs conducted over the last 3.5 decades (e.g., Wells 1994) are beginning to shed light on stock structures of bottlenose dolphins, though additional analyses are needed before stock structures can be elaborated on in the Gulf of Mexico. As research is completed, it may be necessary to revise stocks of bottlenose dolphins in the Gulf of Mexico.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. Surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001).~~ . Tracklines, which were perpendicular to the bathymetry, covered the waters from 200m to the offshore extent of the U.S. EEZ. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

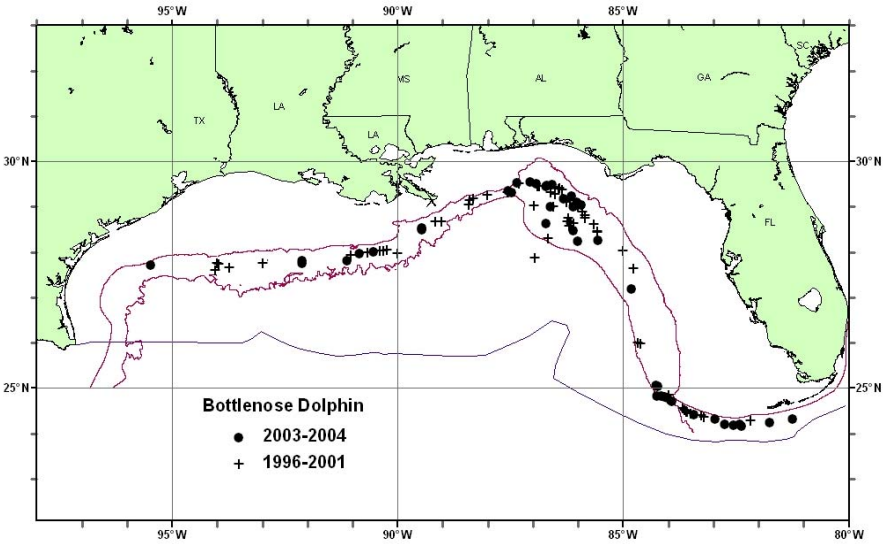


Figure 1. *Distribution of bottlenose dolphin sightings from SEFSC shipboard surveys during spring 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the ~~2~~100m and ~~2~~1,000m isobaths~~,~~ and the ~~dotted line indicates the~~ offshore extent of the U.S. EEZ.*

~~T~~The estimate of abundance for bottlenose dolphins in oceanic waters, pooled from 1996 to 2001, ~~is~~was 2,239 (CV=0.41) (Mullin and Fulling 2004)~~,~~

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are

deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for bottlenose dolphins in oceanic waters, pooled from 2003 to 2004, was 3,708 (CV=0.42) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.
~~which is the best available abundance estimate for this species in the oceanic Gulf of Mexico~~.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for bottlenose dolphins is ~~2,239~~3,708 (CV=0.~~41~~42) taken from Mullin and Fulling (2004). The minimum population estimate for the northern Gulf of Mexico oceanic stock is ~~1,607~~2,641 bottlenose dolphins.

Current Population Trend

~~There are insufficient data to determine the population trends for this stock. ????~~There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003 to 2004 of 3,708 (CV=0.42) and that for 1996-2001 of 2,239 (CV=0.41) are not significantly different (P>0.05), but due to the imprecision of the estimates, the power to detect a difference is low. ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of bottlenose dolphin abundance and stock structure. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~ These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of bottlenose dolphin abundance and stock structure. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of minimum population size, one-half the maximum productivity rate and a recovery factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~1,607~~2,641 ~~(CV=0.41)~~. 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 ~~16~~26.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Annual human-caused mortality and serious injury is unknown for this stock.

Fisheries Information

The level of past or current, direct, human-caused mortality of bottlenose dolphins in the Gulf of Mexico is unknown; however, interactions between bottlenose dolphins and fisheries have been observed in the Gulf of Mexico. There have been no reports of incidental mortality or injury associated with the shrimp trawl fishery in this area. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to bottlenose dolphins in the Gulf of Mexico during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006). Fishery interactions have previously been reported to occur between bottlenose dolphins and the longline swordfish/tuna fishery in the Gulf of Mexico (SEFSC unpublished logbook data), with annual fishery-related mortality and serious injury to bottlenose dolphins estimated to be 2.8 per year (CV=0.74) during 1992-1993. This could include bottlenose dolphins from the continental shelf and oceanic stocks. One animal was hooked in the mouth and released by the pelagic longline fishery in 1998 (Yeung 1999).

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.

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 have been no reports of either serious injury or mortality to bottlenose dolphins in the oceanic Gulf of Mexico (NMFS unpublished data).

STATUS OF STOCK

The status of bottlenose dolphins, relative to OSP, in the U.S. Gulf of Mexico oceanic waters is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. marine mammal stock assessment: guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6. National Marine Fisheries Service, Seattle, WA, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Burn, D. And G. P. Scott. 1988. Synopsis of available information on marine mammal-fisheries interactions in the southeastern United States: preliminary report. U.S. Dep. Commer., Contribution ML-CRG-87/88-26, National Marine Fisheries Service, Miami, FL, 37 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Gitschlag, G. R. and B. A. Herczeg. 1994. Sea turtle observations at explosive removals of energy structures. Mar. Fish. Rev. 56(2): 1-8.

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

Hoelzel, A. R., C. W. Potter and P. B. Best. 1998. Genetic differentiation between parapatric 'nearshore' and 'offshore' populations of the bottlenose dolphin. Proc. R. Soc. Lond. B 265: 1177-1183.

LeDuc, R. G. and B. E. Curry. 1998. Mitochondrial DNA sequence analysis indicates need for revision of the genus *Tursiops*. Rep. int. Whal. Commn. 47: 393.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

Torres, L. G., P. E. Rosel, C. D'Agrosa and A. J. Read. 2003. Improving management of overlapping bottlenose dolphin ecotypes through spatial analysis and genetics. Mar. Mamm. Sci. 19(3): 502-514.

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-12, National Marine Fisheries Service, Seattle, WA, 93 pp.

Waring, G. T., J. M. Quintal, S. L. Swartz, P. J. Clapham, T. V. N. Cole, C. P. Fairfield, A. Hohn, D. L. Palka, M. C.

Rossman, U.S. Fish and Wildlife Service and C. Yeung. 2001. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments-2001. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NE-168. National Marine Fisheries Service, Woods Hole, MA, 310 pp.

Wells, R. S. 1994. Determination of bottlenose dolphin stock discreteness: Application of a combined behavioral and genetic approach. pp. 16-20. *In:* K. R. Wang, P. M. Payne and V.G. Thayer (compilers) Coastal Stock(s) of Atlantic Bottlenose Dolphin: Status Review and Management. Proceedings and Recommendations from a Workshop held in Beaufort, NC, 13-14 September 1993. NOAA Tech. Memo. NMFS-OPR-4, 120 pp.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: National Marine Fisheries Service, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Bottlenose dolphins are distributed throughout the bays, sounds and estuaries of the Gulf of Mexico (Mullin 1988). The identification of biologically-meaningful "stocks" of bottlenose dolphins in these waters is complicated by the high degree of behavioral variability exhibited by this species (Shane *et al.* 1986; Wells and Scott 1999; Wells 2003), and by the lack of requisite information for much of the region.

Distinct stocks are provisionally identified in each of 33 areas of contiguous, enclosed or semi-enclosed bodies of water adjacent to the Gulf of Mexico (Table 1, based on descriptions of relatively discrete dolphin "communities" in some of these areas). A "community" includes resident dolphins that regularly share large portions of their ranges, exhibit similar distinct genetic profiles, and interact with each other to a much greater extent than with dolphins in adjacent waters. The term, as adapted from Wells *et al.* (1987), emphasizes geographic, genetic and social relationships of dolphins. Bottlenose dolphin communities do not constitute closed demographic populations, as individuals from adjacent communities are known to interbreed. Nevertheless, the geographic nature of these areas and long-term, multi-generational stability of residency patterns suggest that many of these communities exist as functioning units of their ecosystems, and under the Marine Mammal Protection Act must be maintained as such. Also, the stable patterns of residency observed within communities suggest that long periods would be required to repopulate the home range of a community were it eradicated or severely depleted. Thus, in the absence of information supporting management on a larger scale, it is appropriate to adopt a risk-averse approach and focus management efforts at the level of the community rather than at some larger demographic scale. Biological support for this risk-averse approach derives from several sources. Long-term (year-round, multi-year) residency by at least some individuals has been reported from nearly every site where photographic identification or tagging studies have been conducted in the Gulf of Mexico. In Texas, some of the dolphins in the Matagorda-Espiritu Santo Bay area (Gruber 1981; Lynn and Würsig 2002), Aransas Pass (Shane 1977; Weller 1998), San Luis Pass (Maze and Würsig 1999; Irwin and Würsig 2004), and Galveston Bay (Bräger 1993; Bräger *et al.* 1994; Fertl 1994) have been reported as long-term residents. Hubard *et al.* (2004) reported sightings of dolphins tagged 12-15 years previously in Mississippi Sound. In Florida, long-term residency has been reported from Choctawhatchee Bay (1989-1993), Tampa Bay (Wells 1986a; Wells *et al.* 1996a), Sarasota Bay (Irvine and Wells 1972; Irvine *et al.* 1981; Wells 1986a, 1991; Scott *et al.* 1990; Wells *et al.* 1987; Wells 2003), Lemon Bay (Wells *et al.* 1996b) and Charlotte Harbor/Pine Island Sound (Shane 1990; Wells *et al.* 1996b, 1997; Shane 2004). In Louisiana, Miller (2004~~2~~3) 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; ~~Fazioli and Wells 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 (1-12km offshore) from just outside Tampa Bay to the south end of Lemon Bay, and~~(2002)~~ found evidence of significant population structure ~~genetic differentiation between Sarasota Bay resident dolphins and those occurring primarily in adjacent Gulf coastal waters~~among all areas on the basis of both mitochondrial DNA control region sequence data and ~~nine~~9 nuclear microsatellite loci. The Sellas *et al.* (2005) findings support the separate identification of bay, sound and estuarine communities from those occurring in adjacent Gulf coastal waters.

The long-term structure and stability of at least some of these communities is exemplified by the residents of Sarasota Bay, Florida. This community has been observed since 1970 (Irvine and Wells 1972; Scott *et al.* 1990; Wells 1991). At least ~~4~~5 generations of identifiable residents currently inhabit the region, including one-third of those first identified in 1970. Maximum immigration and emigration rates of about 2-3% have been estimated (Wells and Scott 1990).

Genetic exchange occurs between resident communities; hence the application of the demographically and behaviorally-based term "community" rather than "population" (Wells 1986a; Sellas *et al.* ~~in review~~2005). Some of the calves in Sarasota Bay apparently have been sired by non-residents (Duffield and Wells 2002). A variety of potential

exchange mechanisms occur in the Gulf. Small numbers of inshore dolphins traveling between regions have been reported, with patterns ranging from traveling through adjacent communities (Wells 1986b; Wells *et al.* 1996a,b) to movements over distances of several hundred km in Texas waters (Gruber 1981; Lynn and Würsig ~~and Lynn 1996~~2002). In many areas year-round residents co-occur with non-resident dolphins, providing potential opportunities for genetic exchange. About 17% of group sightings involving resident Sarasota Bay dolphins include at least 1 non-resident as well (Wells *et al.* 1987). Similar mixing of inshore residents and non-residents is seen off San Luis Pass, Texas (Maze and Würsig 1999), and Pine Island Sound, Florida (Shane 2004). Non-residents exhibit a variety of patterns, ranging from apparent nomadism recorded as transience in a given area, to apparent seasonal or non-seasonal migrations. Passes, especially the mouths of the larger estuaries, serve as mixing areas. For example, several communities mix at the mouth of Tampa Bay, Florida (Wells 1986a), and most of the dolphins identified in the mouths of Galveston Bay and Aransas Pass, Texas, were considered transients (Henningsen 1991; Bräger 1993; Weller 1998).

Seasonal movements of dolphins into and out of some of the bays, sounds and estuaries provide additional opportunities for genetic exchange with residents, and complicate the identification of stocks in coastal and inshore waters. In small bay systems such as Sarasota Bay, Florida, and San Luis Pass, Texas, residents move into Gulf coastal waters in fall/winter, and return inshore in spring/summer (Irvine *et al.* 1981; Maze and Würsig 1999). In larger bay systems, seasonal changes in abundance suggest possible migrations, with increases in more northerly bay systems in summer, and in more southerly systems in winter. Fall/winter increases in abundance have been noted for Tampa Bay (Scott *et al.* 1989) and Charlotte Harbor/Pine Island Sound (Thompson 1981; Scott *et al.* 1989), and are thought to occur in Matagorda Bay (Gruber 1981; Lynn and ~~1995;~~ Würsig ~~and Lynn 1996~~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).

Much uncertainty remains regarding the structure of bottlenose dolphin stocks in many of the Gulf of Mexico bays, sounds and estuaries. Given the apparent co-occurrence of resident and non-resident dolphins in these areas, and the demonstrated variations in abundance, it appears that consideration should be given to the existence of a complex of stocks, and to the roles of bays, sounds and estuaries for stocks emphasizing Gulf of Mexico coastal waters. A starting point for management strategy should be the protection of the long-term resident communities, with their multi-generational geographic, genetic, demographic and social stability. These localized units would be at greatest risk from geographically-localized impacts. Complete characterization of many of these basic units would benefit from additional photo-identification, telemetry and genetic research (Wells 1994).

The current provisional stocks follow the designations in Table 1, with a few revisions. Available information suggests that Block B35, Little Sarasota Bay, can be subsumed under Sarasota Bay, and B36, Caloosahatchee River, can be considered a part of Pine Island Sound. As more information becomes available, additional combination or division may be warranted. For example, a number of geographically and socially distinct subgroupings of dolphins in regions such as Tampa Bay, Charlotte Harbor, Pine Island Sound, Aransas Pass and Matagorda Bay have been identified, but the importance of these distinctions to stock designations remain undetermined (Shane 1977; Gruber 1981; Wells *et al.* 1996a,b, 1997; Lynn and Würsig 2002; Urian 2002).

Understanding the full complement of the stock complex using the bay, sound and estuarine waters of the Gulf of Mexico will require much additional information. The development of biologically-based criteria to better define and manage stocks in this region should integrate multiple approaches, including studies of ranging patterns, genetics, morphology, social patterns, distribution, life history, stomach contents, isozyme analyses and contaminant concentrations. Spatially-explicit population modeling could aid in evaluating the implications of community-based stock definition. As these studies provide new information on what constitutes a bottlenose dolphin "biological stock," current provisional definitions will likely need to be revised. As stocks are more clearly identified, it will be possible to conduct abundance estimates using standardized methodology across sites (thereby avoiding some of the previous problems of mixing results of aerial and boat-based surveys), identify fisheries and other human impacts relative to specific stocks and perform individual stock assessments. As recommended by the Atlantic Scientific Review Group (November 1998, Portland, Maine), an expert panel reviewed the stock structure for bottlenose dolphins in the Gulf of Mexico during a workshop in March 2000 (Hubard and Swartz 2002). The panel sought to describe the scope of risks faced by bottlenose dolphins in the Gulf of Mexico, and outline an approach by which the stock structure could most efficiently be investigated and integrated with data from previous and ongoing studies. The panel agreed that it was appropriate to use the precautionary approach and retain the stocks currently named until further studies are conducted, and made a variety of recommendations for future research (Hubard and Swartz 2002). As a result of this, efforts are being made to conduct research in new locations, such as the central Gulf, in addition to the ongoing studies in Texas and Florida.

Table 1. ~~Previous~~Most recent bottlenose dolphin abundance (N_{BEST}), coefficient of variation (CV) and minimum population estimate (N_{MIN}) in U.S. Gulf of Mexico bays, sounds and estuaries. Because they are based on data collected more than 8 years ago, ~~all~~most estimates are considered unknown for management purposes. Blocks refer to 33 aerial survey blocks illustrated in Figure 1. PBR - Potential Biological Removal; UNK - unknown.

Blocks	Gulf of Mexico Estuary	N_{BEST}	CV	N_{MIN}	PBR	Year	Reference
B51	Laguna Madre	80	1.57	~~31~~UNK	UNK	1992	A
B52	Nueces Bay, Corpus Christi Bay	58	0.61	~~36~~UNK	UNK	1992	A
B50	Compano Bay, Aransas Bay, San Antonio Bay, Redfish Bay, Espiritu Santo Bay	55	0.82	~~30~~UNK	UNK	1992	A
B54	Matagorda Bay, Tres Palacios Bay, Lavaca Bay	61	0.45	~~42~~UNK	UNK	1992	A
B55	West Bay	32	0.15	28	0.3	2000	E
B56	Galveston Bay, East Bay, Trinity Bay	152	0.43	~~107~~UNK	UNK	1992	A
B57	Sabine Lake	0[a]	-		UNK	1992	A
B58	Calcasieu Lake	0[a]	-		UNK	1992	A
B59	Vermillion Bay, West Cote Blanche Bay, Atchafalaya Bay	0[a]	-		UNK	1992	A
B60	Terrebonne Bay, Timbalier Bay	100	0.53	~~66~~UNK	UNK	1993	A
B61	Barataria Bay	138	0.08	129	1.3	2001	D
B30	Mississippi River Delta	0[1]	-		UNK	1993	A
B02-05, 29,31	Bay Boudreau, Mississippi Sound	1,401	0.13	~~1,256~~UNK	UNK	1993	A
B06	Mobile Bay, Bonsecour Bay	122	0.34	~~92~~UNK	UNK	1993	A
B07	Perdido Bay	0[a]	-		UNK	1993	A
B08	Pensacola Bay, East Bay	33	0.80	~~18~~UNK	UNK	1993	A
B09	Choctawhatchee Bay	242	0.31	~~188~~UNK	UNK	1993	A
B10	St. Andrew Bay	124	0.57	~~79~~UNK	UNK	1993	A
B11	St. Joseph Bay	0[a]	-		UNK	1993	A
B12-13	St. Vincent Sound, Apalachicola Bay, St. Georges Sound	387	0.34	~~293~~UNK	UNK	1993	A
B14-15	Apalachee Bay	491	0.39	~~358~~UNK	UNK	1993	A
B16	Waccasassa Bay, Withlacoochee Bay, Crystal Bay	100	0.85	~~54~~UNK	UNK	1994	A
B17	St. Joseph Sound, Clearwater Harbor	37	1.06	~~18~~UNK	UNK	1994	A
B32-34	Tampa Bay	559	0.24	~~458~~UNK	UNK	1994	A
B20	Sarasota Bay	97	na[c]	~~97~~UNK	UNK	1992	B
B35	Little Sarasota Bay	2[b]	0.24	~~2~~UNK	UNK	1985	C
B21	Lemon Bay	0[a]	-		UNK	1994	A
B22-23	Pine Sound, Charlotte Harbor, Gasparilla Sound	209	0.38	~~153~~U	UNK	1994	A

				NK			
B36	Caloosahatchee River	0[a,b]	-		UNK	1985	C
B24	Estero Bay	104	0.67	~~62~~UNK	UNK	1994	A
B25	Chokoloskee Bay, Ten Thousand Islands, Gullivan Bay	208	0.46	~~144~~UNK	UNK	1994	A
B27	Whitewater Bay	242	0.37	~~179~~UNK	UNK	1994	A
B28	Florida Keys (Bahia Honda to Key West)	29	1.00	~~14~~UNK	UNK	1994	A

References: A- Blaylock and Hoggard 1994; B- Wells 1992; C- Scott *et al.* 1989; D- Miller 2003; E- Irwin and Würsig 2004

Notes:

a During earlier surveys (Scott *et al.* 1989), the range of seasonal abundances was as follows: B57, 0-2 (CV= 0.38); B58, 0-6 (0.34); B59, 0-0; B30, 0-182(0.14); B07, 0-0; B21, 0-15(0.43); and B36, 0-0.

b Block not surveyed during surveys reported in Blaylock and Hoggard 1994.

c No CV because NBEST was a direct count of known individuals.

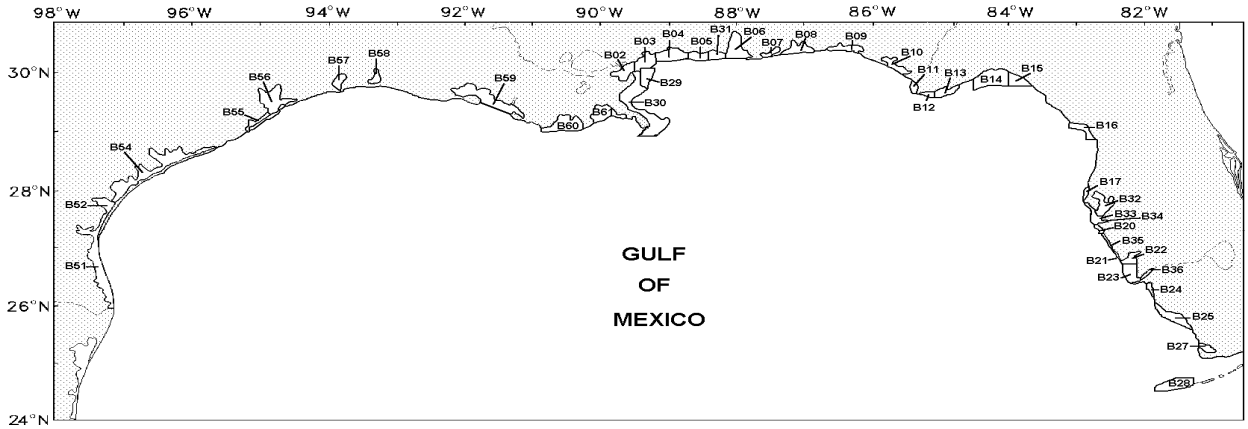


Figure 1. *U.S.A Gulf of Mexico bays and sounds. Each of the alpha-numerically designated blocks corresponds to one1 of the NMFS Southeast Fisheries Science Center logistical aerial survey areas listed in Table 1. The bottlenose dolphins inhabiting each bay and sound are considered to comprise a unique stock for purposes of this assessment.*

POPULATION SIZE

Population size estimates for most of the stocks are greater than 8 years old and therefore the current population size for each stock is considered unknown (Wade and Angliss 1997). Recent mark-recapture population size estimates are available for West Bay, Texas, and Barataria Bay, Louisiana (Table 1). Previous population size (Table 1) was estimated from preliminary analyses of line-transect data collected during aerial surveys conducted in September-October 1992 in Texas and Louisiana; in September-October 1993 in Louisiana, Mississippi, Alabama and the Florida panhandle (Blaylock and Hoggard 1994); and in September-November 1994 along the west coast of Florida (NMFS unpublished data). Standard line-transect perpendicular sighting distance analytical methods (Buckland *et al.* 1993) and the computer program DISTANCE (Laake *et al.* 1993) were used. Stock size in Sarasota Bay, Florida, was obtained through direct count of known individuals (Wells 1992). Analyses are currently underway that should provide updated abundance estimates for Sarasota Bay, Lemon Bay, Gasparilla Sound, Charlotte Harbor, Pine Island Sound, and St. Joseph Bay during 2007 (R.S. Wells, pers. comm.).

Minimum Population Estimate

The population size for all but 2 ~~most~~ stocks is currently unknown and~~. T~~ the ~~recent or the previous~~ minimum population estimates are given for those 2 ~~each~~ stocks in Table 1. The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normally distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The minimum population estimate was calculated for each block from the estimated population size and its associated coefficient of variation. Where the population size resulted from a direct count of known individuals, the minimum population size was identical to the estimated population size.

Current Population Trend

The data are insufficient to determine population trends for all of the Gulf of Mexico bay, sound and estuary bottlenose dolphin communities. ~~The Sarasota Bay community, however, has been monitored since 1970 and has remained relatively constant through 1997 at approximately 105 animals (Wells 1998).~~ Six anomalous mortality events have occurred among portions of these dolphin communities between 1990 and 2004; however, it is not possible to accurately partition the mortalities between bay and coastal stocks, thus the impact of these mortality events on communities is not known.

For Barataria Bay, Louisiana, Miller (200~~4~~3) estimated a population size ranging from 138 to 238 bottlenose dolphins (95% CI = 128-297) using mark-recapture techniques with data collected from June 1999 to May 2002. The previous estimate for Barataria Bay from 1994, 219 dolphins, falls at the high end of this range. Irwin and Würsig (2004) estimated annual population sizes ranging from 28 to 38 dolphins during 1997-2001 for the San Luis Pass/Chocolate portion of West Bay, Texas, where the previous estimate from 1992 was 29 dolphins.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are not known for the dolphin communities that comprise these stocks. While productivity rates may be estimated for individual females within communities, such estimates are confounded at the stock level due to the influx of dolphins from adjacent areas which balance losses, and the unexplained loss of some individuals which offset births and recruitment (Wells 1998). Continued monitoring and expanded survey coverage will be required to address and develop estimates of productivity for these dolphin communities. The maximum net productivity rate was assumed to be 0.04. This value is based on theoretical modeling showing that cetacean populations may not grow at rates much greater than 4% given the constraints of their reproductive life history (Barlow *et al.* 1995).

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is unknown for most stocks because the population size estimate is more than 8 years old. PBR is the product of minimum population size, one-half the maximum productivity rate and a "recovery" factor (Wade and Angliss 1997). The "recovery" factor, which accounts for endangered, depleted, and threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because these stocks are of unknown status. PBR for those stocks with population size estimates less than 8 years old is given in Table 1.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

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

A total of 1,~~377~~404 bottlenose dolphins were found stranded in the U.S. Gulf of Mexico from ~~1999~~2001 through 200~~3~~5 (Table 2) (NMFS unpublished data). Of these, 7~~3~~6 ~~or 11%~~ 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 recreational and commercial fishing gear (Wells and Scott 1994; Wells *et al.* 1998; Gorzelany 1998) and some are struck by recreational and commercial vessels (Wells and Scott 1997). In 1998 alone, 2 resident bottlenose dolphins and an associated calf were killed by vessel strikes and a resident young-of-the-year died from entanglement in a crab-pot float line (R.S. Wells, pers. comm.).

The Gulf of Mexico menhaden fishery was observed to take 9 bottlenose dolphins (3 fatally) between 1992 and 1995 (NMFS unpublished data). During that period, there were 1,366 sets observed out of 26,097 total sets, which if extrapolated for all years suggests that as many as 172 bottlenose dolphins could have been taken in this fishery with up to 57 animals killed. Without an observer program it is not possible to obtain statistically reliable information for this fishery

on the number of sets annually, the incidental take and mortality rates, and the communities from which bottlenose dolphins are being taken.

Some of the bay, sound and estuarine communities were the focus of a live-capture fishery for bottlenose dolphins which supplied dolphins to the U.S. Navy and to oceanaria for research and public display for more than 2 decades ending in 1989 (NMFS unpublished data). During the period 1972-89, 490 bottlenose dolphins, an average of 29 dolphins annually, were removed from a few locations in the Gulf of Mexico, including the Florida Keys, Charlotte Harbor, Tampa Bay, and elsewhere. Mississippi Sound sustained the highest level of removals with 202 dolphins taken from this stock during this period, representing 41% of the total and an annual average of 12 dolphins (compared to a previous PBR of 13). The annual average number of removals never exceeded previous PBR levels, but it may be biologically significant that 73% of the dolphins removed during 1982-88 were females. The impact of those removals on the stocks is unknown.

Feeding or provisioning, and swimming with wild bottlenose dolphins have been documented in Florida, particularly near Panama City Beach in the Panhandle. Feeding wild dolphins is defined under the MMPA as a form of 'take' because it can alter their natural behavior and increase their risk of injury or death. Nevertheless, Samuels and Bejder (2004) observed a high rate of uncontrolled provisioning near Panama City Beach in 1998, and Cunningham-Smith *et al.* (2006) have observed provisioning south of Sarasota Bay continuing since 1990. The effects of swim-with activities on dolphins and their legality under the MMPA are less clear and are currently under review. Near Panama City Beach, Samuels and Bejder (2004) concluded that dolphins were amenable to swimmers due to provisioning. There are emerging questions regarding potential linkages between provisioning and depredation of recreational fishing gear and associated entanglement and ingestion of gear, which is increasing through much of Florida. During 2006, an estimated 2% of the long-term resident dolphins of Sarasota Bay died from ingestion of recreational fishing gear (R.S. Wells, pers. comm.).

One research-related mortality occurred during November 2002 in Sarasota Bay, FL. The animal was a 35-year-old male, and it died in a health assessment research project. The histopathology report stated that drowning was the cause of death. However, the necropsy revealed that the animal was in poor condition as follows: anemic, thin (ribs evident, blubber thin and grossly lacking lipid), no food in the stomach and little evidence of recent feeding in the digestive tract, vertebral fractures with muscle atrophy, with additional conditions present. This has been the only such loss during capture/release research conducted over a 36-year period on Florida's central west coast.

A research-related mortality occurred during July 2006 in Crooked Island Sound, near Panama City, FL, during a NMFS health assessment research project to investigate a series of Unusual Mortality Events in the region.

Fishery Information

The commercial fisheries which potentially could interact with these stocks in the Gulf of Mexico are the shrimp trawl, blue crab trap/pot, stone crab trap/pot, menhaden and gillnet fisheries (Appendix I). Historically, there have been very low numbers of incidental mortality or injury in the stocks associated with the shrimp trawl fishery. Bottlenose dolphins have been reported stranded with polypropylene rope around their flukes (NMFS 1991; McFee and Brooks, Jr. 1998; NMFS unpublished data), indicating the possibility of entanglement with crab pot lines. The blue crab fishery has not been monitored by observers and there are no estimates of bottlenose dolphin mortality or serious injury for this fishery. There is no observer program data for the menhaden fishery but incidental mortality of bottlenose dolphins has been reported for this fishery (Reynolds 1985). No marine mammal mortalities associated with gillnet fisheries have been reported, but stranding data suggest that gillnet and marine mammal interaction does occur, causing mortality and serious injury. In 1995, a Florida state constitutional amendment banned gillnets and large nets from bay, sounds, estuaries and other inshore waters.

Table 2. Bottlenose dolphin strandings in the U.S. Gulf of Mexico (West Florida to Texas) from ~~1999~~2001 to 200~~3~~5. Data are from the Southeast Marine Mammal Stranding Database (SESUS). Percent of animals with indications of human interactions were calculated based on animals which were determined as "yes" or "no" for human interactions. Animals that were "CBD" (could not be determined) were excluded from % with human interactions calculations. Please note human interaction does not necessarily mean the interaction caused the animal's death.

S~~tate~~TATE	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**T~~otal~~OTAL**
Florida						
No. Stranded	57~~156~~	82 [a] ~~130~~	64 [d] ~~57~~	162~~82~~ [a]	135~~64~~ [d]	500~~483~~
No. Human Interactions	2~~5~~	6~~8~~	7~~2~~	4~~6~~	4~~7~~	23~~28~~

	No. CBD	26~~106~~	44~~76~~	34~~26~~	63~~44~~	84~~34~~	251~~286~~
	% With Human Interactions	6%~~10%~~	16%~~15%~~	23%~~6%~~	4%~~16%~~	8%~~23%~~	9%~~14%~~
Alabama							
	No. Stranded	17~~12~~	12~~15~~	7~~17~~	18~~12~~	19~~7~~	73~~63~~
	No. Human Interactions	2~~0~~	0~~0~~	1~~2~~	0~~0~~	0~~1~~	3~~3~~
	No. CBD	8~~8~~	9~~7~~	4~~8~~	18~~9~~	15~~4~~	54~~36~~
	% With Human Interactions	22%~~0%~~	0%~~0%~~	33%~~22%~~	CBD~~0%~~	0%~~33%~~	16%~~11%~~
Mississippi							
	No. Stranded	22~~25~~	21[b]~~27~~	37 [e]~~22~~	27~~21~~[b]	11~~37~~ [e]	118~~126~~
	No. Human Interactions	0~~0~~	0~~1~~	0~~0~~	1~~0~~	0~~0~~	1~~1~~
	No. CBD	8~~17~~	6~~15~~	29~~8~~	13~~6~~	6~~29~~	62~~75~~
	% With Human Interactions	0%~~0%~~	0%~~8%~~	0%~~0%~~	7%~~0%~~	0%~~0%~~	2%~~2%~~
Louisiana							
	No. Stranded	0~~25~~	2~~14~~	33 [f]~~0~~	26~~2~~	22~~33~~ [f]	83~~69~~
	No. Human Interactions	-~~1~~	0~~0~~	0~~-~~	2~~0~~	1~~0~~	3~~1~~
	No. CBD	-~~19~~	2~~14~~	29~~-~~	24~~2~~	15~~29~~	70~~64~~
	% With Human Interactions	-~~17%~~	CBD~~CBD~~	0%~~-~~	100%~~CBD~~	14%~~0%~~	23%~~20%~~
Texas							
	No. Stranded	116~~102~~	154 [c]~~113~~	154 [g]~~116~~	110~~154~~ [e]	96~~154~~ [g]	630~~636~~
	No. Human Interactions	6~~2~~	15~~7~~	10~~6~~	12~~15~~	3~~10~~	46~~40~~
	No. CBD	5~~40~~	57~~47~~	101~~5~~	41~~57~~	17~~101~~	221~~250~~
	% With Human Interactions	5%~~3%~~	15%~~11%~~	19%~~5%~~	17%~~15%~~	4%~~19%~~	11%~~10%~~
T~~otals~~OTAL							
	No. Stranded	212~~320~~	271~~299~~	295~~212~~	343~~271~~	283~~295~~	1404~~1377~~
	No. Human Interactions	10~~8~~	21~~16~~	18~~10~~	19~~21~~	8~~18~~	76~~73~~
	No. CBD	47~~190~~	118~~159~~	197~~47~~	159~~118~~	137~~197~~	658~~711~~
	% With Human Interactions	6%~~6%~~	14%~~11%~~	18%~~6%~~	10%~~14%~~	5%~~18%~~	10%~~11%~~

a Florida mass stranding of 2 animals in December 2002
b Mississippi mass stranding of 2 animals in March 2002
c Texas mass strandings (2 animals in January 2002, 2 animals in March 2002)
d Florida mass stranding of 2 animals in May 2003
e Mississippi mass stranding of 2 animals in April 2003
f Louisiana mass stranding of 3 animals in July 2003
g Texas mass stranding of 5 animals in March 2003

Other Mortality

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

Concentrations of chlorinated hydrocarbons and metals were examined in conjunction with an anomalous mortality event of bottlenose dolphins in Texas bays in 1990 and found to be relatively low in most; however, some had

concentrations at levels of possible toxicological concern (Varanasi *et al.* 1992). No studies to date have determined the amount, if any, of indirect human-induced mortality resulting from pollution or habitat degradation.

Analyses of organochlorine concentrations in the tissues of bottlenose dolphins in Sarasota Bay, Florida, have found that the concentrations found in male dolphins exceeded toxic threshold values that may result in adverse effects on health or reproductive rates (Schwacke *et al.* 2002). Studies of contaminant concentrations relative to life history parameters showed higher levels of mortality in first-born offspring, and higher contaminant concentrations in these calves and in primiparous females (Wells *et al.* 2005). While there are no direct measurements of adverse effects of pollutants on estuarine dolphins, the exposure to environmental pollutants and subsequent effects on population health is an area of concern and active research.

Since 1990, there have been ~~6~~8 bottlenose dolphin die-offs in the northern Gulf of Mexico. From January through May 1990, a total of 367 bottlenose dolphins stranded in the northern Gulf of Mexico. Overall this represented a two-fold increase in the prior maximum recorded strandings for the same period, but in some locations (i.e., Alabama) strandings were 10 times the average number. The cause of the 1990 mortality event could not be determined (Hansen 1992). In March and April 1992, 111 bottlenose dolphins stranded in Texas; about 9 times the average number. Seven of 34 live-captured bottlenose dolphins (20%) in 1992 from Matagorda Bay, Texas, tested positive for previous exposure to cetacean morbillivirus, and it is possible that other estuarine resident stocks have been exposed to the morbillivirus (Duignan *et al.* 1996).

~~In 1992, NOAA Fisheries' Working Group on Unusual Marine Mortality Events was formalized and developed protocols to declare Unusual Mortality Events (UME) and respond to them. Since 1992, 4 UMEs involving bottlenose dolphins have been investigated in the Gulf of Mexico. In 1993-1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb *et al.* 1994). In 1996 a UME was declared for bottlenose dolphins in Mississippi and while the cause was not determined, *Karenia brevis* (red tide) was suspected. Between August 1999 and February 2000, at least 120 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 107 bottlenose dolphins stranded dead (NMFS 2004).~~ In 1992, with the enactment of the Marine Mammal Health and Stranding Response Act, the Working Group on Marine Mammal Unusual Mortality Events was created to determine when an usual mortality event (UME) is occurring, and then to direct responses to such events. Since 1992, 6 bottlenose dolphin UMEs have been declared in the Gulf of Mexico. In 1993-1994 a UME of bottlenose dolphins caused by morbillivirus started in the Florida Panhandle and spread west with most of the mortalities occurring in Texas (Lipscomb 1993; Lipscomb 1994). From February through April 2004, 220 bottlenose dolphins were found dead on Texas beaches, of which 67 occurred in a single 10-day period. In 1996 a UME was declared for bottlenose dolphins in Mississippi when 27 bottlenose dolphins stranded during November and December. The cause was not determined, but a *Karenia brevis* (red tide) bloom was suspected to be responsible. Between August 1999 and February 2000, at least 120 bottlenose dolphins died coincident with *K. brevis* blooms and fish kills in the Florida Panhandle. In March and April 2004, in another Florida Panhandle UME possibly related to *K. brevis* blooms, 107 bottlenose dolphins stranded dead (NMFS 2004). 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. From July to December 2005, a total of 79 bottlenose dolphins stranded. The multi-species UME extended into 2006, and proposed dates for UME closure are in review. Finally, a separate 2005-2006 UME was declared in the Florida panhandle after elevated numbers of dolphin strandings occurred in association with a *K. brevis* bloom. Between September 2005 and September 2006, 98 bottlenose dolphin strandings occurred (plus 1 stranding of a striped dolphin, *Stenella coeruleoalba*). In September 2006 the event was officially declared over.

~~An old, sick dolphin died in a health assessment research project during 2002, the first such loss during capture/release research conducted over a 32 year period on Florida's west coast.~~

STATUS OF STOCK

The status of these stocks relative to OSP is unknown and this species is not listed as threatened or endangered under the Endangered Species Act. The occurrence of 6 anomalous mortality events among bottlenose dolphins along the U.S. Gulf of Mexico coast since 1990 (NMFS unpublished data) is cause for concern; however, the effects of the mortality events on stock abundance have not yet been determined.

The relatively high number of bottlenose dolphin deaths which occurred during the mortality events since 1990 suggests that some of these stocks may be stressed. Human-caused mortality and serious injury for each of these stocks is

not known, but considering the evidence from stranding data (Table 2), the total human-caused mortality and serious injury exceeds 10% of the total known PBR or previous PBR, and, therefore, it is probably not insignificant and approaching the zero mortality and serious injury rate. For these reasons, each of these stocks is a strategic stock.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine Mammal Stock Assessments: Guidelines for Preparation, Background and a Summary of the 1995 Assessments. NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Barros, N. B. and R. S. Wells. 1998. Prey and feeding patterns of resident bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. J. Mamm. 79(3): 1045-1059.

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

Bräger, S. 1993. Diurnal and seasonal behavior patterns of bottlenose dolphins (*Tursiops truncatus*). Mar. Mamm. Sci. 9: 434-440.

Bräger, S., B. Würsig, A. Acevedo and T. Henningsen. 1994. Association patterns of bottlenose dolphins (*Tursiops truncatus*) in Galveston Bay, Texas. J. Mamm. 75(2): 431-437.

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

Cunningham-Smith, P., D. E. Colbert, R. S. Wells and T. Speakman. 2006. Evaluation of human interactions with a wild bottlenose dolphin (*Tursiops truncatus*) near Sarasota Bay, Florida, and efforts to curtail the interactions. Aquat. Mamm. 32(3):346-356.

Duffield, D. A. and R. S. Wells. 1986. Population structure of bottlenose dolphins: Genetic studies of bottlenose dolphins along the central west coast of Florida. Contract Report to National Marine Fisheries Service, Southeast Fisheries Center, Contract No. 45-WCNF-5-00366, 16 pp.

Duffield, D. A. and R. S. Wells. 1991. The combined application of chromosome, protein and molecular data for the investigation of social unit structure and dynamics in *Tursiops truncatus*. pp. 155-169. *In*: A.R. Hoelzel (ed.) Genetic Ecology of Whales and Dolphins. Rep. Int. Whal. Commn., Special Issue 13, Cambridge, U.K.

Duffield, D. A. and R. S. Wells. 2002. The molecular profile of a resident community of bottlenose dolphins, *Tursiops truncatus*. pp. 3-11. *In*: C. J. Pfeiffer (ed.) Cell and Molecular Biology of Marine Mammals. Krieger Publishing, Melbourne, FL.

Duignan, P. J., C. House, D. K. Odell, R. S. Wells, L. Hansen, M. T. Walsh, D. J. St. Aubin, B. K. Rima and J. R. Geraci. 1996. Morbillivirus infection in bottlenose dolphin: Evidence for recurrent epizootics in the Western Atlantic and Gulf of Mexico. Mar. Mamm. Sci. 12(4): 499-515.

~~Fazioli, K. L. and R. S. Wells. 1999. Stock structure of coastal bottlenose dolphins, *Tursiops truncatus*, near Sarasota, Florida. Final Contract Report to the National Marine Fisheries Service, Southeast Fisheries Science Center, Contract No. 40-WCNF701806. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.~~

Fazioli, K. L., S. Hofmann and R. S. Wells. 2006. Use of Gulf of Mexico coastal waters by distinct assemblages of bottlenose dolphins (*Tursiops truncatus*). Aquat. Mamm. 32(2): 212-222.

Fertl, D. C. 1994. Occurrence patterns and behavior of bottlenose dolphins (*Tursiops truncatus*) in the Galveston ship channel. Texas J. Sci. 46: 299-317.

Gorzelany, J. F. 1998. Unusual deaths of two free-ranging Atlantic bottlenose dolphins (*Tursiops truncatus*) related to ingestion of recreational fishing gear. Mar. Mamm. Sci. 14(3): 614-617.

Gruber, J. A. 1981. Ecology of the Atlantic bottlenosed dolphin (*Tursiops truncatus*) in the Pass Cavallo area of Matagorda Bay, Texas. Masters thesis from Texas A&M University, College Station. 182 pp.

Hansen, L. J. (ed.). 1992. Report on investigation of 1990 Gulf of Mexico bottlenose dolphin strandings. NOAA-NMFS-SEFSC Contribution MIA-92/93-21. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Henningsen, T. 1991. Zur Verbreitung und Ökologie des Großen Tümmlers (*Tursiops truncatus*) in Galveston, Texas. Diploma thesis from Christian-Albrechts-Universität, Kiel, Germany. 80 pp.

Henningsen, T. and B. Würsig. 1991. Bottle-nosed dolphins in Galveston Bay, Texas: Numbers and activities. pp. 36-38. *In*: P. G. H. Evans (ed.) European research on cetaceans - *5*. Proceedings of the Fifth Annual Conference of the European Cetacean Society, Sandefjord, Norway, 21-23 February, 1991. Cambridge, UK.

~~Hubard, C. W. 1998. Abundance, distribution, and site fidelity of bottlenose dolphins in Mississippi Sound, Mississippi. Masters thesis from University of Alabama, Tuscaloosa. 101 pp.~~

Hubard, C. W. and S. L. Swartz. 2002. Gulf of Mexico bottlenose dolphin stock identification workshop: 14-15 March 2000, Sarasota, Florida. NOAA Tech. Memo. NMFS-SEFSC-473, 50 pp.

Hubard, C. W., K. Maze-Foley, K. D. Mullin and W. W. Schroeder. 2004. Seasonal abundance and site fidelity of

bottlenose dolphins (*Tursiops truncatus*) in Mississippi Sound. Aquat. Mamm. 30: 299-310.

Irvine, B. and R. S. Wells. 1972. Results of attempts to tag Atlantic bottlenose dolphins (*Tursiops truncatus*). Cetology 13: 1-5.

Irvine, A. B., M. D. Scott, R. S. Wells and J. H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. Fish. Bull. 79: 671-688.

Irwin, L. J. and B. Würsig. 2004. A small resident community of bottlenose dolphins, *Tursiops truncatus*, in Texas: Monitoring recommendations. G. Mex. Sci. 22(1): 13-21.

Laake, J. L., S. T. Buckland, D. R. Anderson and K. P. Burnham. 1993. DISTANCE user's guide, V2.0. Colorado Cooperative Fish & Wildlife Research Unit, Colorado State University, Ft. Collins. 72 pp.

Lipscomb, T. P. 1993. Some answers to questions about morbillivirus. pp. 4-5. *In*: R. A. Blaylock, B. Mase and D. K. Odell (eds.) Strandings, Vol. 2, No. 3, SEFSC Miami Laboratory, Miami, Florida, 7 pp.

Lipscomb, T. P. 1994. Morbilliviral disease in an Atlantic bottlenose dolphin (*Tursiops truncatus*) from the Gulf of Mexico. J. Wildl. Dis. 30(4): 572-576.

~~Lynn, S. K. 1995. Movements, site fidelity, and surfacing patterns of bottlenose dolphins on the central Texas coast. Masters thesis from Texas A&M University, College Station. 92 pp.~~

Lynn, S. K. and B. Würsig. 2002. Summer movement patterns of bottlenose dolphins in a Texas bay. G. Mex. Sci. 20(1): 25-37.

Maze, K. S. and B. Würsig. 1999. Bottlenose dolphins of San Luis Pass, Texas: Occurrence patterns, site fidelity, and habitat use. Aquat. Mamm. 25: 91-103.

McFee, W. E. and W. Brooks, Jr. 1998. Fact finding meeting of marine mammal entanglement in the crab pot fishery: A summary. U.S. Fish and Wildlife Service unpublished report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Miller, C. 2003. Abundance trends and environmental habitat usage patterns of bottlenose dolphins (*Tursiops truncatus*) in lower Barataria and Caminada Bays, Louisiana. Ph.D. dissertation from Louisiana State University, Baton Rouge. 125 pp.

Mullin, K. D. 1988. Comparative seasonal abundance and ecology of bottlenose dolphins (*Tursiops truncatus*) in three habitats of the north-central Gulf of Mexico. Ph. D. dissertation from Mississippi State University, Starkville. 135 pp.

NMFS. 1991. Proposed regime to govern the interactions between marine mammals and commercial fishing operations after October 1, 1993. Draft Environmental Impact Statement, June 1991. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

NMFS. 2004. Interim report on the bottlenose dolphin (*Tursiops truncatus*) unusual mortality event along the Panhandle of Florida, March-April 2004. 35 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Reynolds, J. E., III. 1985. Evaluation of the nature and magnitude of interactions between bottlenose dolphins, *Tursiops truncatus*, and fisheries and other human activities in coastal areas of the southeastern United States. National Technical Information Service PB86-162203, U.S. Department of Commerce, Springfield, VA 22161.

Samuels, A. and L. Bejder. 2004. Chronic interactions between human and free-ranging bottlenose dolphins near Panama City Beach, Florida, USA. J. Cetacean Res. Manage. 6: 69-77.

Schwacke, L. H., E. O. Voit, L. J. Hansen, R. S. Wells, G. B. Mitchum, A. A. Hohn and P. A. Fair. 2002. Probabilistic risk assessment of reproductive effects of polychlorinated biphenyls on bottlenose dolphins (*Tursiops truncatus*) from the southeast United States coast. Environ. Toxicol. Chem. 21(12):2752-2764.

~~Sellas, A. B. 2002. Population structure and group relatedness of bottlenose dolphins (*Tursiops truncatus*) in the coastal Gulf of Mexico using mitochondrial DNA and nuclear microsatellite markers. Master's thesis from University of California, Santa Cruz.~~

~~Sellas, A., R. S. Wells and P. E. Rosel. (in review). Mitochondrial and nuclear DNA analyses reveal fine scale geographic structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Submitted to Conservation Genetics.~~

Scott, G. P., D. M. Burn, L. J. Hansen and R. E. Owen. 1989. Estimates of bottlenose dolphin abundance in the Gulf of Mexico from regional aerial surveys. CRD 88/89-07. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

~~Scott, G. P. 1990. Management-oriented research on bottlenose dolphins by the Southeast Fisheries Center. pp. 623-639. *In*: S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.~~

Scott, M. D., R. S. Wells and A. B. Irvine. 1990. A long-term study of bottlenose dolphins on the west coast of Florida. pp. 235-244. *In*: S. Leatherwood and R. R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Sellas, A. B., R. S. Wells and P. E. Rosel. 2005. Mitochondrial and nuclear DNA analyses reveal fine scale geographic

structure in bottlenose dolphins (*Tursiops truncatus*) in the Gulf of Mexico. Conserv. Genet. 6: 715-728.

Shane, S. H. 1977. The population biology of the Atlantic bottlenose dolphin, *Tursiops truncatus*, in the Aransas Pass area of Texas. Masters thesis from Texas A&M University, College Station. 238 pp.

Shane, S. H. 1990. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. pp. 245-265. *In:* S. Leatherwood and R.R. Reeves (eds.) The bottlenose dolphin. Academic Press, San Diego, CA. 653 pp.

Shane, S. H., R. S. Wells and B. Würsig. 1986. Ecology, behavior, and social organization of the bottlenose dolphin: A review. Mar. Mamm. Sci. 2(1): 34-63.

Shane, S. H. 2004. Residence patterns, group characteristics, and association patterns of bottlenose dolphins near Sanibel Island, Florida. G. Mex. Sci. 22(1): 1-12.

Thompson, N. B. 1981. Estimates of abundance of *Tursiops truncatus* in Charlotte Harbor, Florida. NOAA/NMFS/SEFSC/Miami Laboratory, Fishery Data Analysis Technical Report. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Urian, K. W. 2002. Community structure of bottlenose dolphins (*Tursiops truncatus*) in Tampa Bay, Florida, USA. M.Sc. thesis, University of North Carolina, Wilmington. 26 pp.

Urian, K. W., D. A. Duffield, A. J. Read, R. S. Wells and D. D. Shell. 1996. Seasonality of reproduction in bottlenose dolphins, *Tursiops truncatus*. J. Mamm. 77: 394-403.

Varanasi, U., K. L. Tilbury, D. W. Brown, M. M. Krahn, C. A. Wigren, R. C. Clark and S. L. Chan. 1992. pp. 56-86. *In*: L. J. Hansen (ed.) Report on Investigation of 1990 Gulf of Mexico Bottlenose Dolphin Strandings. Southeast Fisheries Science Center Contribution MIA-92/93-21, 219 pp.

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

~~Waring, G. T., D. L. Palka, K. D. Mullin, J. H. W. Hain, L. J. Hansen and K. D. Bisack. 1997. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 1996. NOAA Tech. Memo. NMFS-NE-114.~~

Weller, D. W. 1998. Global and regional variation in the biology and behavior of bottlenose dolphins. Ph. D. dissertation from Texas A&M University, College Station. 142 pp.

Wells, R. S. 1986a. Population structure of bottlenose dolphins: Behavioral studies along the central west coast of Florida. Contract report to NMFS, SEFSC. Contract No. 45-WCNF-5-00366, 58 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Wells, R. S. 1986b. Structural aspects of dolphin societies. Ph. D. dissertation from University of California, Santa Cruz. 234 pp.

Wells, R. S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. pp. 199-225. *In*: K. Pryor and K.S. Norris (eds.) Dolphin Societies: Discoveries and Puzzles. University of California Press, Berkeley. 397 pp.

Wells, R. S. 1992. The marine mammals of Sarasota Bay. pp. 9.1-9.23. *In*: Sarasota Bay: Framework for action. Sarasota Bay National Estuary Program, Sarasota, FL.

Wells, R. S. 1994. Determination of bottlenose dolphin stock discreteness: Application of a combined behavioral and genetic approach. pp. 16-20. *In*: K. R. Wang, P. M. Payne and V. G. Thayer (compilers) Coastal Stock(s) of Atlantic Bottlenose Dolphin: Status Review and Management. Proceedings and Recommendations from a Workshop held in Beaufort, NC, 13-14 September 1993. NOAA Tech. Memo. NMFS-OPR-4, 120 pp.

Wells, R. S. 1998. Progress report: Sarasota long-term bottlenose dolphin research. Unpublished contract report to the U.S. Department of Commerce, NOAA Fisheries, Southeast Fisheries Science Center, Miami, FL, 5 pp.

Wells, R. S. 2003. Dolphin social complexity: lessons from long-term study and life history. pp. 32-56. *In*: F.B.M. de Waal and P.L. Tyack (eds.) Animal social complexity: intelligence, culture, and individualized societies. Harvard University Press, Cambridge, MA.

Wells, R. S. and M. D. Scott. 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. pp. 407-415. *In*: P. S. Hammond, S. A. Mizroch and G. P. Donovan (eds.) Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters. Rep. Int. Whal. Commn. Special Issue 12, Cambridge, U.K.

~~Wells, R. S. and M. D. Scott. 1999. Bottlenose dolphins. pp. 137-182. *In*: S.H. Ridgway and R. Harrison (eds.) Handbook of Marine Mammals, Vol. 6, the Second Book of Dolphins and Porpoises. Academic Press, San Diego, CA.~~

Wells, R. S. and M. D. Scott. 1994. Incidence of gear entanglement for resident inshore bottlenose dolphins near Sarasota, Florida. Page 629. *In:* W. F. Perrin, G. P. Donovan and J. Barlow (eds.) Gillnets and cetaceans. Rep. Int. Whal. Commn. (Special Issue 15), Cambridge, U.K..

Wells, R. S. and M. D. Scott. 1997. Seasonal incidence of boat strikes on bottlenose dolphins near Sarasota, Florida. Mar. Mamm. Sci. 3: 475-480.

Wells, R. S. and M. D. Scott. 1999. Bottlenose dolphins. pp. 137-182. *In*: S.H. Ridgway and R. Harrison (eds.)

Handbook of Marine Mammals, Vol. 6, the Second Book of Dolphins and Porpoises. Academic Press, San Diego, CA.

Wells, R. S., S. Hofmann and T. L. Moors. 1998. Entanglement and mortality of bottlenose dolphins, *Tursiops truncatus*, in recreational fishing gear in Florida. Fish. Bull. 96(3): 647-650.

Wells, R. S., M. D. Scott and A. B. Irvine. 1987. The social structure of free-ranging bottlenose dolphins. pp. 247-305. *In*: H. Genoways (ed.) Current Mammalogy, Vol. 1. Plenum Press, New York.

Wells, R. S., K. W. Urian, A. J. Read, M. K. Bassos, W. J. Carr and M. D. Scott. 1996a. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. NOAA Tech. Memo. NMFS-SEFSC-385, 25 pp.

Wells, R. S., M. K. Bassos, K. W. Urian, W. J. Carr and M. D. Scott. 1996b. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida: 1990-1994. NOAA Tech. Memo. NMFS-SEFSC-384, 36 pp.

Wells, R. S., M. K. Bassos, K. W. Urian, S. H. Shane, E. C. G. Owen, C. F. Weiss, W. J. Carr and M. D. Scott. 1997. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Pine Island Sound, Florida: 1996. Contract report to National Marine Fisheries Service, Southeast Fisheries Center. Contribution No. 40-WCNF601958. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Wells, R. S., V. Tornero, A. Borrell, A. Aguilar, T. K. Rowles, H. L. Rhinehart, S. Hofmann, W. M. Jarman, A. A. Hohn, and J. C. Sweeney. 2005. Integrating life history and reproductive success data to examine potential relationships with organochlorine compounds for bottlenose dolphins (*Tursiops truncatus*) in Sarasota Bay, Florida. Sci. Total Environ. 349:106-119.

~~Würsig, B. and S. K. Lynn. 1996. Movements, site fidelity, and respiration patterns of bottlenose dolphins on the central Texas coast. NOAA Tech. Memo. NMFS-SEFSC-383, 43 pp.~~

~~December 2005~~~~November~~April 200~~6~~7

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin *et al*. 1987). The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al*. 1987, 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 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 (Fulling *et al.* 2003; Mullin and Fulling 2004). Atlantic spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 200~~3~~0). It has been suggested that this species may move inshore seasonally during spring, but data supporting this hypothesis are limited (Caldwell and Caldwell 1966; Fritts *et al.* 1983).

In a recent study, ~~Bero~~Adams and Rosel (200~~1~~5) presented strong genetic support for differentiation between Gulf of Mexico and western North Atlantic management stocks using both mitochondrial and nuclear markers. However, this study did not test for further population subdivision within the Gulf of Mexico.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Atlantic spotted dolphins for all surveys combined was 3,213 (CV=0.44) (Hansen *et al.* 1995). This is ~~probably~~ an underestimate ~~and should be considered a partial stock estimate~~ because the continental shelf was not entirely covered during these surveys. ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

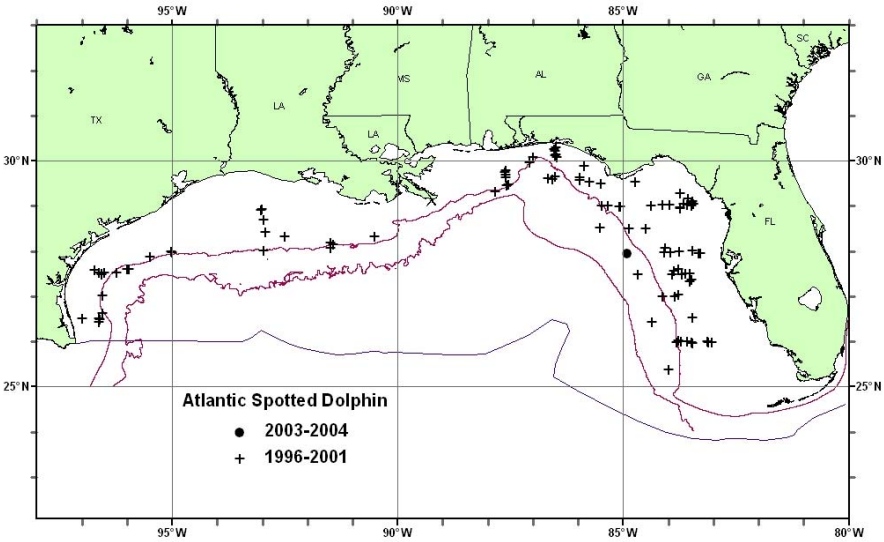


Figure 1. *Distribution of Atlantic spotted dolphin sightings from SEFSC spring~~/summer~~ and fall vessel surveys during 199~~68~~6-200~~14~~1 and from summer 2003 and spring 2004 surveys.~~.~~ All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted line shows the~~ offshore extent of the U.S. EEZ.*

Data were collected from 1996 to 2001 during spring and fall plankton surveys conducted from NOAA ships *Oregon II* (1996, 1997, 1999, 2000) and *Gordon Gunter* (1998, 2000, 2001). Tracklines, which were perpendicular to the bathymetry, covered shelf waters from the 20m to the 200m isobaths in the fall of 1998 ~~and 1999~~through 2001 ~~(Figure 1, Table 1; Fulling *et al.* 2003)~~. The combined estimated abundance of Atlantic spotted dolphins, pooled from 1999 through 2001, for the fall outer continental shelf shipboard surveys was 27,393 (CV=0.23) (Figure 1, Table 1; Fulling *et al.* 2003). Spring ~~S~~surveys were ~~also~~ conducted from April to May 1996 to 2001 (excluding 1998) in oceanic waters of the northern

Gulf of Mexico from 200m to the offshore extent of the U.S. EEZ. Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (~~Figure 1, Table 1;~~ Mullin and Fulling 2004). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both areas. The estimate of abundance for Atlantic spotted dolphins in oceanic waters, pooled from 1996 through 2001, was 175 (CV=0.84) (Mullin and Fulling 2004).

~~Table 1. Abundance estimates (N_{best}) and Coefficient of Variation (CV) of Atlantic spotted dolphins in the northern U.S. Gulf of Mexico outer continental shelf (OCS) (waters 20-200m deep) during fall 1998-2001 and oceanic waters (200m to the offshore extent of the EEZ) during spring/summer 1996-20013-2004 (excluding 1998).~~			
~~**Month/Year**~~	~~**Area**~~	~~**N_{best}**~~	~~**CV**~~
~~Fall 1998-2001~~	~~Outer Continental Shelf~~	~~30,772~~	~~0.27~~
~~Spring/Summer 1996-2001~~2003-2004	~~Oceanic~~	~~175~~0	~~0.84~~
~~**Spring & Fall 1996-2001**~~	~~**OCS & Oceanic**~~	~~**30,947**~~772	~~**0.27**~~

~~The combined estimated abundance of Atlantic spotted dolphins, pooled from 1998 through 2001, for the outer continental shelf shipboard surveys was 30,772 (CV=0.27) (Fulling *et al.* 2003). The estimate of abundance for Atlantic spotted dolphins in oceanic waters, pooled from 1996 through 2001, is 175 (CV=0.84) (Mullin and Fulling 2004).~~

~~The best available abundance estimate for the Atlantic spotted dolphin in the northern Gulf of Mexico is the combined estimate of abundance for both the outer continental shelf and oceanic waters from 1996 to 2001, which is 30,947 (CV=0.27). This estimate is considered the best because these surveys have the most complete coverage of the species' habitat.~~

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extend of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007). The estimate of abundance for Atlantic spotted dolphins in oceanic waters, pooled from 2003 to 2004, was 0 (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of ~~-~~the data for oceanic estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable for oceanic waters~~.0~~.

The best available abundance estimate for the Atlantic spotted dolphin in the northern Gulf of Mexico is the combined estimate of abundance for both the outer continental shelf (fall surveys, 199~~8~~9-2001) and oceanic waters (spring and summer surveys, 2003-2004) ~~from 1998 to 2004~~, which is 27,393 (CV=0.23) (Table 1). This estimate is considered the best because these surveys have the most complete coverage of the species' habitat.

Table 1. Abundance estimates (N_{best}) and Coefficient of Variation (CV) of Atlantic spotted dolphins in the northern U.S. Gulf of Mexico outer continental shelf (OCS) (waters 20-200m deep) during fall 1999~~8~~-2001 and oceanic waters (200m to the offshore extent of the EEZ) during spring/summer 2003-2004.			
Month/Year	**Area**	**N_{best}**	**CV**
Fall 1999-2001	Outer Continental Shelf	~~30,772~~27,393	0.2~~7~~3
Spring/Summer 2003-2004	Oceanic	0	-
Fall & Spring/Summer	**OCS & Oceanic**	**~~30,772~~27,393**	**0.2~~7~~3**

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Atlantic spotted dolphins is ~~30,947~~27,393 (CV=0.2~~7~~3). The minimum population estimate for the northern Gulf of Mexico is 2~~4,752~~2,626 Atlantic spotted dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a "recovery" factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 2~~4,752~~~~612~~2,626. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Atlantic spotted dolphin is 22~~48~~6.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a spotted dolphin during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Atlantic spotted dolphins in the northern Gulf of Mexico is unknown; however, interactions between spotted dolphins and fisheries have been observed in the northern Gulf of Mexico. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were 2 observed incidental takes and releases of spotted dolphins in the Gulf of Mexico during 1994, but no recent reported takes of Atlantic spotted dolphins by this fishery in the Gulf of Mexico. Either spotted dolphin species may have been involved in the observed fishery-related mortality and serious injury incidents, but because of the uncertainty in species identification by fishery observers, they cannot currently be separated. Estimated average annual fishing-related mortality and serious injury of spotted dolphins attributable to this fishery during 1991-1993 was 1.5 annually (CV=0.33).

Other Mortality

A total of ~~7~~17 Atlantic spotted dolphins stranded in the Gulf of Mexico during ~~1999~~1999-200~~3~~5 (Table 2 displays 2001-2005 data). There ~~were~~were ~~no~~ indications of human interactions for 2 animals that stranded in Alabama during 2004~~in any of these stranded animals~~, both of which were classified as likely caused by fishery interactions. ~~There were 2 documented strandings of Atlantic spotted dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions.~~ Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 2. Atlantic spotted dolphin (*Stenella frontalis*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.

S~~tate~~TATE	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**TOTAL**
Alabama	0~~0~~	0~~0~~	1~~0~~	4~~0~~	0~~1~~	5~~1~~
Florida	0~~2~~	0~~2~~	1~~0~~	4~~0~~	2~~1~~	7~~5~~
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Texas	0~~0~~	0~~1~~	0~~0~~	0~~0~~	0~~0~~	0~~1~~
T~~otal~~OTAL	0~~2~~	0~~3~~	2~~0~~	8~~0~~	2~~2~~	12~~7~~

STATUS OF STOCK

The status of Atlantic spotted dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is

not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Adams, L. and P. E. Rosel. 2005. Population differentiation of the Atlantic spotted dolphin *Stenella frontalis* in the Western North Atlantic, including the Gulf of Mexico. Mar. Biol.:1-11.

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73pp.

~~Bero, D. 2001. Population structure of the Atlantic spotted dolphin (*Stenella frontalis*) in the Gulf of Mexico and western North Atlantic. Masters Thesis from University of Charleston. 101 pp.~~

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Caldwell, D. K. and M. C. Caldwell. 1966. Observations on the distribution, coloration, behavior and audible sound production of the spotted dolphin, *Stenella plagiodon* (Cope). Los Angeles County Museum Contribution to Science, 104: 1-28.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Fritts, T. H., A. B. Irvine, R. D. Jennings, L. A. Collum, W. Hoffman and M. A. McGehee. 1983. Turtles, birds, and mammals in the northern Gulf of Mexico and nearby Atlantic waters. U.S. Fish and Wildlife Service, Division of Biological Services, Washington, D.C., FWS/OBS-82/65, 455 pp.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101:923-932.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. NMFS-SEFSC Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull. 101:603-613.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4):~~-~~787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Perrin, W. F., D. K. Caldwell and M. C. Caldwell. 1994. Atlantic spotted dolphin *Stenella frontalis* (G. Cuvier, 1829). pp. 173-190. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Rice, D. W. 1998. Marine mammals of the world, systematics and distribution. Spec. Publ. No 4. The Society for Marine Mammalogy, Lawrence, KS, 231 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit

for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of spotted dolphin in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*) and the pantropical spotted dolphin (*S. attenuata*) (Perrin *et al*. 1987). The Atlantic spotted dolphin occurs in two forms which may be distinct sub-species (Perrin *et al*. 1987, 1994; Rice 1998): the large, heavily spotted form which inhabits the continental shelf and is usually found inside or near the 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 (Mullin and Fulling 2004). Pantropical spotted dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

Some of the Pacific Ocean populations have been divided into different geographic stocks based on morphological characteristics (Perrin *et al.* 1987; Perrin and Hohn 1994). The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of pantropical spotted dolphins for all surveys combined was 31,320 (CV=0.20) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

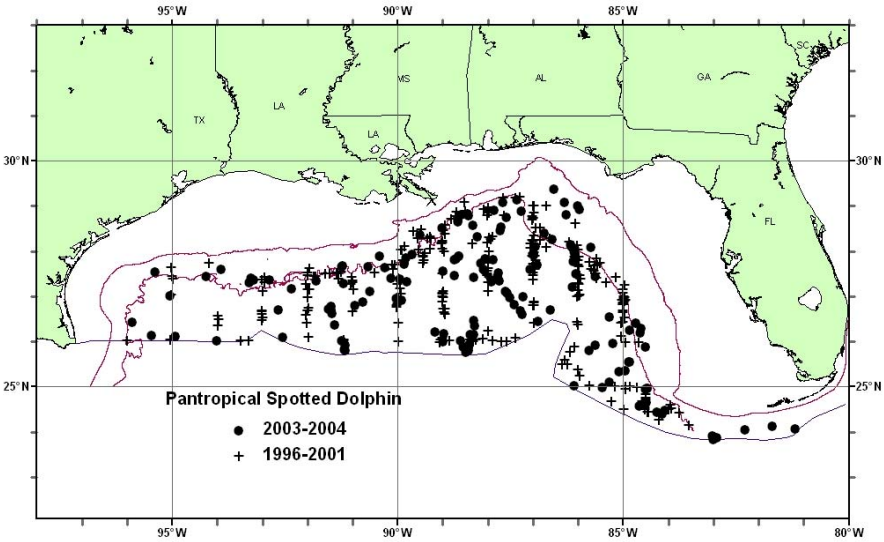


Figure 1. *Distribution of pantropical spotted dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001).~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for pantropical spotted dolphins in oceanic waters, pooled from 1996 to 2001, ~~is~~was 91,321 (CV=0.16) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the~~

~~northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for pantropical spotted dolphins in oceanic waters, pooled from 2003 to 2004, was 34,067 (CV=0.18) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for pantropical spotted dolphins is ~~91,321~~34,067 (CV=0.~~16~~18). The minimum population estimate for the northern Gulf of Mexico is ~~79,879~~29,311 pantropical spotted dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 34,067 (CV=0.18) and that for 1996-2001 of 91,321 (CV=0.16)~~–~~ are significantly different (P<0.05). However, the 2003-2004 estimate is similar to that for ~~and that for~~ 1991-1994 of 31,320 (CV=0.20)~~ are significantly different (P<0.05)~~. ~~This temporal abundance estimates change in abundance is difficult to interpret without a Gulf of Mexico-wide understanding of pantropical spotted dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~

These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of pantropical spotted dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate, and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~79,879~~29,311~~ (CV=0.16)~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico pantropical spotted dolphin is ~~799~~293.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~There was 1 documented stranding of a pantropical spotted dolphin in the northern Gulf of Mexico during 1987-1994 which was classified as likely caused by fishery interactions.~~ ~~—~~There has been no reported fishing-related mortality of pantropical spotted dolphins during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of pantropical spotted dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to pantropical spotted dolphins by this fishery during 1998-200~~3~~5.

Other Mortality

~~Four~~Seven pantropical spotted dolphins stranded in the Gulf of Mexico during 1999-200~~3~~5 (Table 1 displays 2001-2005 data). There was no evidence of human interactions for the stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Pantropical spotted dolphin (*Stenella attenuata*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.

S~~tate~~TATE	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**TOTAL**
Alabama	0~~0~~	0~~0~~	0~~0~~	0~~0~~	1~~0~~	1~~0~~
Florida	0~~0~~	1~~0~~	1~~0~~	2~~1~~	0~~1~~	4~~2~~
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Texas	1~~1~~	0~~0~~	0~~1~~	0~~0~~	0~~0~~	1~~2~~
T~~otal~~OTAL	1~~1~~	1~~0~~	1~~1~~	2~~1~~	1~~1~~	6~~4~~

STATUS OF STOCK

The status of pantropical spotted dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2003. Abundance and distribution of cetaceans in the southern U.S. Atlantic Ocean during summer 1998. Fish. Bull. 101: 603_613.

.~~———~~Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Perrin, W. F. and. A. A. Hohn. 1994. Pantropical spotted dolphin *Stenella attenuata* (Meyen, 1833). pp. 129-159. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Perrin, W. F., D. K. Caldwell and M. C. Caldwell. 1994. Atlantic spotted dolphin. pp.173_190. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Volume 5: The first book of dolphins. Academic Press, San Diego, 418 pp.

. Rice, D. W. 1998. Marine mammals of the world, systematics and distribution. Spec. Publ. No 4. The Society for Marine Mammalogy, Lawrence, KS, 231 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The striped dolphin is distributed worldwide in tropical to temperate oceanic waters (Leatherwood and Reeves 1983; Perrin *et al.* 1994). Sightings of these animals in the northern Gulf of Mexico occur in oceanic waters (Mullin and Fulling 2004). Striped dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). ~~-~~Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of striped dolphins for all surveys combined was 4,858 (CV=0.44) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

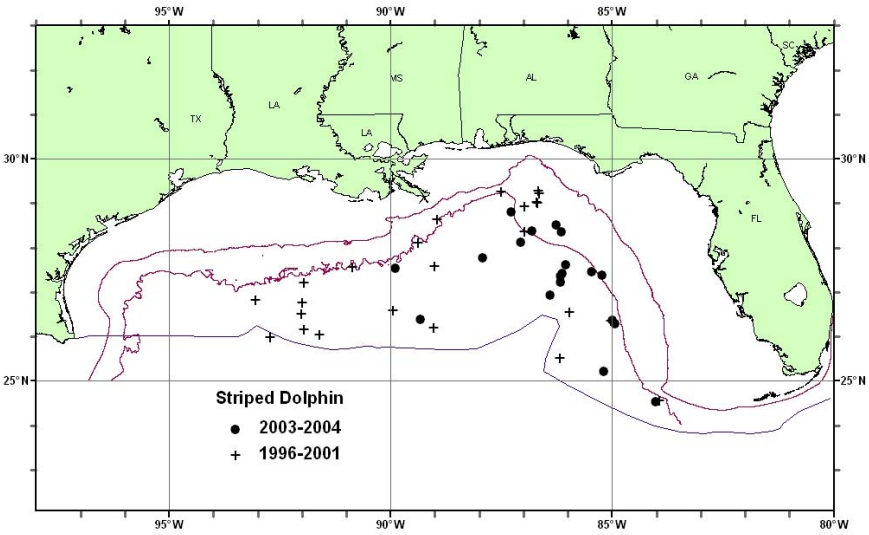


Figure 1. *Distribution of striped dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for striped dolphins in oceanic waters, pooled from 1996 to 2001, ~~is~~was 6,505 (CV=0.43) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for striped dolphins in oceanic waters, pooled from 2003 to 2004, was 3,325 (CV=0.48) (Mullin 2007), which is the best available abundance estimate for this species in the

northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for striped dolphins is ~~6,505~~3,325 (CV=0.~~43~~48). The minimum population estimate for the northern Gulf of Mexico is ~~4,599~~2,266 striped dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 3,325 (CV=0.48) and that for 1996-2001 of 6,505 (CV=0.43) ~~and that for 1991-1994 of 4,858 (CV=0.44)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These estimates are similar to that for 1991-1994 of 4,858 (CV=0.44). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of striped dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of striped dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~4,599~~2,266 ~~(CV=0.43)~~. 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 ~~46~~23.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of striped dolphins during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of striped dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to striped dolphins by this fishery.

Other Mortality

There we~~as~~re ~~1~~2 reported strandings of a striped dolphin in the Gulf of Mexico during 1999-200~~3~~5. There was no evidence of human interaction for th~~is~~ese stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of striped dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed

as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Perrin, W. F., C. E. Wilson and F. I. Archer II. 1994. Striped dolphin *Stenella coeruleoalba* (Meyen, 1833). pp. 129-159. *In:* S. H. Ridgway and R. Harrison (eds.) *Handbook* of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The spinner dolphin is distributed worldwide in tropical to temperate oceanic waters (Leatherwood and Reeves 1983; Perrin and Gilpatrick 1994). Sightings of these animals in the northern Gulf of Mexico occur in oceanic waters (Mullin and Fulling 2004). Spinner dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). ~~-~~Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of spinner dolphins for all surveys combined was 6,316 (CV=0.43) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

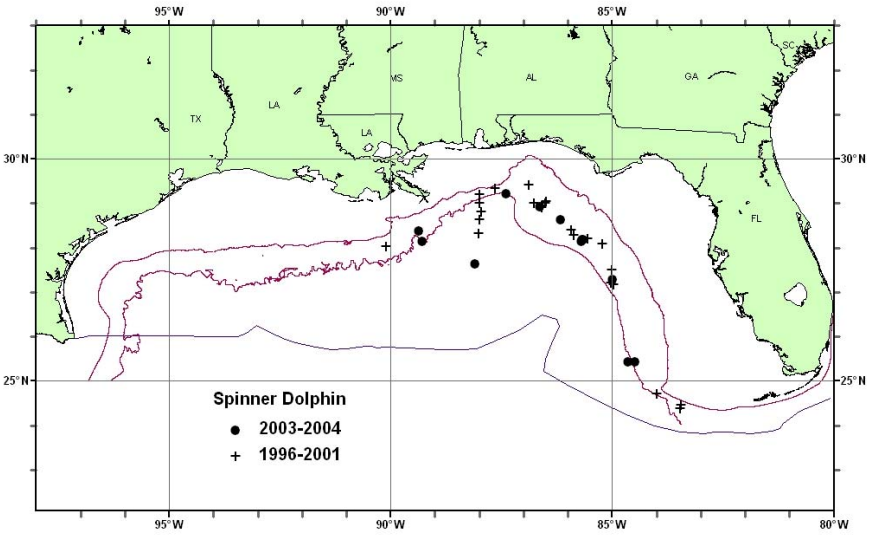


Figure 1. *Distribution of spinner dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for spinner dolphins in oceanic waters, pooled from 1996 to 2001, ~~is~~was 11,971 (CV=0.71) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for spinner dolphins in oceanic waters, pooled from 2003 to 2004, was 1,989 (CV=0.48) (Mullin 2007), which is the best available abundance estimate for this species in the

northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for spinner dolphins is ~~11,971~~1,989 (CV=0.~~71~~48). ~~-~~The minimum population estimate for the northern Gulf of Mexico is ~~6,990~~1,356 spinner dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,989 (CV=0.48) and that for 1996-2001 of 11,971 (CV=0.71) ~~and that for 1991-1994 of 6,316 (CV=0.43)~~ are ~~not~~ significantly different (P~~>~~<0.05)~~, but due to the precision of the estimates, the power to detect a difference is low~~. ~~This change in abundance is difficult to interpret without a Gulf of Mexico-wide understanding of spinner dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~The 1991-1994 estimate of 6,316 (CV=0.43) was intermediate~~d~~ to these two estimates. ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of spinner dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of spinner dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~6,990~~1,356 ~~(CV=0.71)~~. 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 ~~70~~14.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of spinner dolphins during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of spinner dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to spinner dolphins by this fishery.

Other Mortality

There were ~~5~~6 reported strandings of spinner dolphins in the Gulf of Mexico during 1999-200~~3~~5 (Table 1 displays 2001-2005 data). There was evidence of human interaction for 1 of the 2003 Texas stranded animals. This animal had monofilament line around its tail stock but not into the skin, and abrasions around its flukes as though the animal had been towed. In addition, possible propeller marks were noted. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do

wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Spinner dolphin (*Stenella longirostris*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.

S~~tate~~TATE	2001~~1999~~	2002~~2000~~	2003~~2001~~	2004~~2002~~	2005~~2003~~	TOTAL
Alabama	0~~0~~	0~~0~~	2~~0~~	0~~0~~	0~~2~~	2~~2~~
Florida	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Texas	0~~0~~	0~~1~~	2~~0~~	1~~0~~	0~~2~~	3~~3~~
T~~otal~~OTAL	0~~0~~	0~~1~~	4~~0~~	1~~0~~	0~~4~~	5~~5~~

STATUS OF STOCK

The status of spinner dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New

Orleans, LA.
Perrin, W. F. and J. W. Gilpatrick, Jr. 1994. Spinner dolphin *Stenella longirostris* (Gray, 1828). pp. 99-128. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.
Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.
Wade, P. R. and R. P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, WA. U.S. Dep. Commer., NOAA Tech Memo. NMFS-OPR-12, 93 pp.
Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.
Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The rough-toothed dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983; Miyazaki and Perrin 1994). Rough-toothed dolphins occur in both oceanic and continental shelf waters in the northern Gulf of Mexico (Fulling *et al.* 2003; Mullin and Fulling 2004). Rough-toothed dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of rough-toothed dolphins for all surveys combined was 852 (CV= 0.31) (Hansen *et al.* 1995). This was probably an underestimate and should be considered a partial stock estimate because the continental shelf area~~s were~~ was not entirely covered~~ by either the vessel or GulfCet aerial surveys~~. ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

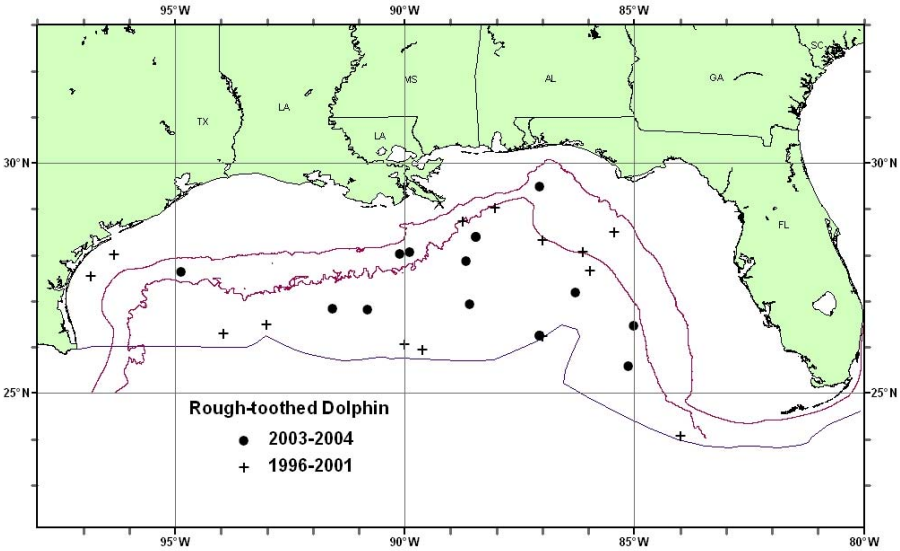


Figure 1. *Distribution of rough-toothed dolphin sightings from SEFSC spring and fall vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths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

~~Surveys during plankton~~Similar -surveys were ~~were~~ conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico from 200m to the offshore extent of the U.S. EEZ. Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Mullin and Fulling 2004). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both continental shelf and oceanic waters. The estimate of abundance for rough-toothed dolphins in oceanic waters, pooled from 1996 through 2001, ~~is~~was 985 (CV=0.44) (Mullin and Fulling 2004). Data were collected from 199~~6~~9 to 2001 during ~~spring and~~ fall plankton surveys ~~conducted from NOAA ships *Oregon II* (1996, 1997, 1999, 2000) and *Gordon Gunter* (1998, 1999, 2000, 2001)~~. Tracklines, which were perpendicular to the bathymetry, covered shelf waters from 20 to 200 m deep in the fall of 1998 ~~and 1999~~ through 2001 (Figure 1 and Table 1; see Fulling *et al.* 2003). The estimated abundance of rough-toothed dolphins, pooled from 1999 through 2001, for the outer continental shelf shipboard surveys was 1,434 (CV=0.85) (see Fulling *et al.* 2003).

~~Surveys were also conducted during April/May from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico from 200m to the offshore extent of the U.S. EEZ. Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1 and Table 1; Mullin and Fulling 2004). Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate for both continental shelf and oceanic waters.~~

Table 1. Abundance estimates (N_{best}) and Coefficient of Variation (CV) of rough-toothed dolphins in the northern U.S. Gulf of Mexico outer continental shelf (OCS) (waters 20-200~~-~~m deep) during fall 199~~8~~9-2001 and oceanic waters (200m to the offshore extent of the EEZ) during spring/summer ~~1996-2001~~2003-2004 ~~(excluding 1998)~~.

Month/Year	Area	N_{best}	CV
Fall 199~~8~~9-2001	Outer Continental Shelf	1,~~238~~434	0.~~6~~85
Spring/Summer ~~1996-2001~~2003 - 2004	Oceanic	~~985~~1,508	0.~~44~~39
Spring/Summer & Fall ~~1996-2001~~	**OCS & Oceanic**	**2, ~~223~~~~76~~942**	**0.~~41~~46**

~~The combined estimated abundance of rough-toothed dolphins, pooled from 1998 through 2001, for the outer continental shelf shipboard surveys was 1,238 (CV=0.65) (Fulling *et al.* 2003). The estimate of abundance for rough-toothed dolphins in oceanic waters, pooled from 1996 through 2001, is 985 (CV=0.44) (Mullin and Fulling 2004).~~

~~The best available abundance estimate for the rough-toothed dolphin in the northern Gulf of Mexico is the combined estimate of abundance for both the outer continental shelf and oceanic waters from 1996 to 2001, which is 2,223 (CV=0.41). This estimate is considered the best because these surveys have the most complete coverage of the species' habitat. This species was observed in shelf waters, with 2 sightings occurring off the coast of Texas and 1 sighting off the southern Florida Panhandle (Fulling *et al.* 2003). Group sizes recorded for rough-toothed dolphins in shelf waters were 8, 11 and 20 individuals.~~

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* ~~(Mullin 2006)~~. The estimate of abundance for rough-toothed dolphins in oceanic waters from 2003 and 2004, was 1,508 (CV=0.39) (Mullin 200~~6~~7),

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of ~~-~~the data for oceanic estimates prior to 2003 were older than this 8-year limit and due to the different oceanic sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable for oceanic waters. The best available abundance estimate for the rough-toothed dolphin in the northern Gulf of Mexico is the combined estimate of abundance for both the outer continental shelf and oceanic waters which is 2,~~76~~942 (CV=0.46).

~~The estimate of abundance for rough-toothed dolphins in oceanic waters, pooled from 2003 to 2004, was XX (CV=0.XX) (Mullin 2006), which is the best available abundance estimate for this species in the northern Gulf of Mexico.~~

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for rough-toothed dolphins is ~~2,223~~1,508~~2,76~~942 (CV=0.4~~41~~39~~6~~). The minimum population estimate for the northern Gulf of Mexico is ~~1,595~~099~~2~~,034 rough-toothed dolphins.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. For purposes of this assessment, the

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a "recovery" factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~1,595099~~2,034. 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 ~~1611~~20.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

~~There were 2 documented strandings of rough-toothed dolphins in the northern Gulf of Mexico during 1987-1994 which were classified as likely caused by fishery interactions.~~ There has been no reported fishing-related mortality or serious injury of rough-toothed dolphins during 199~~8~~2-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of rough-toothed dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to rough-toothed dolphins by this fishery in the Gulf of Mexico during 199~~8~~2-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Other Mortality

There were ~~22~~47 stranded rough-toothed dolphins in the northern Gulf of Mexico during 1999-200~~3~~5, including ~~1~~a mass stranding of 19 animals in February 2001 and a mass stranding of 11 animals in March 2005 (Table 2 displays 2001-2005 data). There was no evidence of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 2. Rough-toothed dolphin (*Steno bredanensis*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.

S~~tate~~TATE	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**TOTAL**
Alabama	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Florida	19 [a]~~0~~	1~~1~~	1~~19~~ [a]	12~~1~~	11[b]~~1~~	44~~22~~
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Texas	0~~0~~	0~~0~~	0~~0~~	1~~0~~	1~~0~~	2~~0~~
T~~otal~~OTAL	19~~0~~	1~~1~~	1~~19~~	13~~1~~	12~~1~~	46~~22~~

a Florida mass stranding of 19 animals in February 2001
b Florida mass stranding of 11 animals in March 2005

STATUS OF STOCK

The status of rough-toothed dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be

insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Fulling, G. L., K. D. Mullin and C. W. Hubard. 2003. Abundance and distribution of cetaceans in outer continental shelf waters of the U.S. Gulf of Mexico. Fish. Bull. 101: 923-932.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Miyazaki, N. and W. F. Perrin. 1994. Rough-toothed dolphin *Steno bredanensis* (Lesson, 1828). pp. 1-21. *In:* S. H. Ridgeway and R. Harrison (eds.) *Handbook* of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The Clymene dolphin is endemic to tropical and sub-tropical waters of the Atlantic (Leatherwood and Reeves 1983; Perrin and Mead 1994). Sightings of these animals in the northern Gulf of Mexico occur primarily over the deeper waters off the continental shelf (Mullin *et al.* 1994). Clymene dolphins were seen in the winter, spring and summer during GulfCet aerial surveys of the northern Gulf of Mexico during 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Clymene dolphins for all surveys combined was 5,571 (CV=0.37) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

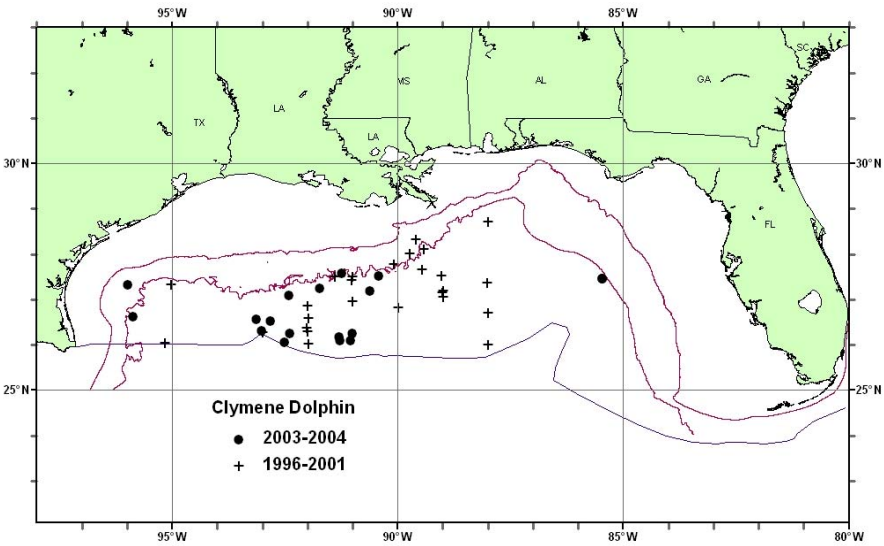


Figure 1. *Distribution of Clymene dolphin sightings from SEFSC shipboard spring surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for Clymene dolphins in oceanic waters, pooled from 1996 to 2001, ~~is~~was 17,355 (CV=0.65) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004

surveys were considered most reliable. The estimate of abundance for Clymene dolphins in oceanic waters, pooled from 2003 to 2004, was 6,575 (CV=0.36) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Clymene dolphins is ~~17,355~~6,575 (CV=0.~~65~~36). The minimum population estimate for the northern Gulf of Mexico is ~~10,528~~4,901 Clymene dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 6,575 (CV=0.36) and that for 1996-2001 of 17,355 (CV=0.65) are significantly different (P<0.05). However, the 2003-2004 estimate is similar to that for 1991-1994~~ and that for 1991-1994~~ of 5,571 (CV=0.37)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low~~. ~~temporal estimates~~

These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Clymene dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~10,528~~4,901~~ (CV=0.65)~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Clymene dolphin is ~~105~~49.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of Clymene dolphins during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Clymene dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Clymene dolphins by this fishery.

Other Mortality

There were ~~2~~3 reported stranding events of Clymene dolphins in the Gulf of Mexico during 1999-200~~3~~5. One animal stranded in Florida in July 2002, ~~and~~ 2 animals mass stranded in Louisiana in September 2003, and 1 animal stranded in Texas in April 2004. There were no indications of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of Clymene dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not

listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R.W. Davis and G.S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D., L. V. Higgins, T. A. Jefferson and L. J. Hansen. 1994. Sightings of the Clymene dolphin (*Stenella clymene*) in the Gulf of Mexico. Mar. Mamm. Sci. 10(4): 464-470.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Perrin, W. F. and J. G. Mead. 1994. Clymene dolphin *Stenella clymene* (Gray, 1846). pp. 161-171. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

~~December 2005~~~~November~~April 200~~6~~7

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

Fraser's dolphin is distributed worldwide in tropical waters (Perrin *et al.* 1994). Sightings in the northern Gulf of Mexico occur in oceanic waters (>200m) (Figure 1). Fraser's dolphins have been observed in the northern Gulf of Mexico during all seasons (Leatherwood *et al.* 1993; Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

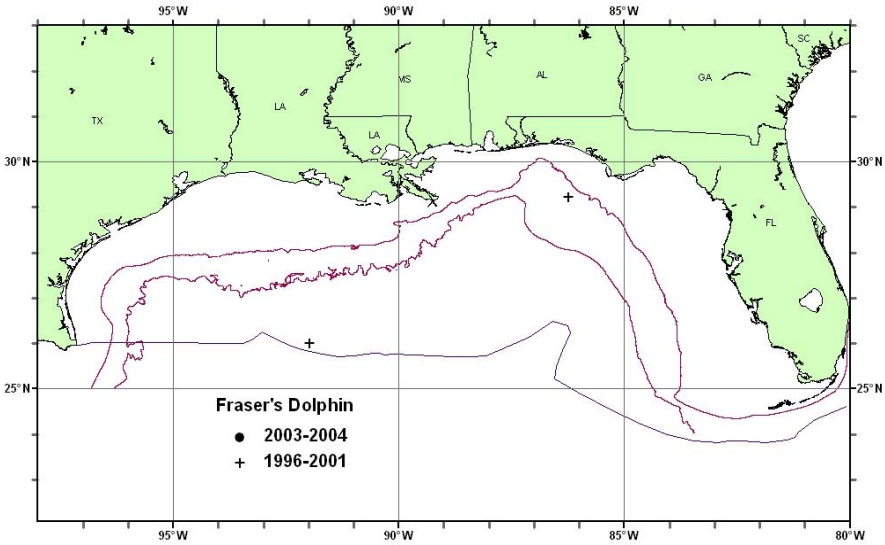


Figure 1. *Distribution of Fraser's dolphin sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline.

Survey effort-weighted estimated average abundance of Fraser's dolphins for all surveys combined was 127 (CV= 0.90) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~ Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for Fraser's dolphins in oceanic waters, pooled from 1996 to 2001, is 726 (CV=0.70) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward exten~~d~~t of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 200~~6~~7).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Fraser's dolphins in oceanic waters, pooled from 2003 to 2004, was 0 (Mullin 200~~6~~7). Because sightings of groups of Fraser's dolphins have historically been uncommon to rare, it is probable that Fraser's dolphins were in the northern Gulf of Mexico during 2003 and 2004 but were not encountered. Therefore, the best available abundance estimate for this species in the northern Gulf of Mexico is unknown.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for Fraser's dolphins is ~~7260~~unknown ~~(CV=0.70)~~. The minimum population estimate for the northern Gulf of Mexico for ~~is 427~~ 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) ~~are not~~were not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low.

These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Fraser's dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.
~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Fraser's dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~427 (CV=0.70)~~ 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 ~~4.3~~un~~known~~determined.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Fraser's dolphin during 1998-200~~3~~5 (Yeung 1999, Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Fraser's dolphins in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to Fraser's dolphins by this fishery.

Other Mortality

There was 1 reported stranding event of Fraser's dolphins in the Gulf of Mexico during 1999-200~~3~~5. Ten animals mass stranded in Florida during April 2003. There was no evidence of human interaction for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of Fraser's dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this

stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. ~~This~~ Despite an undetermined PBR, this is not a strategic stock because there is no documented ~~average annual fishery~~human-related mortality and serious injury ~~does not exceed PBR~~.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle, and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson, and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Leatherwood, S., T. A. Jefferson, J. C. Norris, W. E. Stevens, L. J. Hansen and K. D. Mullin. 1993. Occurrence and sounds of Fraser's dolphin in the Gulf of Mexico. Texas J. Sci. 45(4): 349-354.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Perrin, W. F., S. Leatherwood and A. Collet. 1994. Fraser's dolphin *Lagenodelphis hosei* (Fraser 1956). pp. 225-240. *In:* S. H. Ridgway and R. Harrison (eds.) *Handbook* of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The killer whale is distributed worldwide from tropical to polar regions (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico during 1951-1995 occurred primarily in oceanic waters ranging from 256 to 2,652m (averaging 1,242m) in the north-central Gulf of Mexico (O'Sullivan and Mullin 1997). Despite extensive shelf surveys (O'Sullivan and Mullin 1997), no killer whales have been reported on the Gulf of Mexico shelf waters other than those reported in 1921, 1985 and 1987 by Katona *et al.* (1988). Killer whales were seen only in the summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000), were reported from May through June during vessel surveys (Mullin and Fulling 2004) and recorded in May, August, September and November by earlier opportunistic ship-based sources (O'Sullivan and Mullin 1997).

Different stocks were identified in the northeastern Pacific based on morphological, behavioral and genetic characteristics (Bigg *et al.* 1990; Hoelzel 1991). There is no information on stock differentiation for the Atlantic Ocean population, although an analysis of vocalizations of killer whales from Iceland and Norway indicated that whales from these areas may represent different stocks (Moore *et al.* 1988). Thirty-two individuals have been photographically identified to date, with 6 individuals having been sighted over a 5 year period, and 1 whale resighted over 10 years. Three animals have been sighted over a range of more than 1,100km (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

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during summer in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of killer whales for all surveys combined was 277 (CV=0.42) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

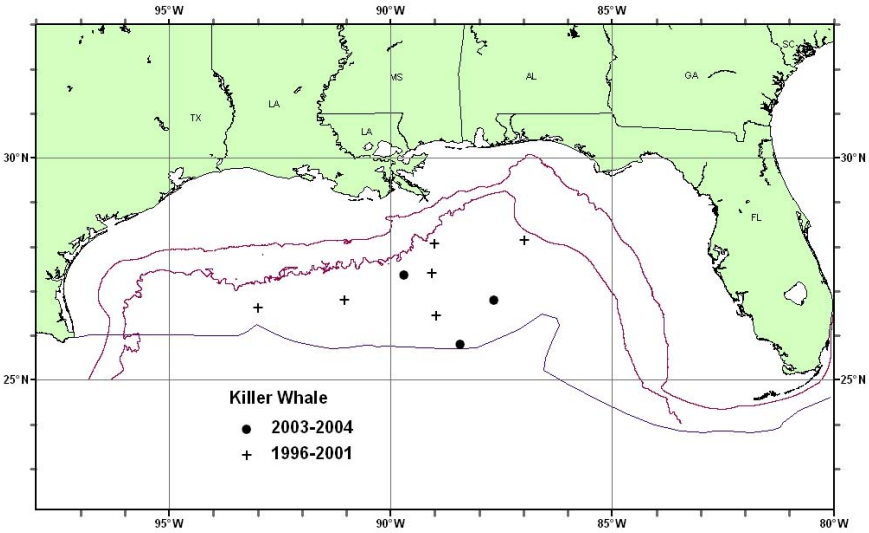


Figure 1. *Distribution of killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted line indicates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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for killer whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 133 (CV=0.49) (Mullin and Fulling 2004).

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for killer whales in oceanic waters, pooled from 2003 to 2004, was 49 (CV=0.77) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico.~~

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for killer whales is ~~133~~49 (CV=0.~~49~~77). The minimum population estimate for the northern Gulf of Mexico is ~~90~~28 killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 49 (CV=0.77) and that for 1996-2001 of 133 (CV=0.49) ~~and that for 1991-1994 of 277 (CV=0.42)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for 1991-1994 was 277 (CV=0.42). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of killer whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of killer whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~90~~28 ~~(CV=0.40)~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico killer whale is 0.~~9~~3.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a killer whale during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of killer whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to killer whales by this fishery.

Other Mortality

There were no reported strandings of killer whales in the Gulf of Mexico during 1999-200~~3~~5. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of killer whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but the rarity of mortality reports for this species suggests that this level is ~~but assumed to be less than 10% of the calculated PBR and can be considered to be~~ insignificant and approaching a zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Bigg, M. A., P. F. Olesiuk, G. M. Ellis, J. K. B. Ford and K. C. Balcomb. 1990. Social organization and genealogy of resident killer whales (*Orcinus orca*) in the coastal waters of British Columbia and Washington State. pp. 383-405. *In:* P. S. Hammond, S. A. Mizroch and G. P. Donovan (eds.) Individual recognition of cetaceans: Use of photoidentification and other techniques to estimate population parameters. Rep. Int. Whal. Commn., Special Issue 12, Cambridge, 440 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Hoelzel, A. R. 1991. Analysis of regional mitochondrial DNA variation in the killer whale; implications for conservation. pp. 225-233. *In:* A. R. Hoelzel (ed.) Genetic ecology of whales and dolphins. Rep. Int. Whal. Commn. Special Issue 13, Cambridge, 311 pp.

Katona, S. K., J. A. Beard, P. E. Girton, and F. Wenzel. 1988. Killer whales (*Orcinus orca*) from the Bay of Fundy to the equator, including the Gulf of Mexico. Rit Fiskideild. 11: 205-224.

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

Moore, S. E., J. K. Francine, A. E. Bowles and K. B. Ford. 1988. Analysis of calls of killer whales, *Orcinus orca*, from Iceland and Norway. Rit. Fiskideild. 11:225-250.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

O'Sullivan, S. and K. D. Mullin. 1997. Killer whales (*Orcinus orca*) in the northern Gulf of Mexico. Mar. Mamm. Sci. 13(1): 141-147.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS_SEFSC_430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

The false killer whale is distributed worldwide throughout warm temperate and tropical oceans (Leatherwood and Reeves 1983). Sightings of this species in the northern Gulf of Mexico occur in oceanic waters (Figure 1; Mullin and Fulling 2004). False killer whales were seen only in the spring and summer during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000) and in the spring during vessel surveys (Mullin and Fulling 2004).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of false killer whales for all surveys combined was 381 (CV=0.62) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

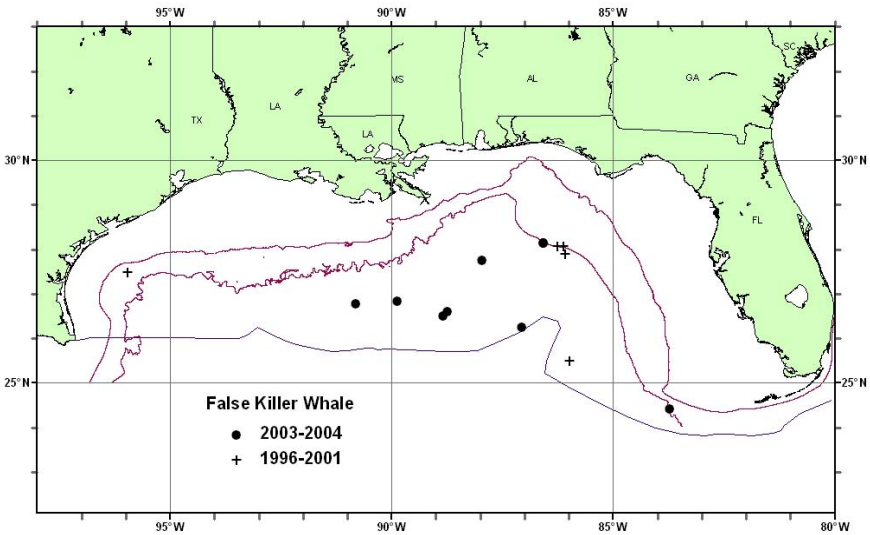


Figure 1. *Distribution of false killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001)~~. ~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for false killer whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 1,038 (CV=0.71) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004

surveys were considered most reliable. The estimate of abundance for false killer whales in oceanic waters, pooled from 2003 to 2004, was 777 (CV=0.56) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for false killer whales is ~~1,038~~777 (CV=0.~~71~~56). The minimum population estimate for the northern Gulf of Mexico is ~~606~~501 false killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 777 (CV=0.56) and that for 1996-2001 of 1,038 (CV=0.71) ~~and that for 1991-1994 of 381 (CV=0.62)~~ 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 381 (CV=0.62). These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of false killer whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~ These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of false killer whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~606~~501 ~~(CV=0.71)~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico false killer whale is ~~6.1~~5.0.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been 1 reported fishing-related mortality of a false killer whale during 1998-200~~3~~5, which was a stranding in 1999 classified as likely caused by fishery interactions or other human-related causes due to mutilation of limbs (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of false killer whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to false killer whales by this fishery.

Other Mortality

There was 1 reported stranding of a false killer whale in the Gulf of Mexico during 1999-200~~3~~5. This animal, which stranded in Alabama in 1999, was classified as likely caused by fishery interactions or other human-related causes. The fins and flukes of the animal had been amputated. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise

among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of false killer whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS_SEFSC_430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

PYGMY KILLER WHALE (*Feresa attenuata*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy killer whale is distributed worldwide in tropical and subtropical waters (Ross and Leatherwood 1994). Sightings of these animals in the northern Gulf of Mexico occur in oceanic waters (Mullin and Fulling 2004). Sightings of pygmy killer whales were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of pygmy killer whales for all surveys combined was 518 (CV=0.81) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

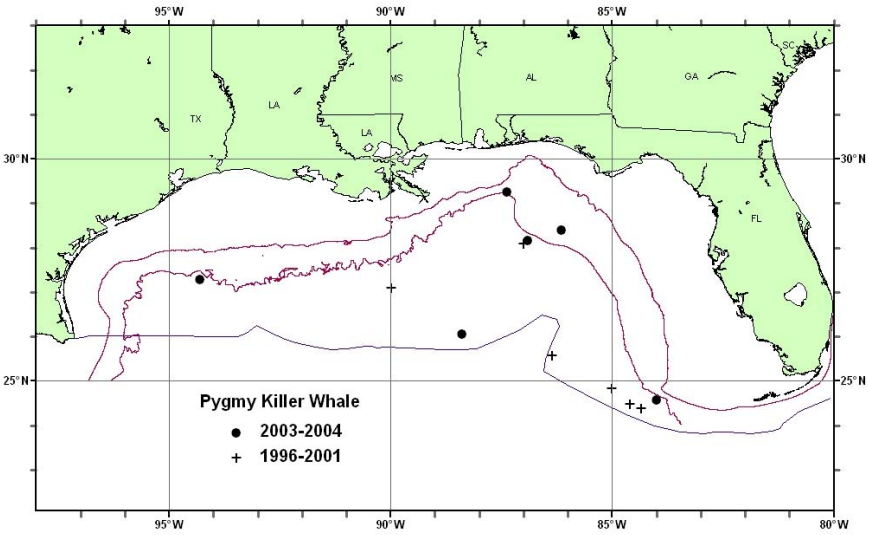


Figure 1. *Distribution of pygmy killer whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for pygmy killer whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 408 (CV=0.60) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for pygmy killer whales in oceanic waters, pooled from 2003 to 2004, was 323 (CV=0.60) (Mullin 2007), which is the best available abundance estimate for this species in the

northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for pygmy killer whales is ~~408~~323 (CV=0.60). The minimum population estimate for the northern Gulf of Mexico is ~~256~~203 pygmy killer whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 323 (CV=0.60) and that for 1996-2001 of 408 (CV=0.60) ~~and that for 1991-1994 of 518 (CV=0.81)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These estimates are generally similar to that for 1991-1994 of 518 (CV=0.81). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of pygmy killer whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of pygmy killer whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is ~~256~~203 ~~(CV=0.60)~~. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico pygmy killer whale is 2.~~6~~0.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a pygmy killer whale during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of pygmy killer whales in the northern Gulf of Mexico is unknown. There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell and Caldwell 1971). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to pygmy killer whales by this fishery.

Other Mortality

There w~~as~~ere ~~1~~2 reported strandings of a ~~a~~ pygmy killer whale in the Gulf of Mexico during 1999-200~~3~~5. There was no evidence of human interaction for th~~is~~ese stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

STATUS OF STOCK

The status of pygmy killer whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the

population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

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

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R.W. Davis and G.S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Ross, G. J. B. and S. Leatherwood. 1994. Pygmy killer whale *Feresa attenuata* (Gray, 1874). pp. 387-404. *In:* S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 5: The first book of dolphins. Academic Press, London, 416 pp.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

DWARF SPERM WHALE (*Kogia sima*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). Sightings of these animals in the northern Gulf of Mexico occur primarily in oceanic waters (Figure 1; Mullin *et al.* 1991; Mullin and Fulling 2004). Dwarf sperm whales and pygmy sperm whales (*Kogia breviceps*) are difficult to differentiate at sea, and sightings of either species are usually categorized as *Kogia* spp. Sightings of this category were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The difficulty in sighting dwarf and pygmy sperm whales may be exacerbated by their avoidance reaction towards ships, and change in behavior towards approaching survey aircraft (Würsig *et al.* 1998).

In a study using hematological and stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales and/or dive deeper during feeding bouts. Diagnostic morphological characters have also been useful in distinguishing the 2 *Kogia* species (Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin, in proportion to the animal's total length, can be used to differentiate between the 2 *Kogia* species when such measurements are obtainable (Barros and Duffield 2003).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of dwarf and pygmy sperm whales for all surveys combined was 547 (CV =0.28) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

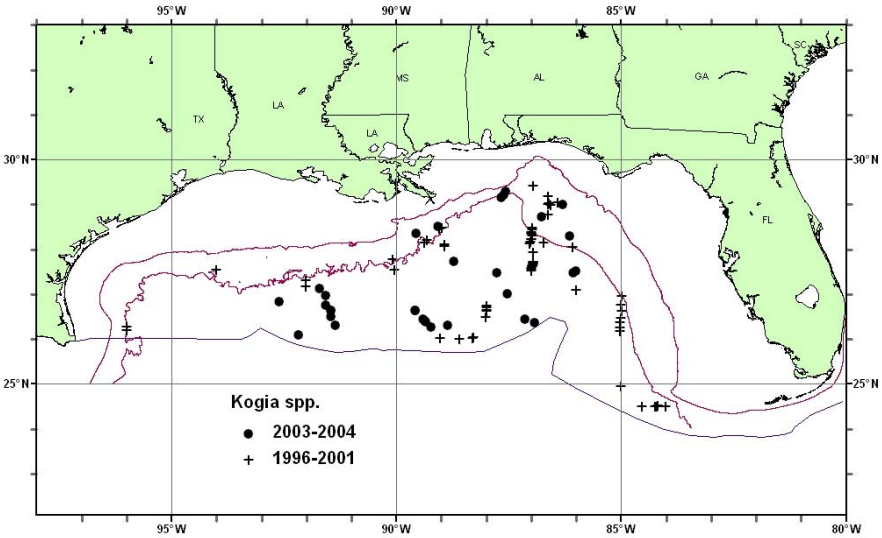


Figure 1. *Distribution of dwarf and pygmy sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001).~~ .~~Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004).~~ Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for dwarf and pygmy sperm whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 742 (CV=0.29) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for these species in the northern~~

~~Gulf of Mexico~~. A separate estimate of abundance for dwarf sperm whales ~~cannot~~could not be estimated due to uncertainty of species identification at sea.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for dwarf and pygmy sperm whales in oceanic waters, pooled from 2003 to 2004, was 453 (CV=0.35) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for dwarf and pygmy sperm whales is ~~742~~453 (CV=0.~~29~~35). It is not possible to determine the minimum population estimate for only dwarf sperm whales. The minimum population estimate for the northern Gulf of Mexico is ~~584~~340 dwarf and pygmy sperm whales.

Current Population Trend

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

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Kogia* spp. for 2003-2004 of 453 (CV=0.35) and that for 1996-2001 of 742 (CV=0.29) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for *Kogia* spp. for 1991-1994 was 547 (CV=0.28). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size for dwarf and pygmy sperm whales is ~~574~~340 ~~(CV=0.29)~~. 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 (O~~P~~SP), 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 ~~5.8~~3.4. It is not possible to determine the PBR for only dwarf sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of dwarf or pygmy sperm whales during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of dwarf sperm whales in the northern Gulf of Mexico is

unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to dwarf sperm whales by this fishery.

Other Mortality

There were no documented strandings of dwarf sperm whales in the northern Gulf of Mexico during 1999-200~~3~~5 which were classified as likely caused by fishery interactions~~, but there have been stranding investigation reports of dwarf sperm whales which may have died as a result of other human-related causes~~. At least ~~7~~11 dwarf sperm whale strandings were documented in the northern Gulf of Mexico from 1999 through 200~~3~~5 (Table 1 displays 2001-2005 data; ~~5~~8 showed no signs of human interaction and ~~2~~3 were designated "could not be determined"). An additional ~~5~~7 *Kogia* spp. stranded during ~~this same period~~1999-2005 (2 in TX in 2000, 1 in TX in 2001, 2 in TX in 2002, 1 in MS in 2003, and 1 in FL in 2004). Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Dwarf sperm whale (*Kogia sima*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.						
~~State~~**STATE**	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**TOTAL**
Alabama	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Florida	0~~0~~	3~~2~~	1~~0~~	1~~3~~	1~~1~~	6~~6~~
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Texas	0~~0~~	1~~0~~	0~~0~~	2~~1~~	0~~0~~	3~~1~~
~~Total~~**TOTAL**	0~~0~~	4~~2~~	1~~0~~	3~~4~~	1~~1~~	9~~7~~

STATUS OF STOCK

The status of dwarf sperm whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR. However, the continuing inability to distinguish between species of *Kogia* raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Barros, N. B. and D. A. Duffield. 2003. Unraveling the mysteries of pygmy and dwarf sperm whales. Strandings Newsletter of the Southeast U.S. Marine Mammal Stranding Network. December 2003. NOAA Tech. Memo. NMFS-SEFSC-521, 11 pp.

Barros, N. B., D. A. Duffield, P. H. Ostrom, D. K. Odell and V. R. Cornish. 1998. Nearshore vs. offshore ecotype differentiation of *Kogia breviceps* and *K. sima* based on hemoglobin, morphometric and dietary analyses. Abstracts. World Marine Mammal Science Conference. Monaco. 20-24 January.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Caldwell, D. K. and M. C. Caldwell. 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): Dwarf sperm whale *Kogia sima* Owen, 1866. pp. 235-260. *In*: S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego, CA.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. NMFS-SEFSC, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm.

Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Würsig, B., S. K. Lynn, T. A. Jefferson and K. D. Mullin. 1998. Behavior of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquat. Mamm. 24: 41-50.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

PYGMY SPERM WHALE (*Kogia breviceps*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). Sightings of these animals in the northern Gulf of Mexico occur primarily in oceanic waters (Figure 1; Mullin *et al.* 1991; Mullin and Fulling 2004). Pygmy sperm whales and dwarf sperm whales (*Kogia sima*) are difficult to differentiate at sea, and sightings of either species are often categorized as *Kogia* sp. Sightings of this category were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico from 1992 to 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000). The difficulty in sighting pygmy and dwarf sperm whales may be exacerbated by their avoidance reaction towards ships, and change in behavior towards approaching survey aircraft (Würsig *et al.* 1998).

In a study using hematological and stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. Diagnostic morphological characters have also been useful in distinguishing the 2 *Kogia* species (Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin, in proportion to the animal's total length, can be used to differentiate between the 2 *Kogia* species when such measurements are obtainable (Barros and Duffield 2003).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of pygmy and dwarf sperm whales for all surveys combined was 547 (CV=0.28) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

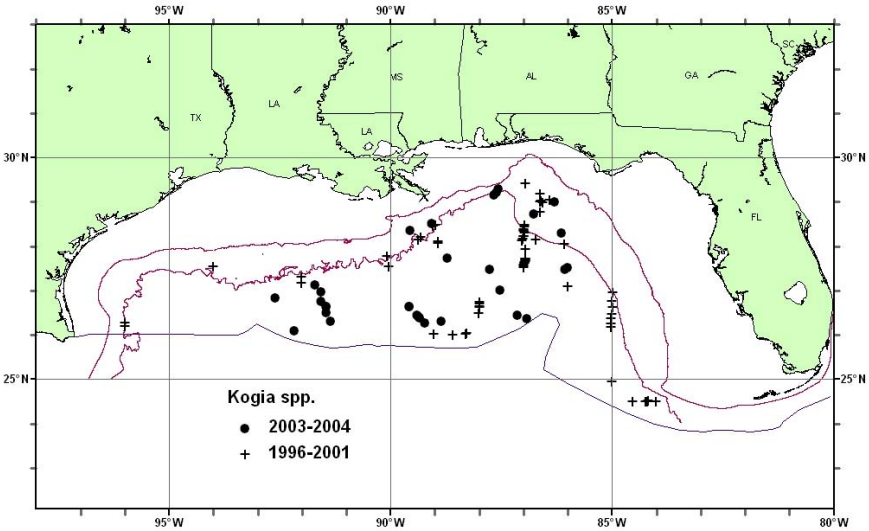


Figure 1. *Distribution of pygmy and dwarf sperm whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for pygmy and dwarf sperm whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was

742 (CV=0.29) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for these species in the northern Gulf of Mexico~~. A separate estimate of abundance for pygmy sperm whales c~~annot~~ould not be estimated due to uncertainty of species identification at sea.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for pygmy and dwarf sperm whales in oceanic waters, pooled from 2003 to 2004, was 453 (CV=0.35) (Mullin 2007), which is the best available abundance estimate for these species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for pygmy and dwarf sperm whales is ~~742~~453 (CV=0.~~29~~35). It is not possible to determine the minimum population estimate for only pygmy sperm whales. The minimum population estimate for the northern Gulf of Mexico is ~~584~~340 pygmy and dwarf sperm whales.

Current Population Trend

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

There are insufficient data to determine the population trends for this species due to uncertainty in species identification at sea. The pooled abundance estimate for *Kogia* spp. for 2003-2004 of 453 (CV=0.35) and that for 1996-2001 of 742 (CV=0.29) are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. The abundance estimate for *Kogia* spp. for 1991-1994 was 547 (CV=0.28). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of *Kogia* abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for pygmy and dwarf sperm whales is ~~584~~340 ~~(CV=0.29)~~. 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 ~~5.8~~3.4. It is not possible to determine the PBR for only pygmy sperm whales.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of dwarf or pygmy sperm whales during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of dwarf sperm whales in the northern Gulf of Mexico is

unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to dwarf sperm whales by this fishery.

Other Mortality

At least 1~~2~~5 pygmy sperm whale strandings were documented in the northern Gulf of Mexico during 1999-200~~3~~5 (Table 1 displays 2001-2005 data; 1~~1~~3 showed no signs of human interaction and ~~1~~2 w~~as~~ere designated "could not be determined"). Two animals mass stranded in Florida during January 2001. ~~An additional 5 *Kogia* spp. stranded during 1999-2003~~ An additional 7 *Kogia* spp. stranded during 1999-2005 (2 in TX in 2000, 1 in TX in 2001, 2 in TX in 2002, 1 in MS in 2003, and 1 in FL in 2004).~~.~~ Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Pygmy sperm whale (*Kogia breviceps*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.

S~~tate~~TATE	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**TOTAL**
Alabama	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Florida	2 [a]~~0~~	2~~0~~	3~~2~~ [a]	1~~2~~	0~~3~~	8~~7~~
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~
Texas	1~~0~~	2~~1~~	1~~1~~	0~~2~~	2~~1~~	6~~5~~
T~~otal~~OTAL	3~~0~~	4~~1~~	4~~3~~	1~~4~~	2~~4~~	14~~12~~

a Florida mass stranding of 2 animals in January 2001

STATUS OF STOCK

The status of pygmy sperm whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR. However, the continuing inability to distinguish between species of *Kogia* raises concerns about the possibility of mortalities of one stock or the other exceeding PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Barros, N. B. and D. A. Duffield. 2003. Unraveling the mysteries of pygmy and dwarf sperm whales. Strandings Newsletter of the Southeast U.S. Marine Mammal Stranding Network. December 2003. NOAA Tech. Memo. NMFS-SEFSC-521, 11 pp.

Barros, N. B., D. A. Duffield, P. H. Ostrom, D. K. Odell and V. R. Cornish. 1998. Nearshore vs. offshore ecotype differentiation of *Kogia breviceps* and *K. sima* based on hemoglobin, morphometric and dietary analyses. Abstracts. World Marine Mammal Science Conference. Monaco. 20-24 January.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Caldwell, D. K. and M. C. Caldwell. 1989. Pygmy sperm whale *Kogia breviceps* (de Blainville, 1838): Dwarf sperm whale *Kogia sima* Owen, 1866. pp. 235-260. *In*: S. H. Ridgway and R. Harrison (eds.) Handbook of marine mammals, Vol. 4: River dolphins and the larger toothed whales. Academic Press, San Diego, CA.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Würsig, B., S. K. Lynn, T. A. Jefferson and K. D. Mullin. 1998. Behavior of cetaceans in the northern Gulf of Mexico relative to survey ships and aircraft. Aquat. Mamm. 24:41-50.

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

~~December 2005~~~~November~~April 200~~6~~7

MELON-HEADED WHALE (*Peponocephala electra*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The melon-headed whale is distributed worldwide in tropical to sub-tropical waters (Jefferson *et al.* 1994). Sightings in the northern Gulf of Mexico occur in oceanic waters (Mullin *et al*. 1994; Mullin and Fulling 2004). Sightings of melon-headed whales were documented in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (~~-~~Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered 1 stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al*. 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys ~~–~~during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of melon-headed whales for all surveys combined was 3,965 (CV=0.39) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

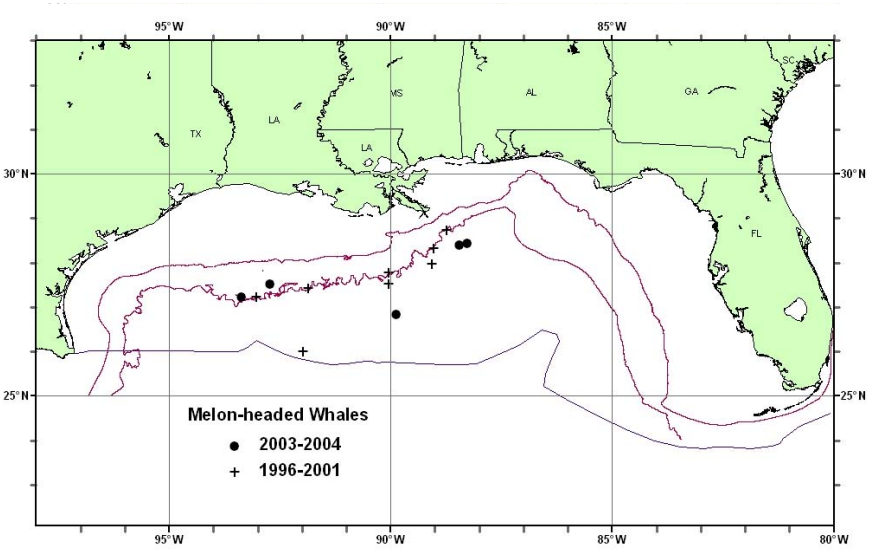


Figure 1. *Distribution of melon-headed whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for melon-headed whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 3,451 (CV=0.55) (Mullin and Fulling 2004)~~), which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for melon-headed whales in oceanic waters, pooled from 2003 to 2004, was 2,283 (CV=0.76) (Mullin 2007), which is the best available abundance estimate for this species in

the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for melon-headed whales is ~~3,451~~2,283 (CV=0.~~55~~76). The minimum population estimate for the northern Gulf of Mexico is ~~2,238~~1,293 melon-headed whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003 to 2004 of 2,283 (CV=0.76) and that for 1996-2001 of 3,451 (CV=0.55) ~~and that for 1991-1994 of 3,965 (CV=0.39)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is low. These estimates are generally similar to that for 1991-1994 of 3,965 (CV=0.39). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of melon-headed whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~ These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of melon-headed whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~2,238~~1,293 ~~(CV=0.55)~~. 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 (O~~P~~SP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico melon-headed whale is ~~22~~13.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a melon-headed whale during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of melon-headed whales in the northern Gulf of Mexico is unknown. There has historically been some take of this species in small cetacean fisheries in the Caribbean (Caldwell *et al*. 1976). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no reports of mortality or serious injury to melon-headed whales by this fishery.

Other Mortality

There were ~~6~~6 reported strandings of melon-headed whales in the Gulf of Mexico during 1999-200~~3~~5 (Table 1 displays 2001-2005 data). There was no evidence of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery-interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Melon-headed whale (*Peponocephala electra*) strandings along the U.S. Gulf of Mexico coast, ~~1999~~2001-200~~3~~5.

S~~tate~~TATE	**2001~~1999~~**	**2002~~2000~~**	**2003~~2001~~**	**2004~~2002~~**	**2005~~2003~~**	**TOTAL**
Alabama	0~~0~~	0~~0~~	2~~0~~	0~~0~~	0~~2~~	2
Florida	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0
Louisiana	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0
Mississippi	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0~~0~~	0
Texas	0~~0~~	0~~1~~	2~~0~~	1~~0~~	0~~2~~	3
T~~otal~~OTAL	0~~0~~	0~~1~~	4~~0~~	1~~0~~	0~~4~~	5

STATUS OF STOCK

The status of melon-headed whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Caldwell, D. K., M. C. Caldwell and R. V. Walker. 1976. First records for Fraser's dolphin (*Lagenodelphis hosei*) in the Atlantic and the melon-headed whale (*Peponocephala electra*) in the western Atlantic. Cetology 25: 1-4.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Jefferson, T. A., S. Leatherwood, and M. A. Weber. 1994. Marine mammals of the world. FAO, Rome, 320 pp.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Mullin, K. D., T. A. Jefferson, L. J. Hansen and W. Hoggard. 1994. First sightings of melon-headed whales (*Peponocephala electra*) in the Gulf of Mexico. Mar. Mamm. Sci. 10(3): 342-348.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

~~December 2005~~~~November~~April 200~~6~~7

RISSO'S DOLPHIN (*Grampus griseus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Risso's dolphin is distributed worldwide in tropical to warm temperate waters (Leatherwood and Reeves 1983). Risso's dolphins in the northern Gulf of Mexico occur throughout oceanic waters but are concentrated in continental slope waters (Baumgartner 1997). Risso's dolphins were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently ~~no~~ little 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.~~ In 2006, a Risso's dolphin that stranded on the Florida Gulf Coast was rehabilitated, satellite tagged and released into the Gulf west 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 (R. Wells, pers. comm.). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of Risso's dolphins for all surveys combined was 2,749 (CV=0.27) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

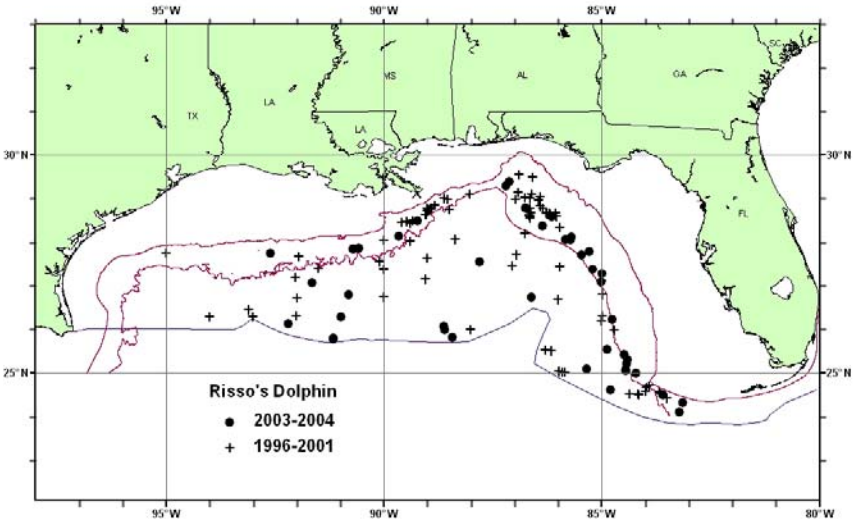


Figure 1. *Distribution of Risso's dolphin sightings from SEFSC vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the ~~dotted line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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for Risso's dolphins in oceanic waters, pooled from 1996 to 2001, ~~is~~was 2,169 (CV=0.32) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are

deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for Risso's dolphins in oceanic waters, pooled from 2003 to 2004, was 1,589 (CV=0.27) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

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 ~~2,169~~1,589 (CV=0.~~32~~27). The minimum population estimate for the northern Gulf of Mexico is 1,~~668~~271 Risso's dolphins.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 1,589 (CV=0.27) and that for 1996-2001 of 1,777 (CV=0.34) ~~and that for 1991-1994 of 2,749 (CV=0.27)~~ are not significantly different (P>0.05), but due to the precision of the estimates, the power to detect a difference is relatively low.

These estimates are generally similar to that for 1991-1994 of 2,749 (CV=0.27). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Risso's dolphin abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of Risso's dolphin abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 1,~~668~~271. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP), is assumed to be 0.5 because the stock is of unknown status. PBR for the northern Gulf of Mexico Risso's dolphin is ~~17~~13.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of a Risso's dolphin during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006). However, during 2005 there was one Risso's dolphin released alive with no serious injury after an entanglement interaction with the pelagic longline fishery (Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of Risso's dolphins in the northern Gulf of Mexico is unknown. This species has been taken in the U.S. longline swordfish/tuna fishery in the northern Gulf of Mexico and in the U.S. Atlantic (Lee *et al*. 1994). Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico (see Appendix III for a description of the large pelagics longline fishery). There were no reports of mortality or serious injury to Risso's dolphins by this fishery during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006). During 2005 one Risso's dolphin was observed entangled and released alive. The animal was not hooked, but was tangled with mainline and leader around its flukes. All gear was removed and the animal dove immediately. It is presumed to have not been seriously injured (Fairfield Walsh and Garrison 2006)~~)~~. One Risso's dolphin was observed taken and released alive during 1992; the extent

of injury to the animal was unknown (SEFSC, unpublished data). One lethal take of a Risso's dolphin by the fishery was observed in the Gulf of Mexico during 1993 (SEFSC, unpublished data). Estimated average annual fishery-related mortality and serious injury attributable to the longline swordfish/tuna fishery in the Gulf of Mexico during 1992-1993 was 19 Risso's dolphins (CV=0.20).

Other Mortality

There were ~~2~~9 reported strandings of Risso's dolphin in the Gulf of Mexico during 1999-200~~3~~5 (Table 1 displays 2001-2005 data). There was no evidence of human interactions for these stranded animals. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

Table 1. Risso's dolphin (*Grampus griseus*) strandings along the U.S. Gulf of Mexico coast, 2001- 2005.

S~~tate~~TATE	**2001**	**2002**	**2003**	**2004**	**2005**	**TOTAL**
Alabama	0	0	0	0	0	0
Florida	0	0	0	0	5[a]	5
Louisiana	0	0	0	0	0	0
Mississippi	0	0	0	0	0	0
Texas	1	0	0	1	1	3
TOTAL~~otal~~	~~0~~1	0	0	1	6	8

a Florida mass stranding of 5 animals in ~~March~~July 2005

STATUS OF STOCK

The status of Risso's dolphins in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Baumgartner, M. F. 1997. The distribution of Risso's dolphin (*Grampus griseus*) with respect to physiography in the northern Gulf of Mexico. Mar. Mamm. Sci. 13:614-638.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R.W. Davis and G.S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals

Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Lee, D. W., C. J. Brown, A. J. Catalano, J. R. Grubich, T. W. Greig, R. J. Miller and M.T. Judge. 1994. SEFSC pelagic longline observer program data summary for 1992-1993. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-347, 19 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172. *In:* R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 96-0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

SHORT-FINNED PILOT WHALE (*Globicephala macrorhynchus*): Northern Gulf of Mexico Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The short-finned pilot whale is distributed worldwide in tropical to temperate waters (Leatherwood and Reeves 1983). Sightings of these animals in the northern Gulf of Mexico occur primarily on the continental slope (Mullin and Fulling 2004). Short-finned pilot whales were seen in all seasons during GulfCet aerial surveys of the northern Gulf of Mexico between 1992 and 1998 (Hansen *et al.* 1996; Mullin and Hoggard 2000).

The Gulf of Mexico population is provisionally being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the Atlantic Ocean stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

POPULATION SIZE

Estimates of abundance were derived through the application of distance sampling analysis (Buckland *et al.* 2001) and the computer program DISTANCE (Thomas *et al.* 1998) to sighting data. From 1991 through 1994, line-transect vessel surveys were conducted in conjunction with bluefin tuna ichthyoplankton surveys during spring in the northern Gulf of Mexico from the 200m isobath to the seaward extent of the U.S. Exclusive Economic Zone (EEZ) (Hansen *et al.* 1995). Annual cetacean surveys were conducted along a fixed plankton sampling trackline. Survey effort-weighted estimated average abundance of short-finned pilot whales for all surveys combined was 353 (CV=0.89) (Hansen *et al.* 1995). ~~As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations.~~

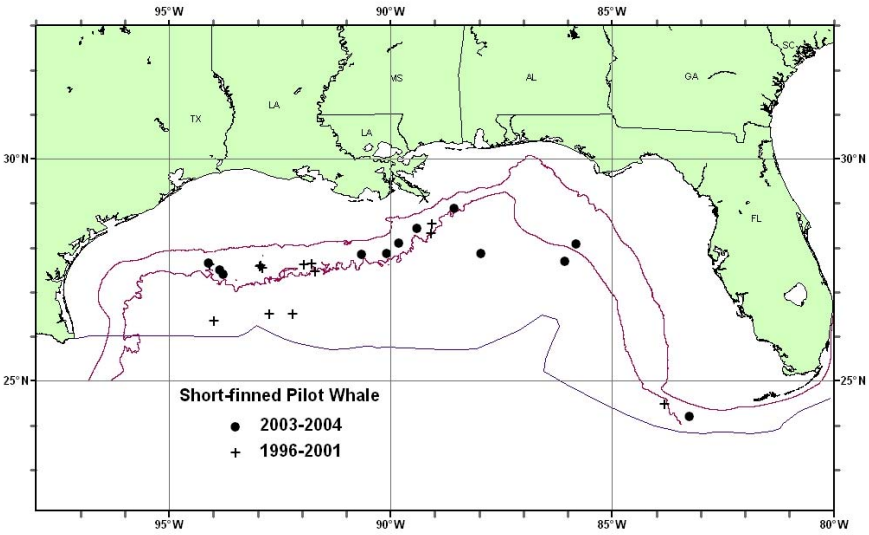


Figure 1. *Distribution of short-finned pilot whale sightings from SEFSC spring vessel surveys during 1996-2001 and from summer 2003 and spring 2004 surveys. All the on-effort sightings are shown, though not all were used to estimate abundance. Solid lines indicate the 100m and 1,000m isobaths and the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

Similar surveys were conducted during ~~April/May~~spring from 1996 to 2001 (excluding 1998) in oceanic waters of the northern Gulf of Mexico~~, using NOAA ships *Oregon II* (1996, 1997, 1999) and *Gordon Gunter* (2000, 2001). Estimates for all oceanic strata were summed, as survey effort was not uniformly distributed, to calculate a total estimate for the entire northern Gulf of Mexico oceanic waters (Figure 1; Mullin and Fulling 2004)~~. Due to limited survey effort in any given year, survey effort was pooled across all years to develop an average abundance estimate.

The estimate of abundance for short-finned pilot whales in oceanic waters, pooled from 1996 to 2001, ~~is~~was 2,388 (CV=0.48) (Mullin and Fulling 2004)~~, which is the best available abundance estimate for this species in the northern Gulf of Mexico~~.

During summer 2003 and spring 2004, line-transect surveys dedicated to estimating the abundance of oceanic cetaceans were conducted in the northern Gulf of Mexico. During each year, a grid of uniformly-spaced transect lines from a random start were surveyed from the 200m isobath to the seaward extent of the U.S. EEZ using NOAA Ship *Gordon Gunter* (Mullin 2007).

As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable, and therefore should not be used for PBR determinations. Because most of the data for estimates prior to 2003 were older than this 8-year limit and due to the different sampling strategies, estimates from the 2003 and 2004 surveys were considered most reliable. The estimate of abundance for short-finned pilot whales in oceanic waters, pooled

from 2003 to 2004, was 716 (CV=0.34) (Mullin 2007), which is the best available abundance estimate for this species in the northern Gulf of Mexico.

Minimum Population Estimate

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the log-normal distributed abundance estimate. This is equivalent to the 20th percentile of the log-normal distributed abundance estimate as specified by Wade and Angliss (1997). The best estimate of abundance for short-finned pilot whales is ~~2,388~~716 (CV=0.~~48~~34). The minimum population estimate for the northern Gulf of Mexico is ~~1,628~~542 short-finned pilot whales.

Current Population Trend

There are insufficient data to determine the population trends for this species. The pooled abundance estimate for 2003-2004 of 716 (CV=0.34) and that for 1996-2001 of 2,388 (CV=0.48) ~~and that for 1991-1994 of 353 (CV=0.52)~~ are not significantly different (P>0.05), but due to the imprecision of the estimates, the power to detect a difference is low. The abundance estimate for 1991-1994 was 353 (CV=0.52). ~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of short-finned pilot whale abundance. Sixty-five percent of the oceanic waters in the Gulf of Mexico are south of the U.S. EEZ, and a shift in distribution across this boundary would not be detected.~~These temporal abundance estimates are difficult to interpret without a Gulf of Mexico-wide understanding of short-finned pilot whale abundance. The Gulf of Mexico is composed of waters belonging to the U.S., Mexico and Cuba. U.S. waters only comprise about 40% of the entire Gulf of Mexico, and 65% of oceanic waters are south of the U.S. EEZ. The oceanography of the Gulf of Mexico is quite dynamic, and the spatial scale of the Gulf is small relative to the ability of most cetacean species to travel. Studies based on abundance and distribution surveys restricted to U.S. waters are unable to detect temporal shifts in distribution beyond U.S. waters that might account for any changes in abundance.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

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

POTENTIAL BIOLOGICAL REMOVAL

Potential biological removal level (PBR) is the product of the minimum population size, one half the maximum net productivity rate and a recovery factor (MMPA Sec. 3.16 U.S.C. 1362; Wade and Angliss 1997). ~~—~~The minimum population size is ~~1,628~~542 ~~(CV=0.48)~~. 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 ~~16~~5.4.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

There has been no reported fishing-related mortality of short-finned pilot whales during 1998-200~~3~~5 (Yeung 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006).

Fisheries Information

The level of past or current, direct, human-caused mortality of short-finned pilot whales in the northern Gulf of Mexico is unknown. Pelagic swordfish, tunas and billfish are the targets of the longline fishery operating in the U.S. Gulf of Mexico. There were no recent reports of mortality or serious injury to short-finned pilot whales by this fishery. 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 ~~were~~ 2 reported mass strandings of short-finned pilot whales in the Gulf of Mexico since 1999 ~~during 1999-2003~~. Both mass strandings occurred in Florida. Two animals mass stranded in May 1999, and 9 animals in October 2001. ~~One of the 9 animals from 2001 displayed evidence of human interactions; for the remaining animals t~~There was no evidence of human interactions for these stranded animals. There have been no other documented strandings of short-finned pilot whales in the Gulf of Mexico during 1999-2005. Stranding data probably underestimate the extent of fishery-related mortality and serious injury because not all of the marine mammals which die or are seriously injured in fishery interactions wash ashore, not all that wash ashore are discovered, reported or investigated, nor will all of

those that do wash ashore necessarily show signs of entanglement or other fishery interaction. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of fishery interactions.

~~Table 1. Short-finned pilot whale (*Globicephala macrorhynchus*) strandings along the U.S. Gulf of Mexico coast, 1999-2003.~~

~~State~~	~~1999~~	~~2000~~	~~2001~~	~~2002~~	~~2003~~	~~TOTAL~~
~~Alabama~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Florida~~	~~2~~ [a]	~~0~~	~~9~~ [b]	~~0~~	~~0~~	~~11~~
~~Louisiana~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Mississippi~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Texas~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~
~~Total~~	~~2~~	~~0~~	~~9~~	~~0~~	~~0~~	~~11~~

~~[a] Florida mass stranding of 2 animals in May 1999~~
~~[b] Florida mass stranding of 9 animals in October 2001~~

STATUS OF STOCK

The status of short-finned pilot whales in the northern Gulf of Mexico, relative to OSP, is unknown. The species is not listed as threatened or endangered under the Endangered Species Act. There are insufficient data to determine the population trends for this species. The total level of U.S. Gulf of Mexico fishery-~~related~~caused mortality and serious injury for this stock is unknown, but assumed to be less than 10% of the calculated PBR and can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock because average annual fishery-related mortality and serious injury does not exceed PBR.

REFERENCES

Barlow, J., S. L. Swartz, T. C. Eagle and P. R. Wade. 1995. U.S. Marine mammal stock assessments: Guidelines for preparation, background, and a summary of the 1995 assessments. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-6, 73 pp.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. Introduction to distance sampling: ~~e~~Estimating abundance of biological populations. Oxford University Press, 432 pp.

Fairfield Walsh, C. and L. P. Garrison. 2006. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2005. NOAA Tech. Memo. NOAA NMFS-SEFSC-539, 52 pp.

Garrison, L. P. 2003. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2001-2002. NOAA Tech. Memo. NMFS-SEFSC-515, 52 pp.

Garrison, L. P. 2005. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2004. NOAA Tech. Memo. NMFS-SEFSC-531, 57 pp.

Garrison, L. P. and P. M. Richards. 2004. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2003. NOAA Tech. Memo. NMFS-SEFSC-527, 57 pp.

Hansen, L. J., K. D. Mullin and C. L. Roden. 1995. Estimates of cetacean abundance in the northern Gulf of Mexico from vessel surveys. Southeast Fisheries Science Center, Miami Laboratory, Contribution No. MIA-94/95-25, 9 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Hansen, L. J., K. D. Mullin, T. A. Jefferson and G. P. Scott. 1996. Visual surveys aboard ships and aircraft. pp. 55-132. *In:* R. W. Davis and G. S. Fargion (eds.) Distribution and abundance of marine mammals in the north-central and western Gulf of Mexico: Final report. Volume II: Technical report. OCS Study MMS 96- 0027. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

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

Mullin, K. D. 2007. Abundance of cetaceans in the oceanic Gulf of Mexico based on 2003-2004 ship surveys. 26 pp. Available from: NMFS, Southeast Fisheries Science Center, P.O. Drawer 1207, Pascagoula, MS 39568.

Mullin, K. D. and G. L. Fulling. 2004. Abundance of cetaceans in the oceanic northern Gulf of Mexico. Mar. Mamm. Sci. 20(4): 787-807.

Mullin, K. D. and W. Hoggard. 2000. Visual surveys of cetaceans and sea turtles from aircraft and ships. pp. 111-172.

In: R. W. Davis, W. E. Evans and B. Würsig (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: distribution, abundance and habitat associations. Volume II: Technical report. OCS Study MMS 2000-003. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA.

Thomas, L., J. L. Laake, J. F. Derry, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. Strindberg, S. L. Hedley, F. F. C. Marques, J. H. Pollard and R. M. Fewster. 1998. Distance 3.5. Research Unit for Wildlife Population Assessment, University of St. Andrews, St. Andrews, UK.

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

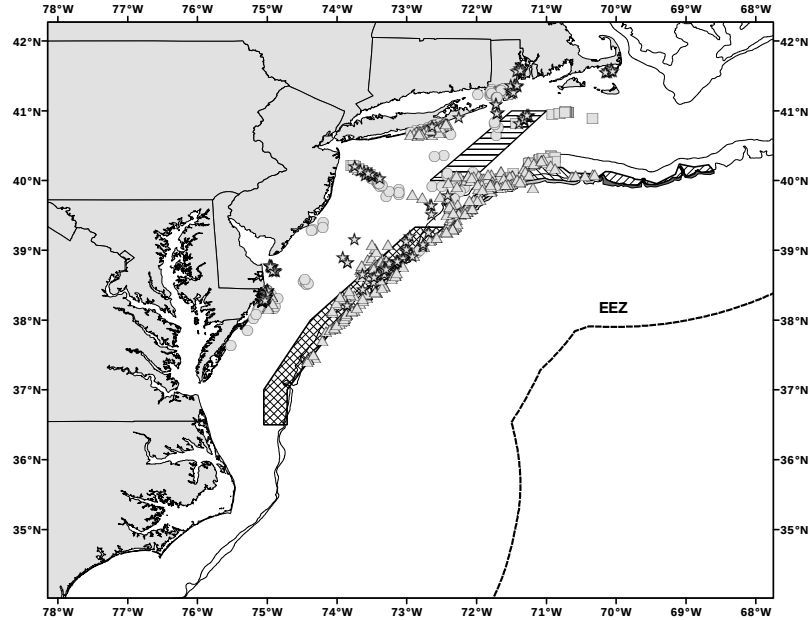
Yeung, C. 1999. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1998. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-430, 26 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

Yeung, C. 2001. Estimates of marine mammal and marine turtle bycatch by the U.S. Atlantic pelagic longline fleet in 1999-2000. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-SEFSC-467, 43 pp. Available from: NMFS, Southeast Fisheries Science Center, 75 Virginia Beach Dr., Miami, FL 33149.

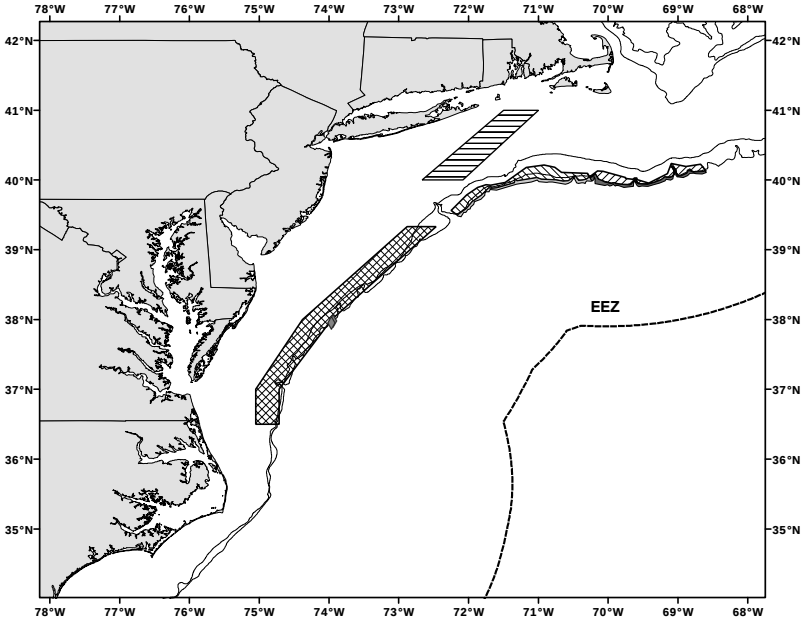
Figure 11. 2001 mid-Atlantic bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- common dolphin
- Restricted Gear Area 1
- Restricted Gear Area 2
- Restricted Gear Area 3
- Restricted Gear Area 4
- Northern Gear Restricted Area
- Southern Gear Restricted Area



(A)

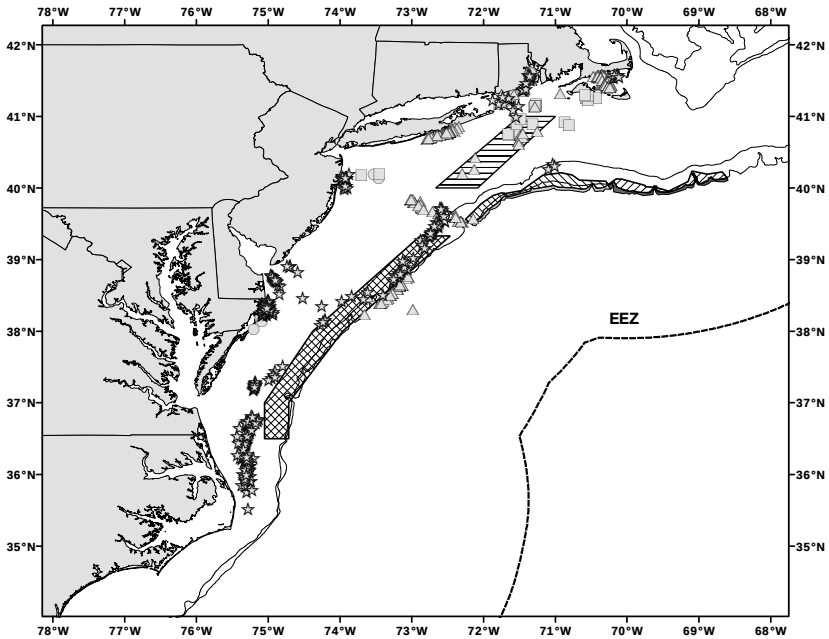


(B)

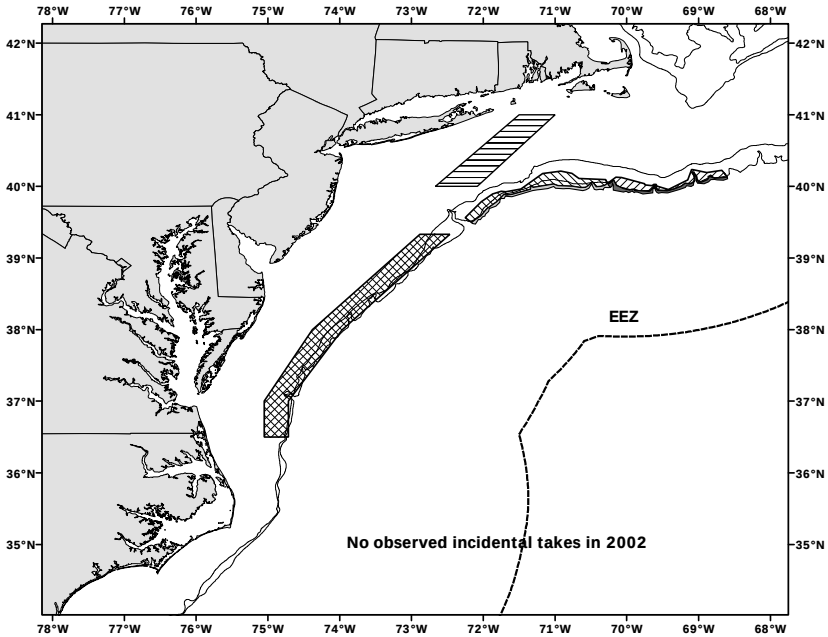
Figure 12. 2002 mid-Atlantic bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- Restricted Gear Area 1
- Restricted Gear Area 2
- Restricted Gear Area 3
- Restricted Gear Area 4
- Northern Gear Restricted Area
- Southern Gear Restricted Area



(A)

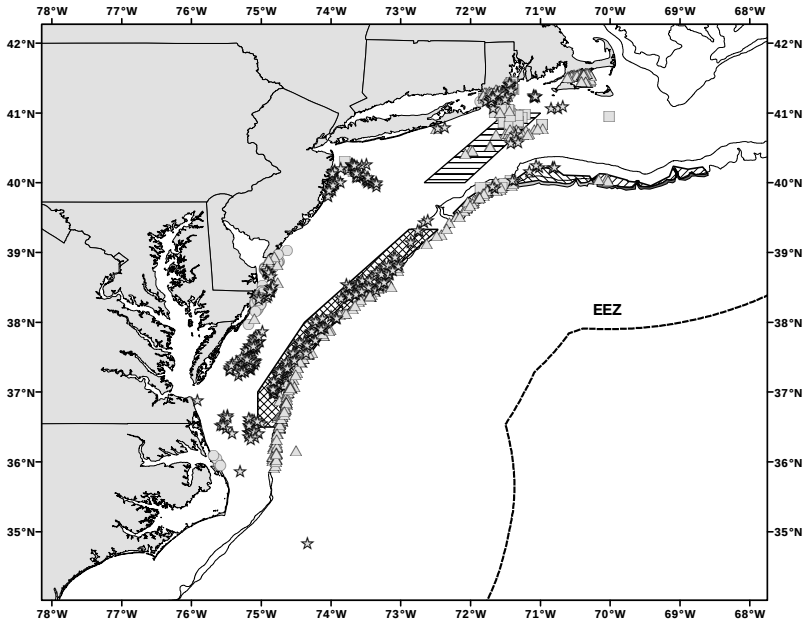


(B)

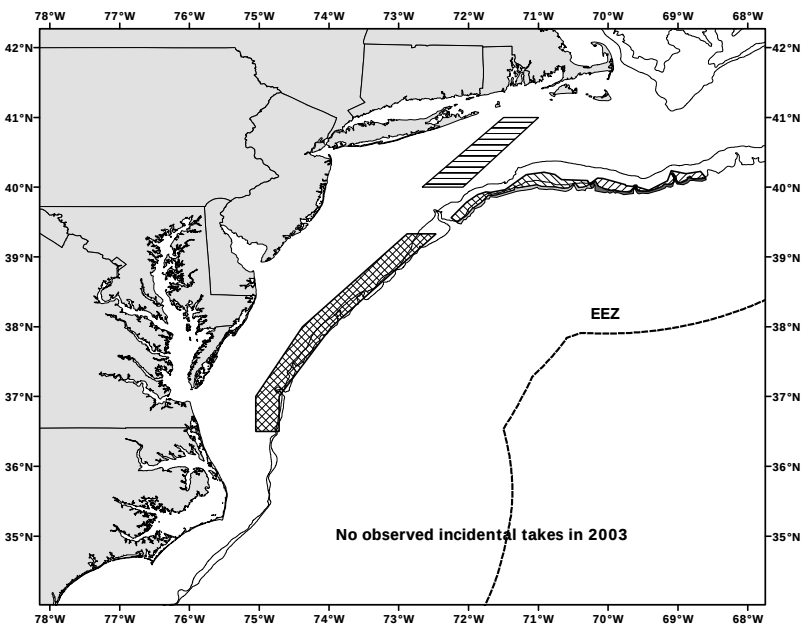
Figure 13. 2003 mid-Atlantic bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- Restricted Gear Area 1
- Restricted Gear Area 2
- Restricted Gear Area 3
- Restricted Gear Area 4
- Northern Gear Restricted Area
- Southern Gear Restricted Area



(A)

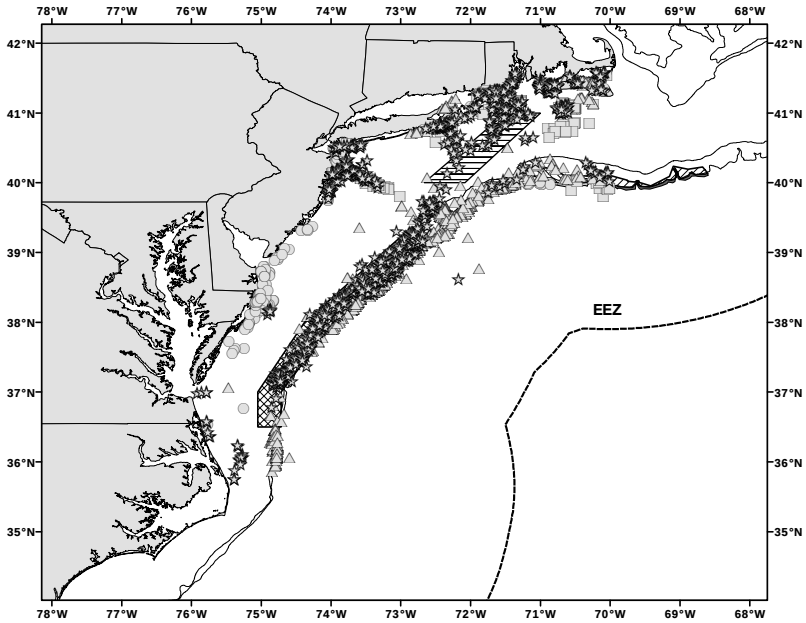


(B)

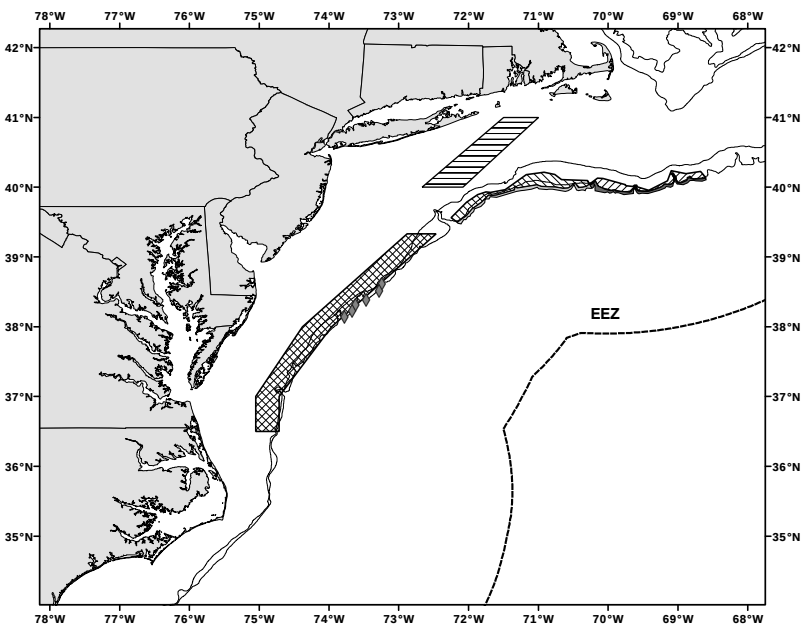
Figure 14. 2004 mid-Atlantic bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- common dolphin
- Restricted Gear Area 1
- Restricted Gear Area 2
- Restricted Gear Area 3
- Restricted Gear Area 4
- Northern Gear Restricted Area
- Southern Gear Restricted Area



(A)

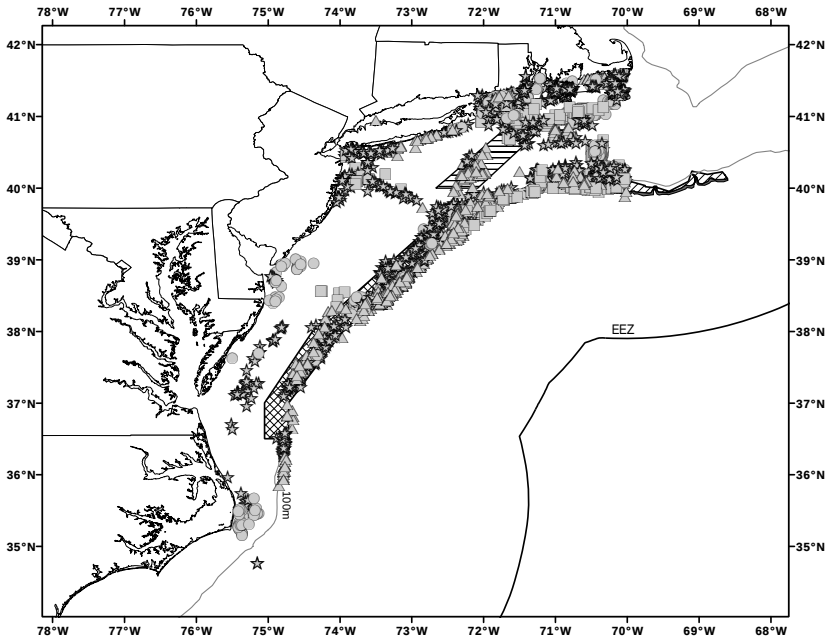


(B)

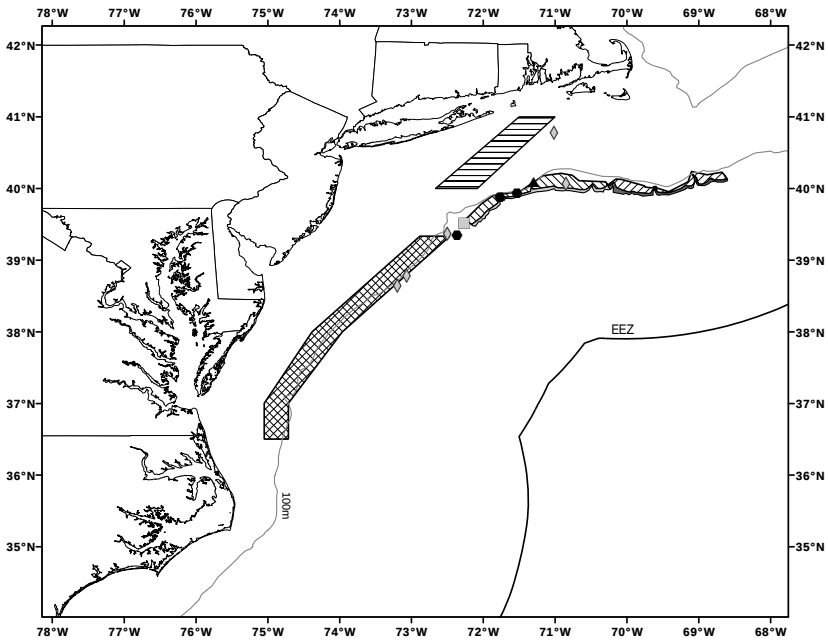
Figure 15. 2005 mid-Atlantic bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- common dolphin
- white-sided dolphin
- unknown dolphin
- unknown pilot whale
- Restricted Gear Area 1
- Restricted Gear Area 2
- Restricted Gear Area 3
- Restricted Gear Area 4
- Northern Gear Restricted Area
- Southern Gear Restricted Area



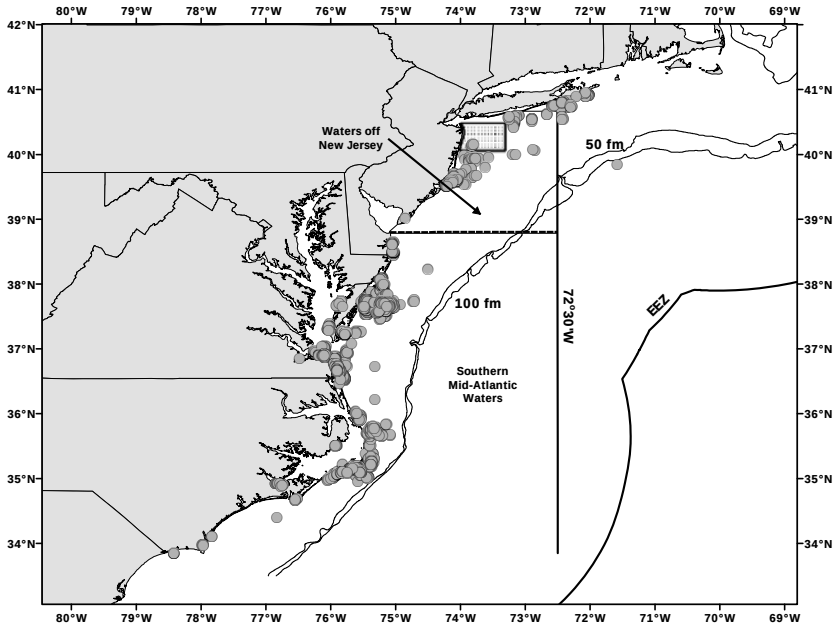
(A)



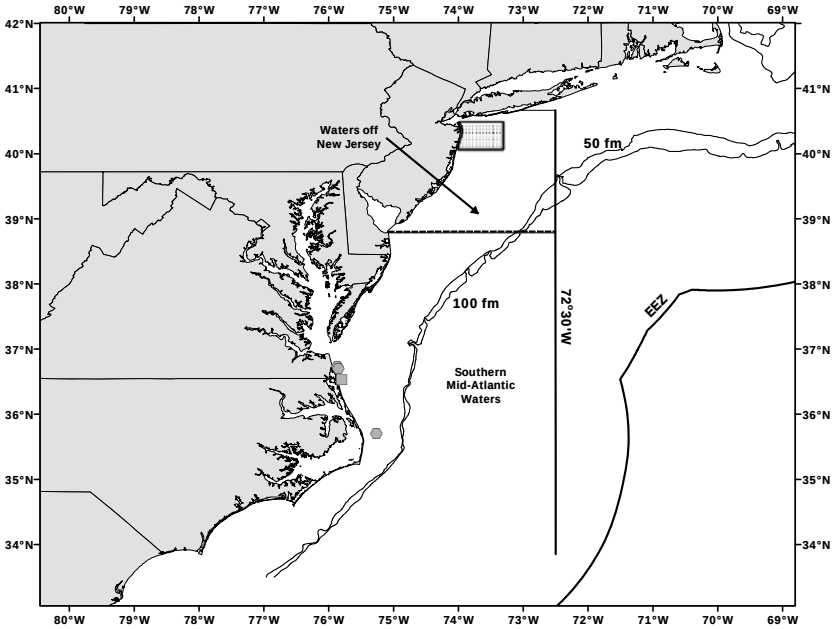
(B)

Figure 6. 2001 mid-Atlantic observed hauls (A) and observed takes (B)

- Observed hauls
- Bottlenose Dolphin
- Harbor Porpoise
- New Jersey/Southern Mid-Atlantic Waters Boundary
- Mudhole Closure Area



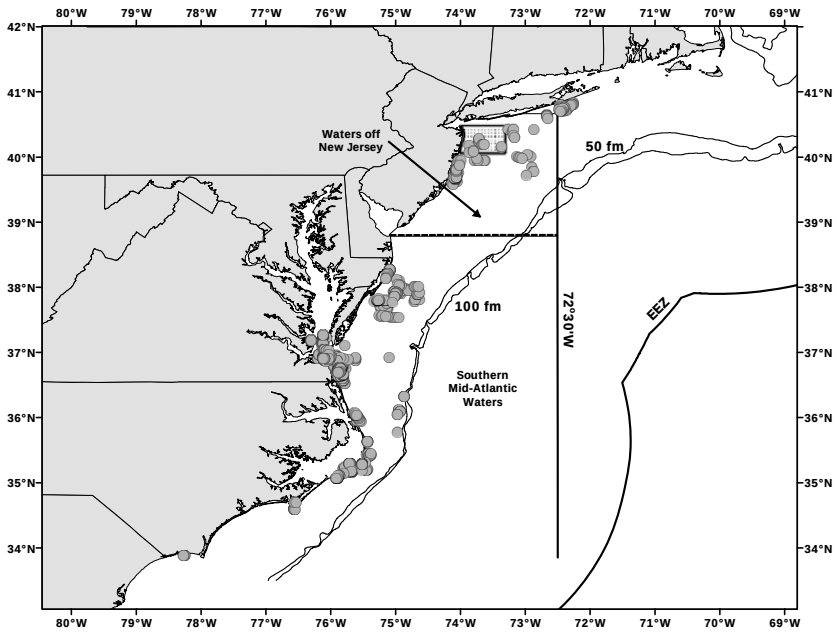
(A)



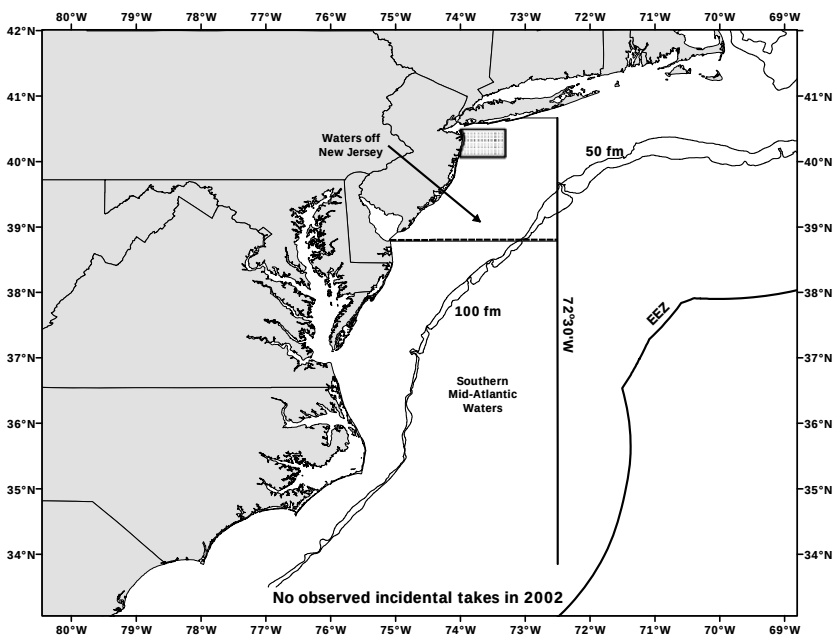
(B)

Figure 7. 2002 mid-Atlantic observed hauls (A) and observed takes (B)

- Observed hauls
- New Jersey/Southern Mid-Atlantic Waters Boundary
- Mudhole Closure Area



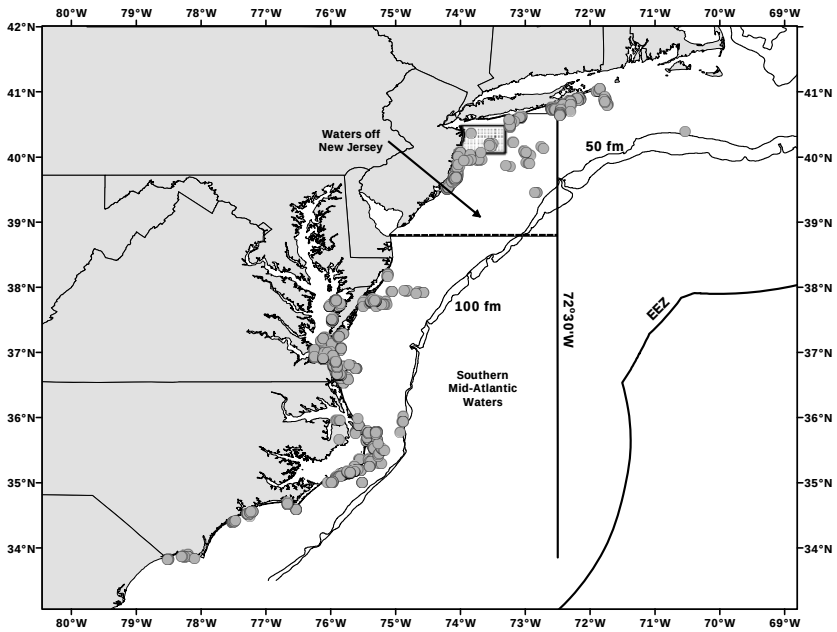
(A)



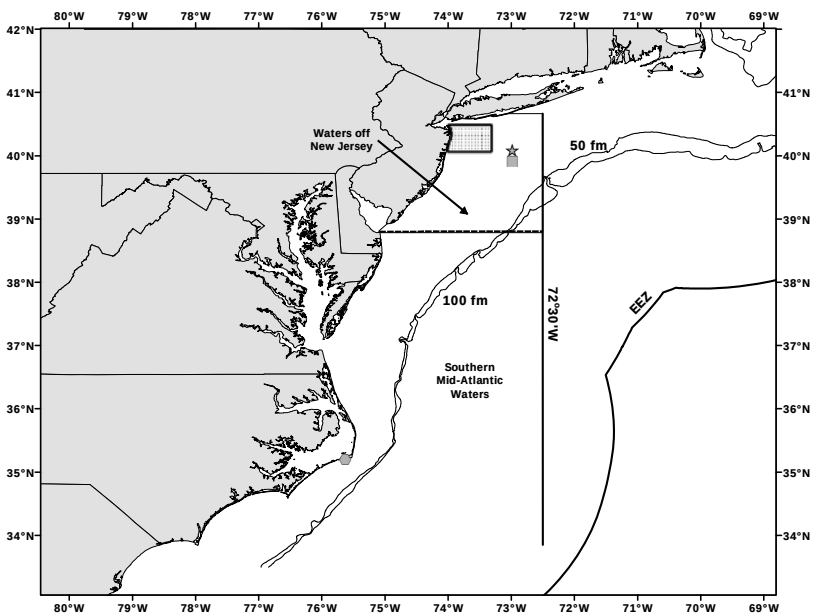
(B)

Figure 8. 2003 mid-Atlantic observed hauls (A) and observed takes (B)

- Observed hauls
- Bottlenose Dolphin
- Harbor Porpoise
- Unknown Seal
- New Jersey/Southern Mid-Atlantic Waters Boundary
- Mudhole Closure Area



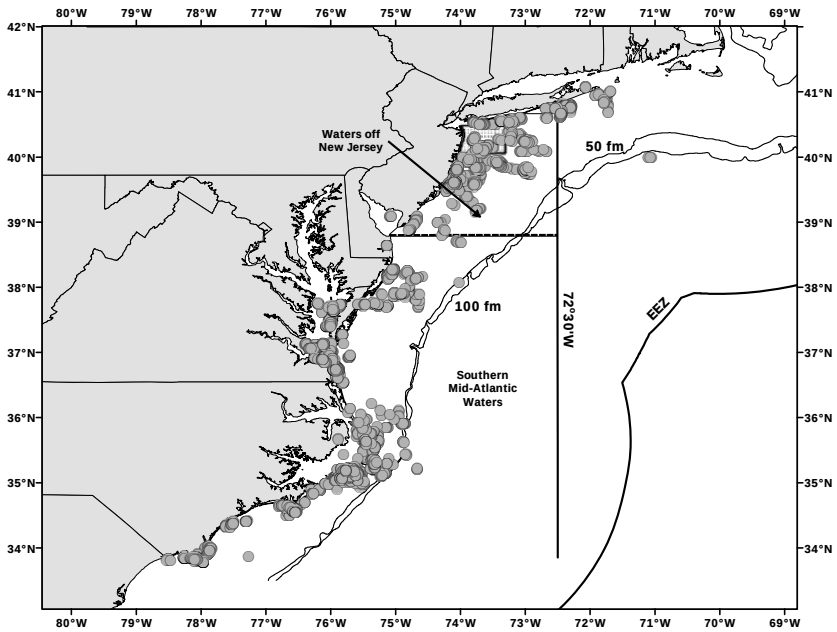
(A)



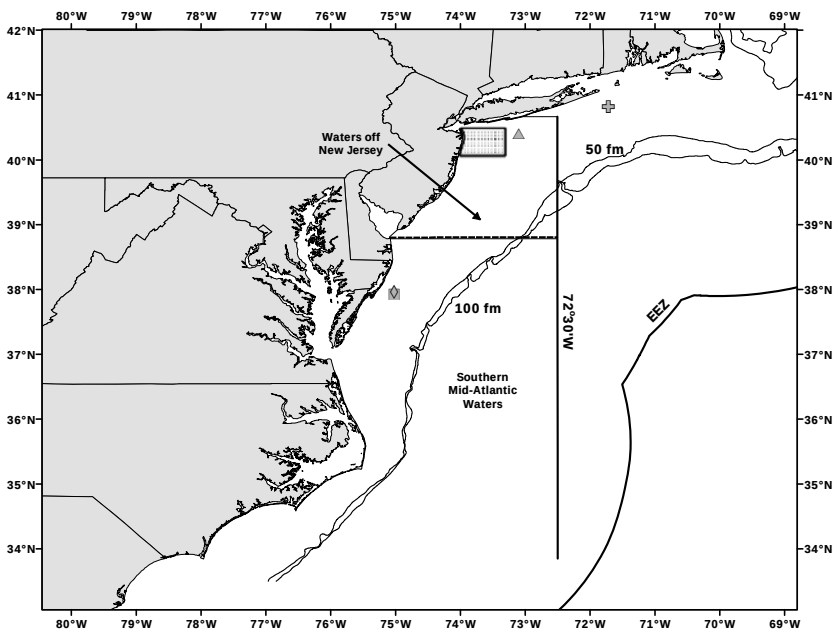
(B)

Figure 9. 2004 mid-Atlantic observed hauls (A) and observed takes (B)

- Observed hauls
- Harbor Porpoise
- Harbor Porpoise/Gray Seal
- Harbor Seal
- Unknown Porpoise/Dolphin
- New Jersey/Southern Mid-Atlantic Waters Boundary
- Mudhole Closure Area



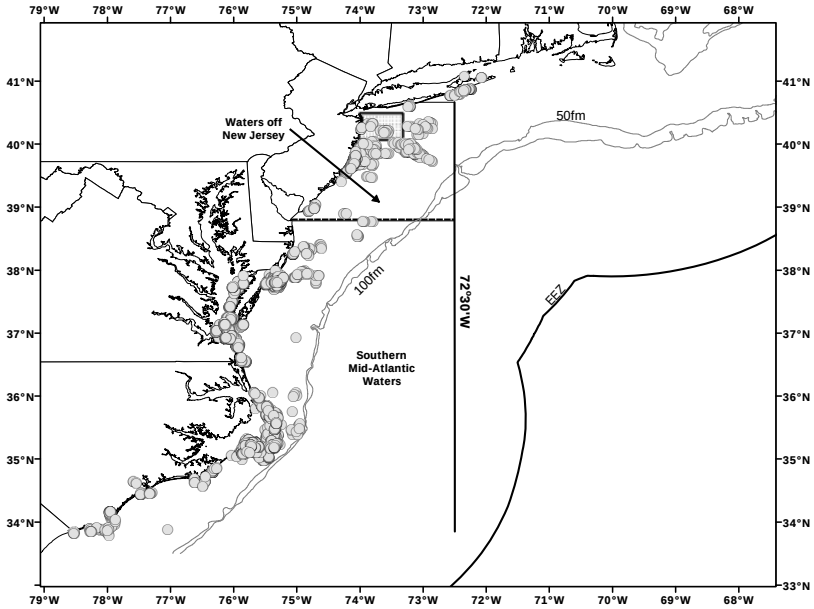
(A)



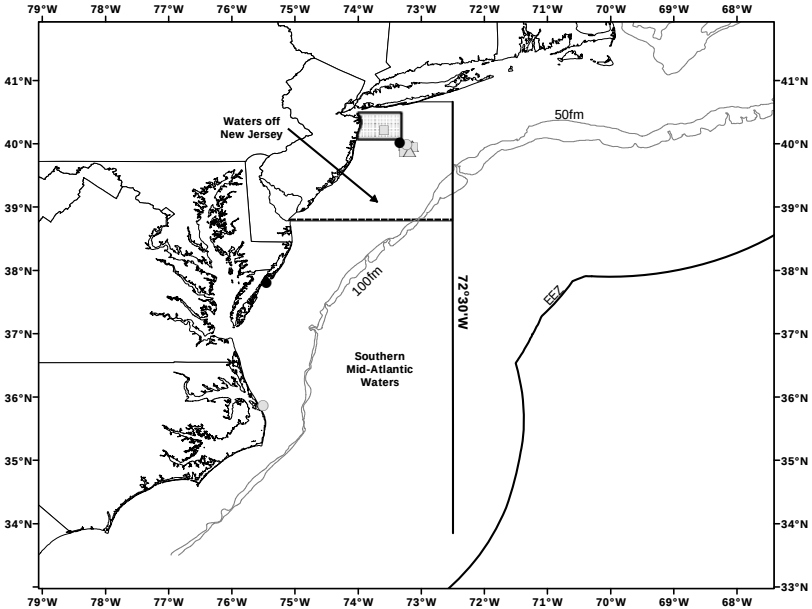
(B)

Figure 10. 2005 mid-Atlantic observed hauls (A) and observed takes (B)

- Observed hauls
- bottlenose dolphin
- harbor porpoise
- unknown dolphin
- harbor seal
- New Jersey/Southern Mid-Atlantic Waters Boundary
- Mudhole Closure Area

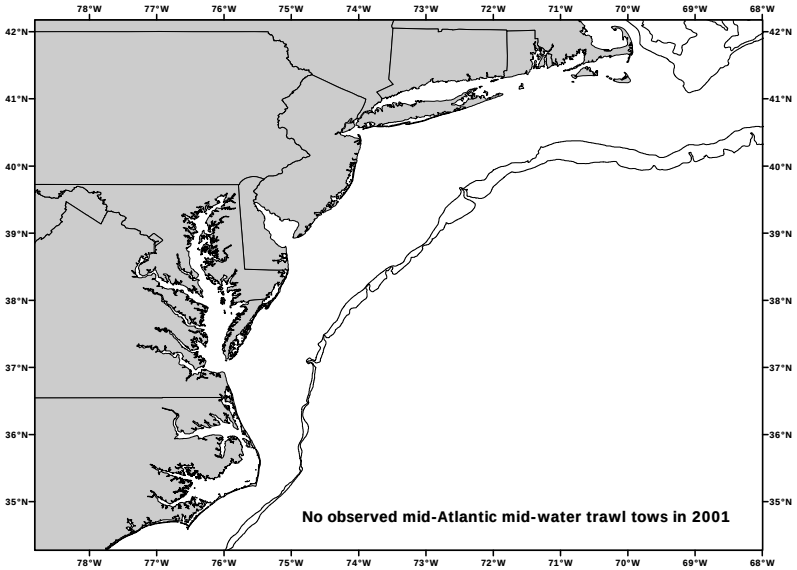


(A)

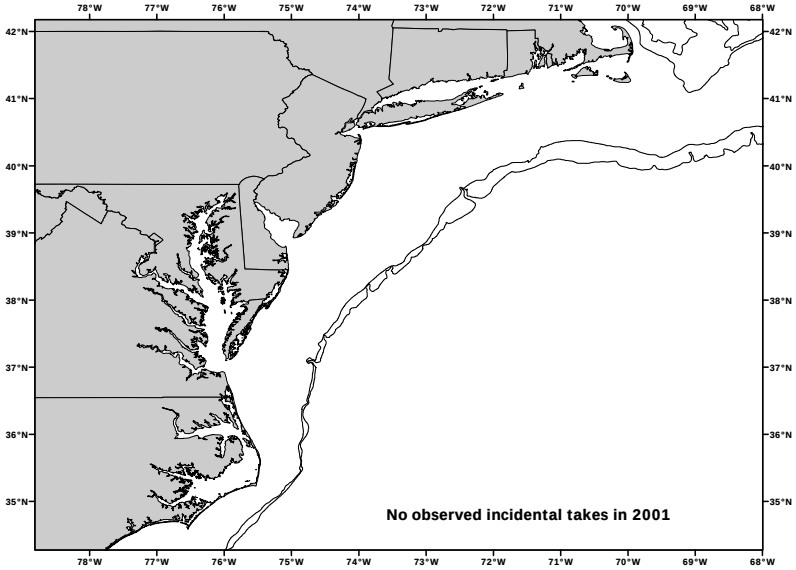


(B)

Figure 26. 2001 mid-Atlantic mid-water trawl observed tows (A) and observed incidental takes (B)



(A)

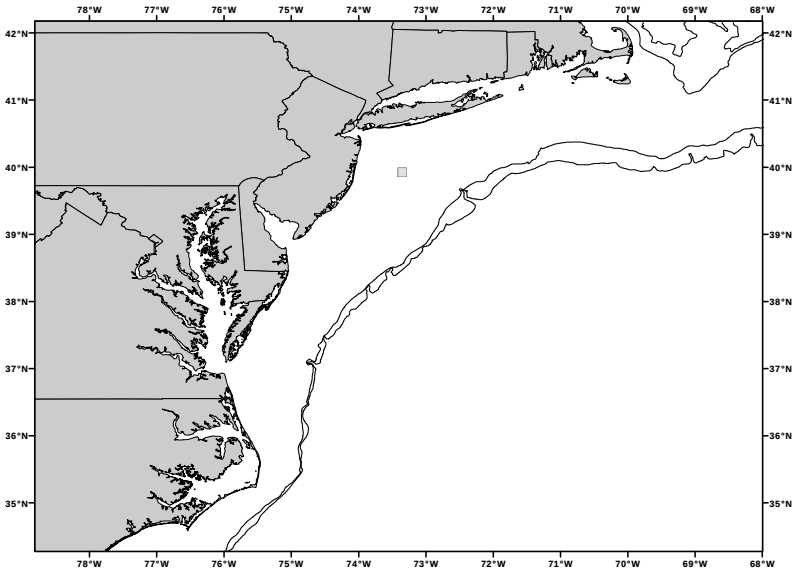


(B)

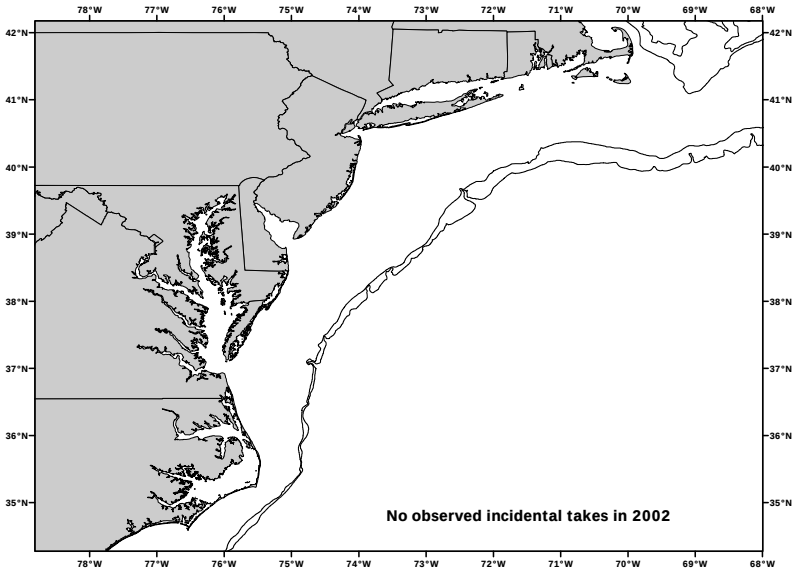
Figure 27. 2002 mid-Atlantic mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

Atlantic mackerel



(A)

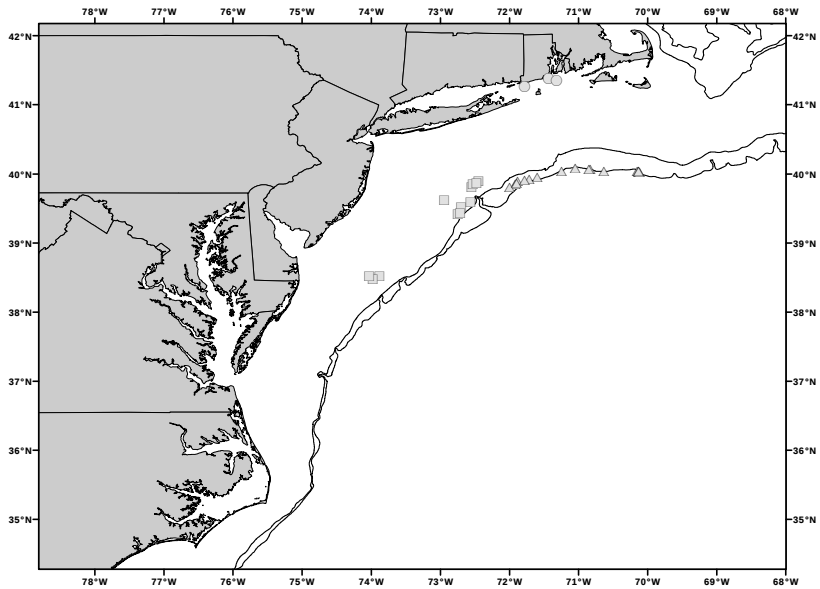


(B)

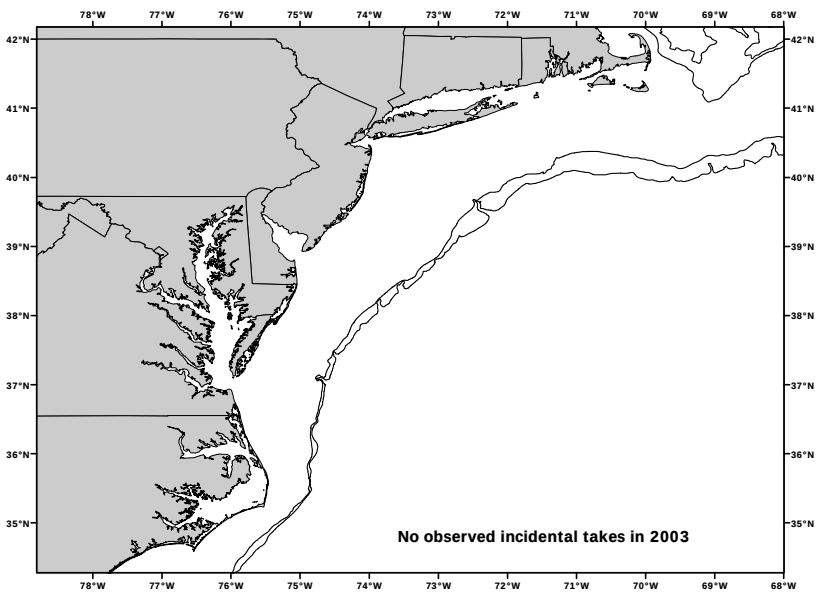
Figure 28. 2003 mid-Atlantic mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

- Atlantic herring
- Atlantic mackerel
- mixed finfish



(A)

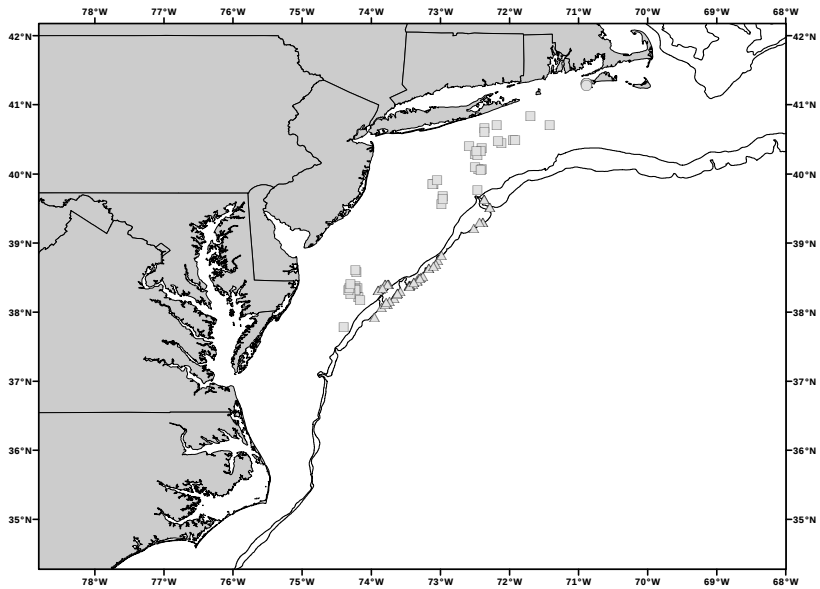


(B)

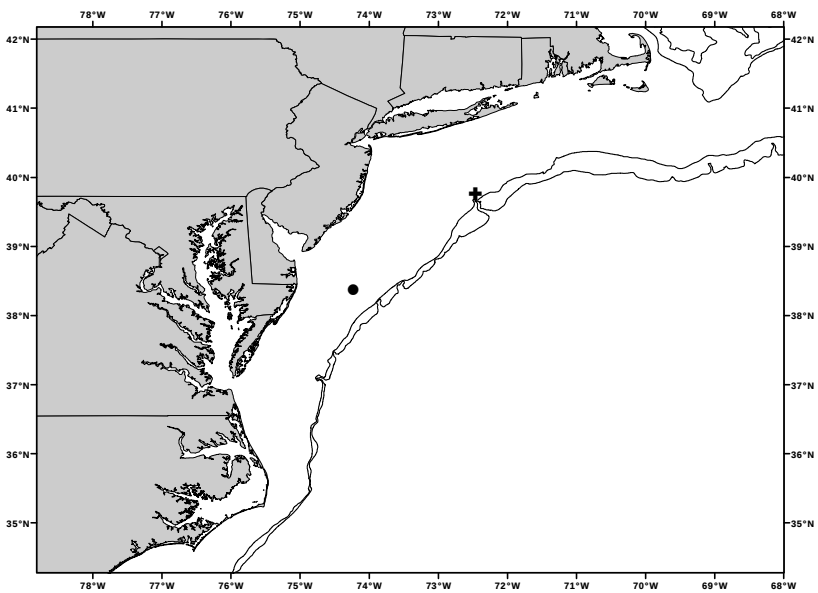
Figure 29. 2004 mid-Atlantic mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

- Atlantic herring
- Atlantic mackerel
- mixed finfish
- unknown dolphin
- white-sided dolphin



(A)

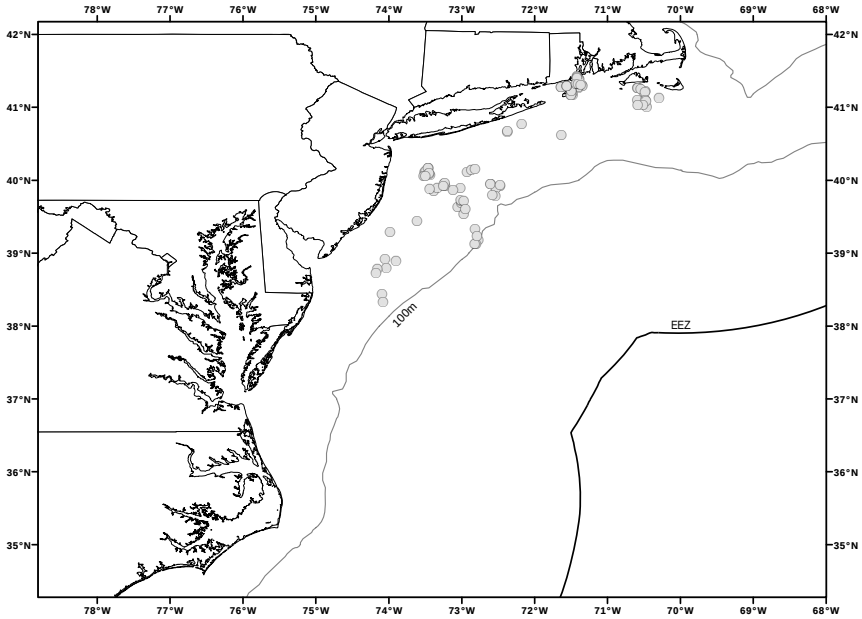


(B)

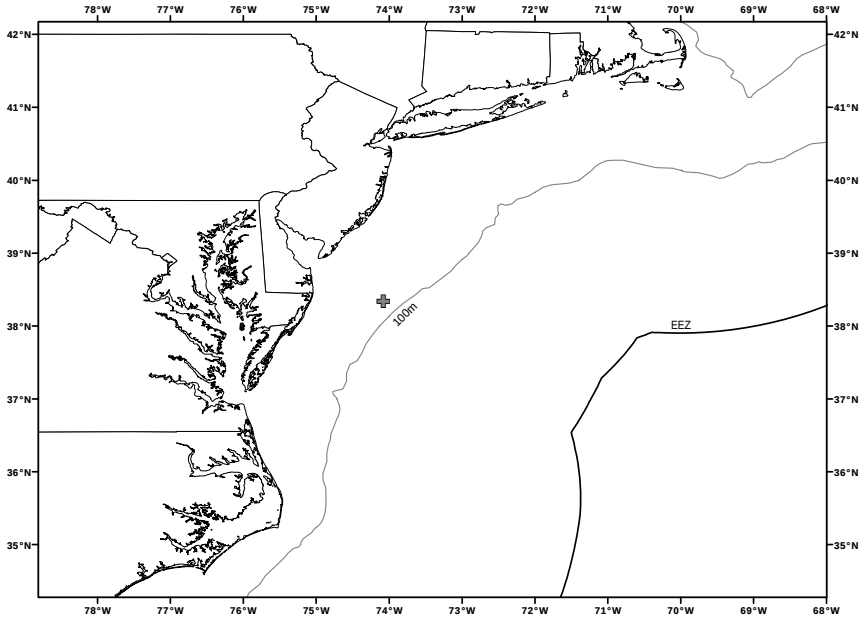
Figure 30. 2005 mid-Atlantic mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

- Atlantic herring
- herring, nk
- Atlantic mackerel
- scup
- sea scallop
- white-sided dolphin



(A)

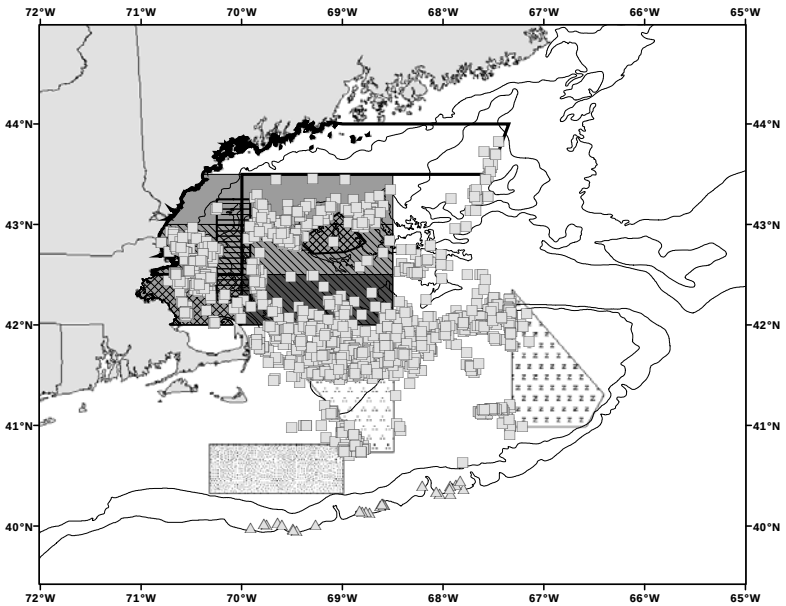


(B)

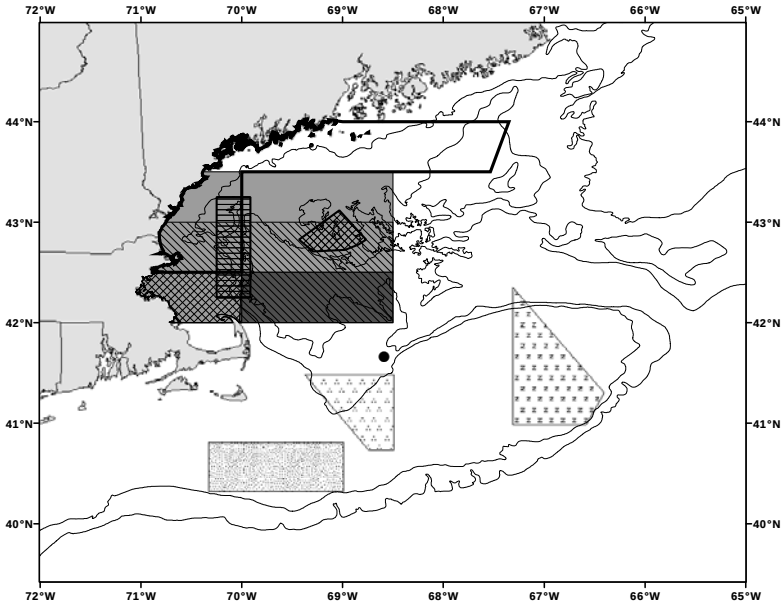
Figure 16. 2001 Northeast bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- harp seal
- Cashes Ledge
- Western Gulf Of Maine Closed Area
- Rolling Closure Area 2
- Rolling Closure Area 4
- Rolling Closure Area 5
- Rolling Closure Area 1
- Rolling Closure Area 3
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



(A)

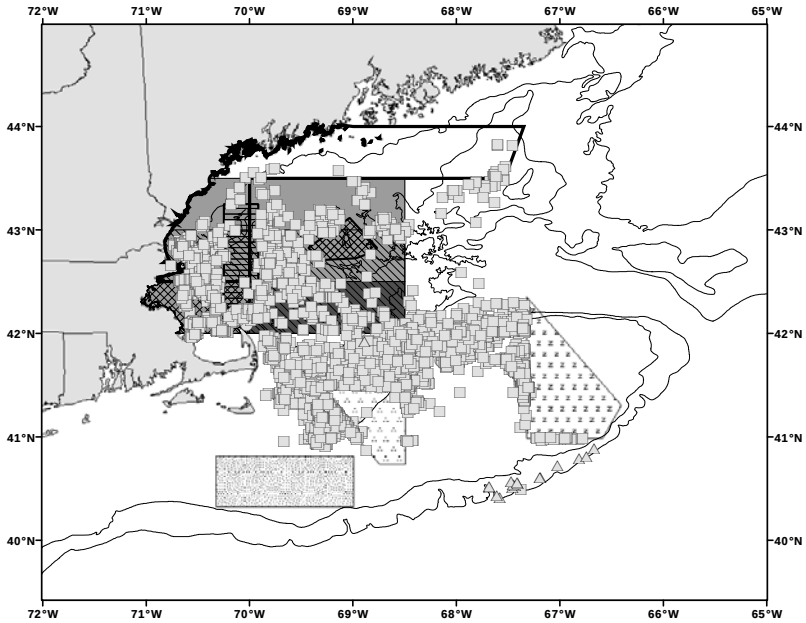


(B)

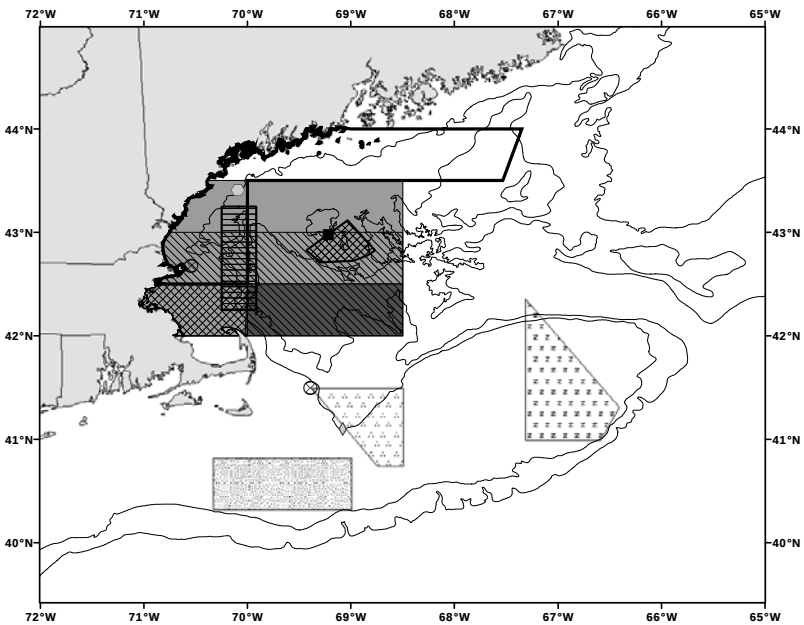
Figure 17. 2002 Northeast bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- common dolphin
- harbor seal
- unknown seal
- white-sided dolphin
- Cashes Ledge
- Western Gulf Of Maine Closed Area
- Rolling Closure Area 2
- Rolling Closure Area 4
- Rolling Closure Area 5
- Rolling Closure Area 1
- Rolling Closure Area 3
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



(A)

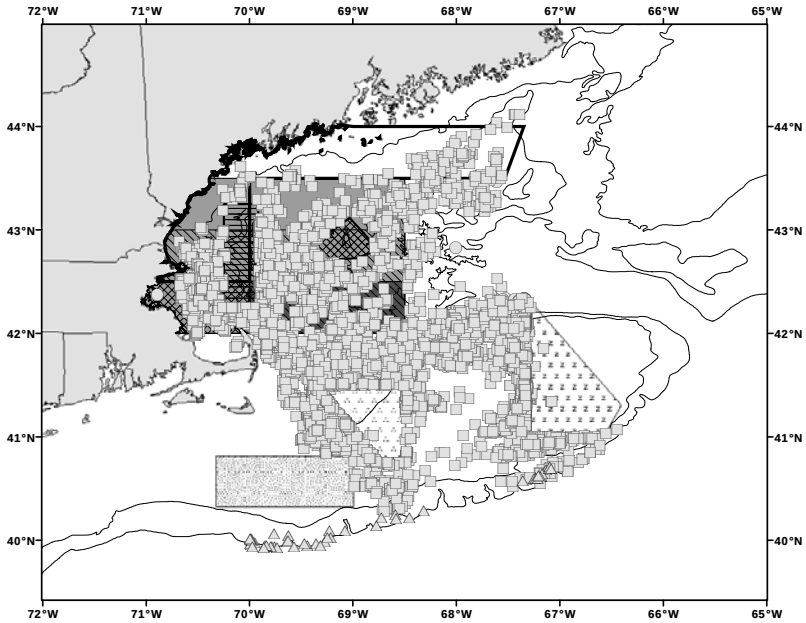


(B)

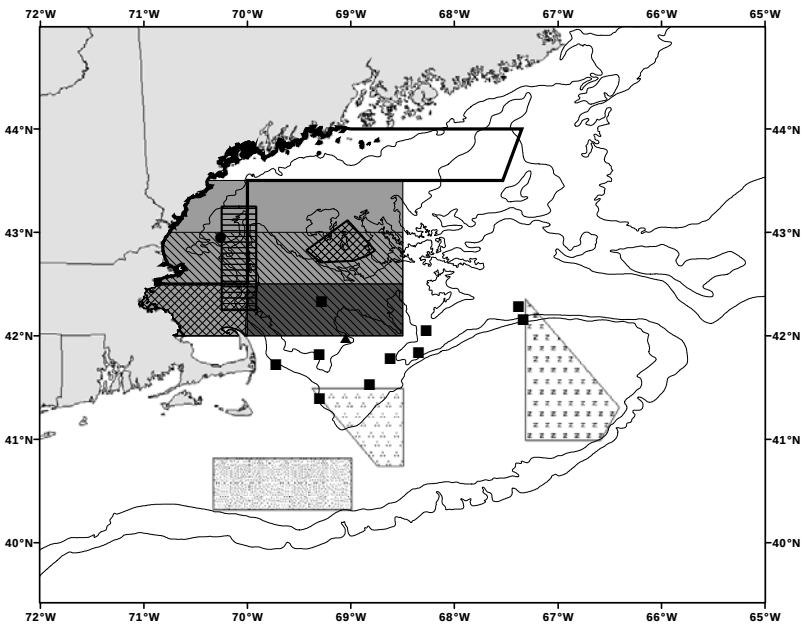
Figure 18. 2003 Northeast bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- harbor porpoise
- unknown dolphin
- white-sided dolphin
- Cashes Ledge
- Western Gulf Of Maine Closed Area
- Rolling Closure Area 2
- Rolling Closure Area 4
- Rolling Closure Area 5
- Rolling Closure Area 1
- Rolling Closure Area 3
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



(A)

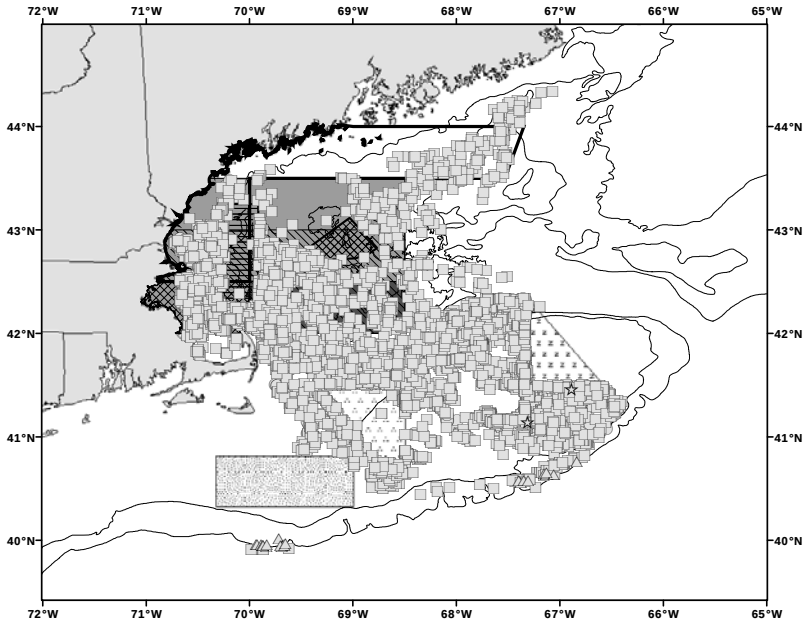


(B)

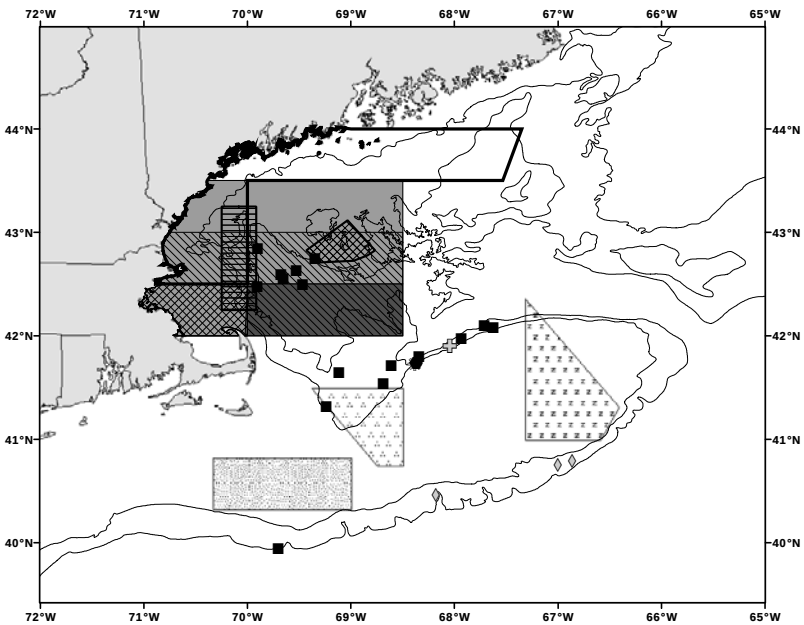
Figure 19. 2004 Northeast bottom trawl observec tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- common dolphin
- long-finned pilot whale
- unknown pilot whale
- unknown whale
- white-sided dolphin
- Cashes Ledge
- Western Gulf Of Maine Closed Area
- Rolling Closure Area 2
- Rolling Closure Area 4
- Rolling Closure Area 5
- Rolling Closure Area 1
- Rolling Closure Area 3
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



(A)

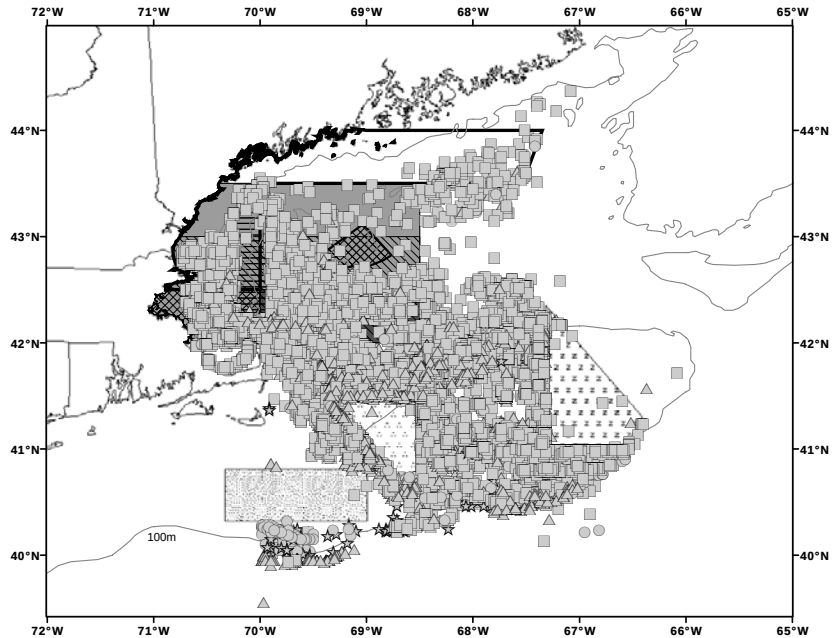


(B)

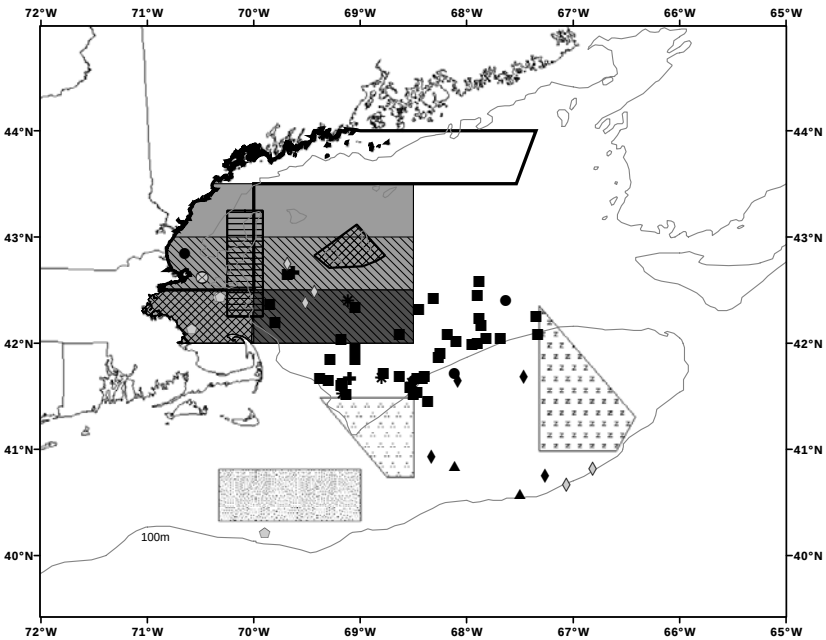
Figure 20. 2005 Northeast bottom trawl observed tows (A) and observed incidental takes (B)

Observed tows

- mixed finfish/invertebrates
- multi-species groundfish
- squid/mackerel/butterfish
- summer flounder/scup/black sea bass
- common dolphin
- harbor porpoise
- unknown dolphin
- unknown pilot whale
- unknown porpoise/dolphin
- white-sided dolphin
- gray seal
- harbor seal
- harp seal
- unknown seal
- Cashes Ledge
- Western Gulf Of Maine Closed Area
- Rolling Closure Area 2
- Rolling Closure Area 4
- Rolling Closure Area 5
- Rolling Closure Area 1
- Rolling Closure Area 3
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



(A)



(B)

Figure 1. 2001 Northeast sink gillnet observed hauls (A) and observed takes (B)

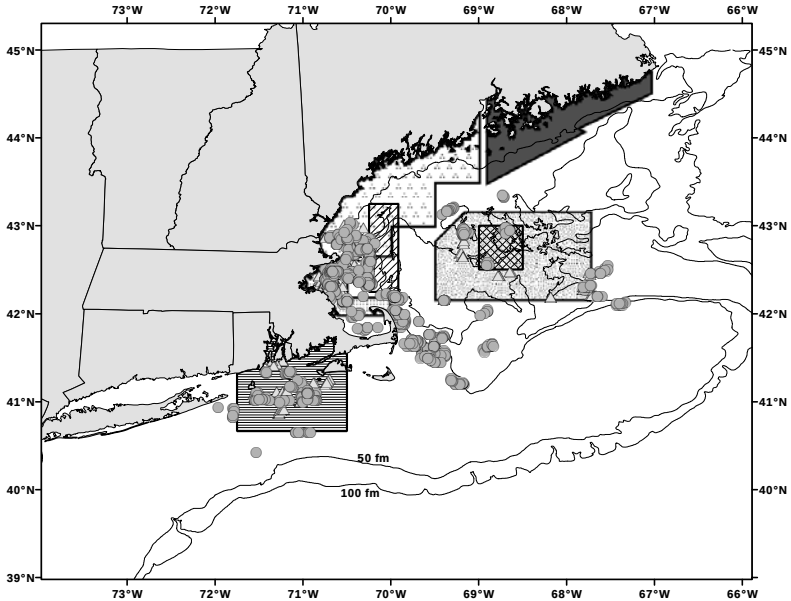
- Observed hauls not within the timeframe of the pinger regulated areas
- Observed hauls within the timeframe of the pinger regulated areas

Observed incidental takes not within the timeframe of the pinger regulated areas

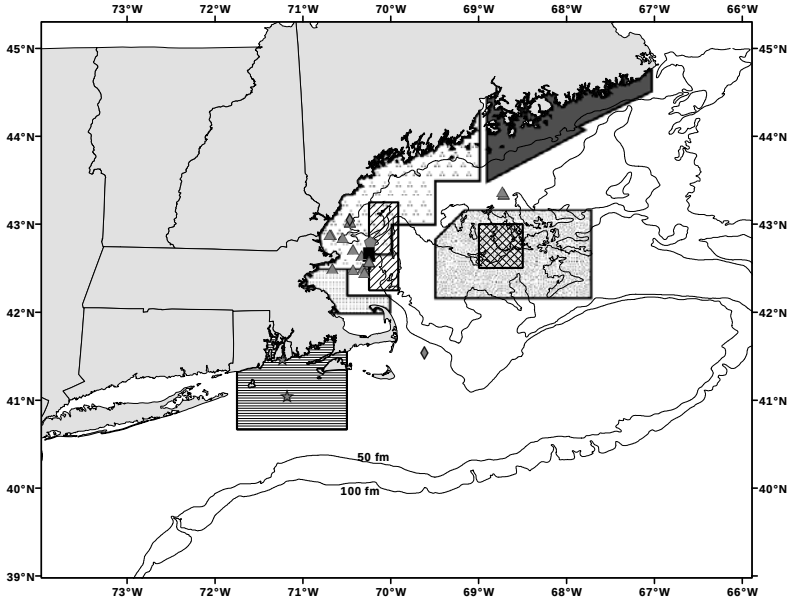
- Gray Seal
- Harbor Seal

Observed incidental takes within the timeframe of the pinger regulated areas

- Harbor Porpoise/Unknown Seal
- Harbor Seal/White-sided Dolphin
- Harbor Seal
- Harp Seal
- Unknown Seal
- Western Gulf Of Maine Closed Area
- Cape Cod South Pinger Regulated Time/Area Closure
- Cashes Ledge Time/Area Closure
- Massachusetts Bay Pinger Regulated Time/Area Closure
- Mid Coast Pinger Regulated Time/Area Closure
- Northeast Time/Area Closure
- Offshore Pinger Regulated Time/Area Closure



(A)



(B)

Figure 2. 2002 Northeast sink gillnet observed hauls (A) and observed takes (B)

- Observed hauls not within the timeframe of the pinger regulated areas
- Observed hauls within the timeframe of the pinger regulated areas

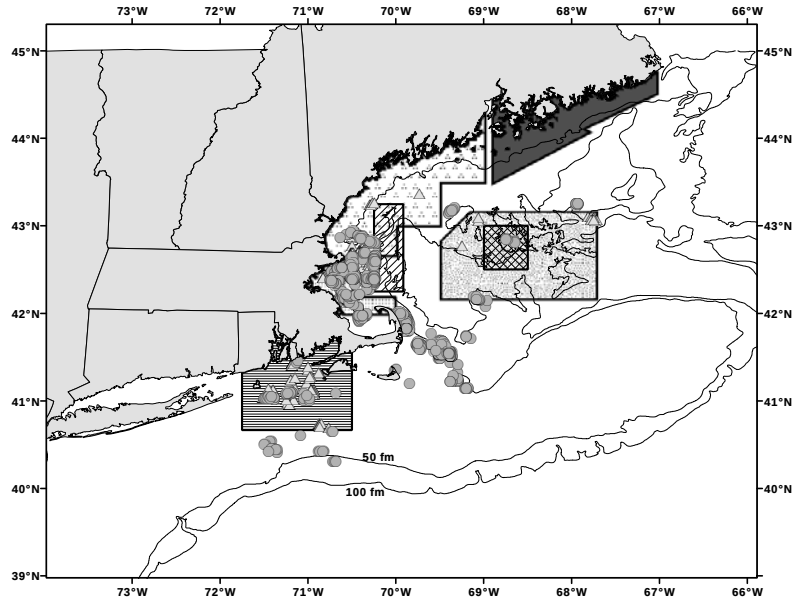
Observed incidental takes not within the timeframe of the pinger regulated areas

- Harbor Porpoise
- White-sided Dolphin
- Harbor Seal
- Unknown Seal

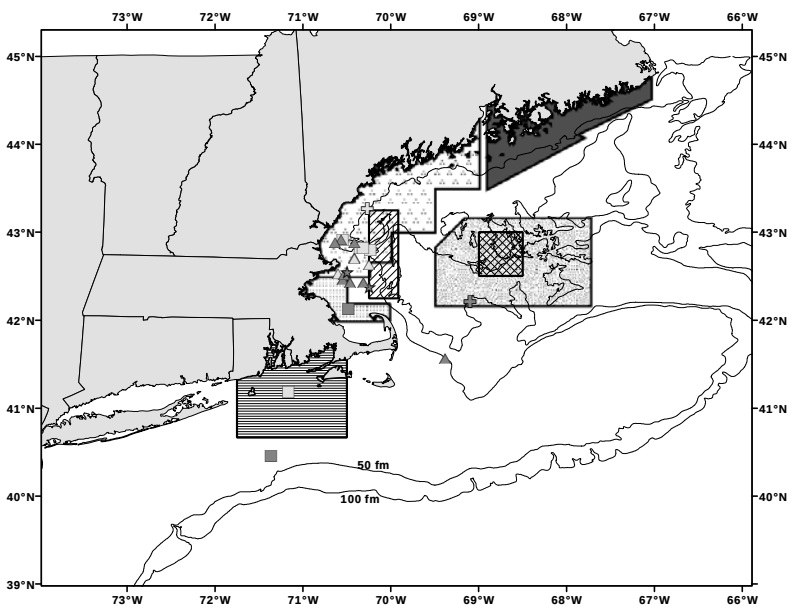
Observed incidental takes within the timeframe of the pinger regulated areas

- Harbor Porpoise
- White-sided Dolphin
- Harbor Seal

- Western Gulf Of Maine Closed Area
- Cape Cod South Pinger Regulated Time/Area Closure
- Cashes Ledge Time/Area Closure
- Massachusetts Bay Pinger Regulated Time/Area Closure
- Mid Coast Pinger Regulated Time/Area Closure
- Northeast Time/Area Closure
- Offshore Pinger Regulated Time/Area Closure



(A)



(B)

Figure 3. 2003 Northeast sink gillnet observed hauls (A) and observed takes (B)

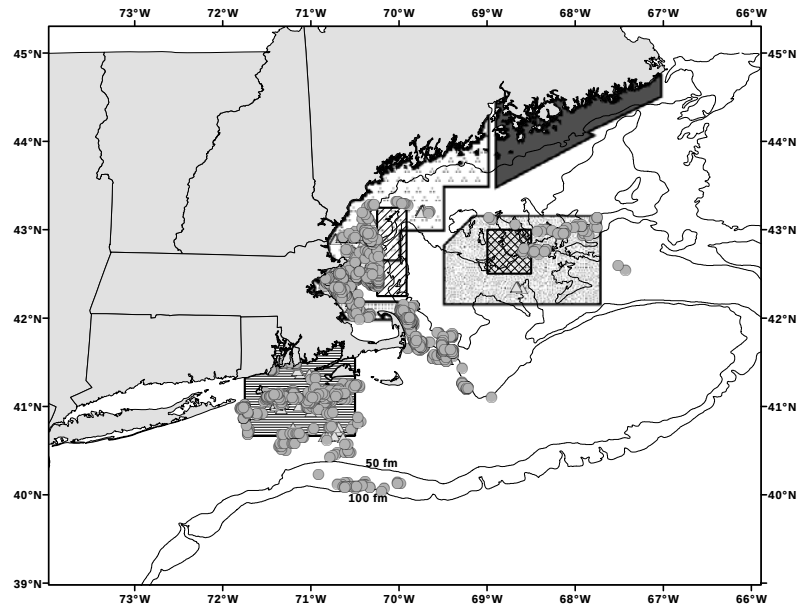
- Observed hauls not within the timeframe of the pinger regulated areas
- Observed hauls within the timeframe of the pinger regulated areas

Observed incidental takes not within the timeframe of the pinger regulated areas

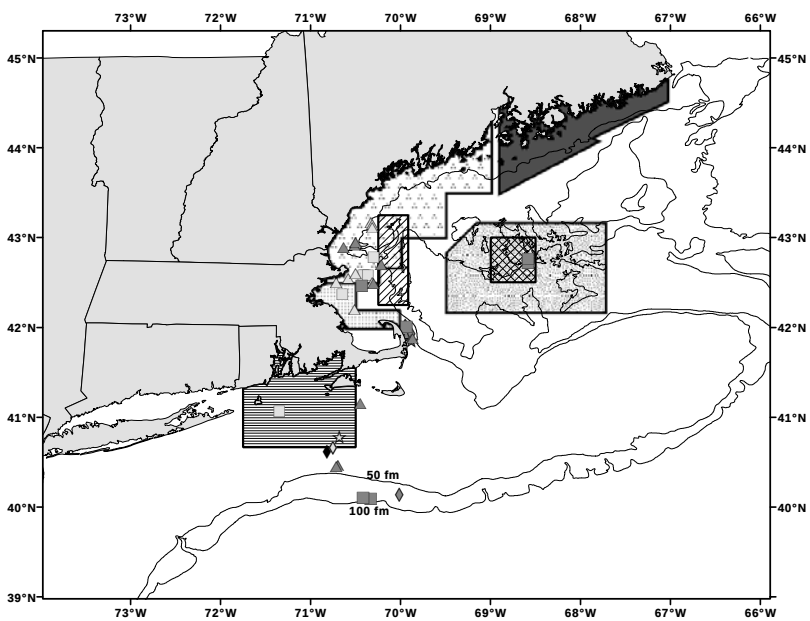
- Harbor Porpoise
- White-sided Dolphin
- Gray Seal
- Harbor Seal
- Harbor Seal/Gray Seal
- Unknown Seal

Observed incidental takes withn the timeframe of the pinger regulated areas

- Harbor Porpoise
- Gray Seal
- Harbor Seal
- Unknown Seal
- Western Gulf Of Maine Closed Area
- Cape Cod South Pinger Regulated Time/Area Closure
- Cashes Ledge Time/Area Closure
- Massachusetts Bay Pinger Regulated Time/Area Closure
- Mid Coast Pinger Regulated Time/Area Closure
- Northeast Time/Area Closure
- Offshore Pinger Regulated Time/Area Closure



(A)



(B)

Figure 4. 2004 Northeast sink gillnet observed hauls (A) and observed takes (B)

- Observed hauls not within the timeframe of the pinger regulated areas
- Observed hauls within the timeframe of the pinger regulated areas

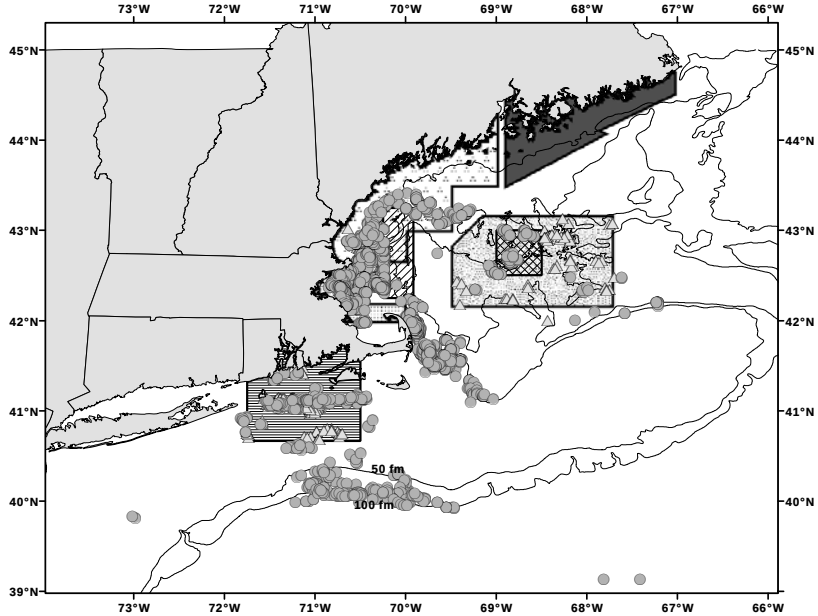
Observed incidental takes not within the timeframe of the pinger regulated areas

- Bottlenose Dolphin
- Harbor Porpoise
- Unknown Dolphin
- Unknown Porpoise/Dolphin
- Harbor Porpoise/Gray Seal
- Harbor Porpoise/Harp Seal
- Gray Seal
- Harbor Seal
- Harp Seal
- Harp Seal/Unknown Seal
- Unknown Seal

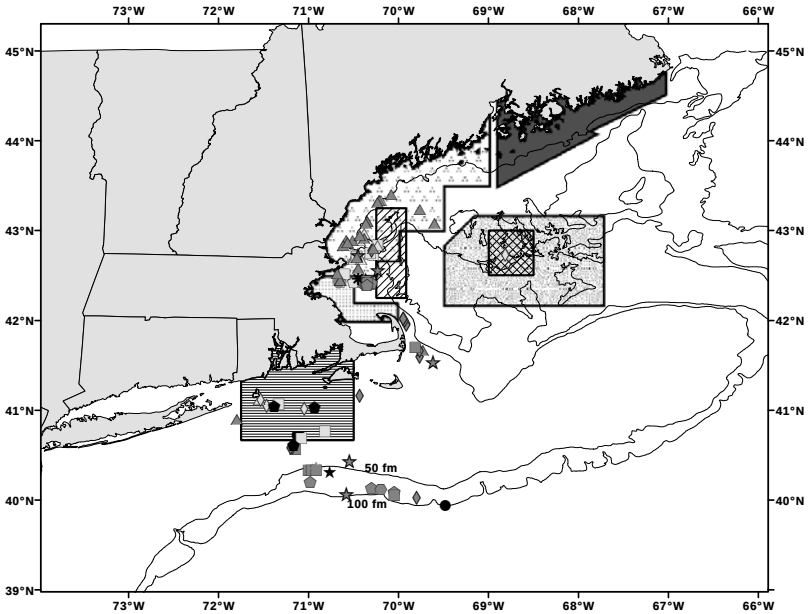
Observed incidental takes within the timeframe of the pinger regulated areas

- Gray Seal
- Harbor Porpoise
- Harbor Porpoise/Hood Seal
- Harbor Seal
- Harp Seal
- Unknown Porpoise/Dolphin
- Unknown Seal/Harbor Seal

- Western Gulf Of Maine Closed Area
- Cape Cod South Pinger Regulated Time/Area Closure
- Cashes Ledge Time/Area Closure
- Massachusetts Bay Pinger Regulated Time/Area Closure
- Mid Coast Pinger Regulated Time/Area Closure
- Northeast Time/Area Closure
- Offshore Pinger Regulated Time/Area Closure



(A)



(B)

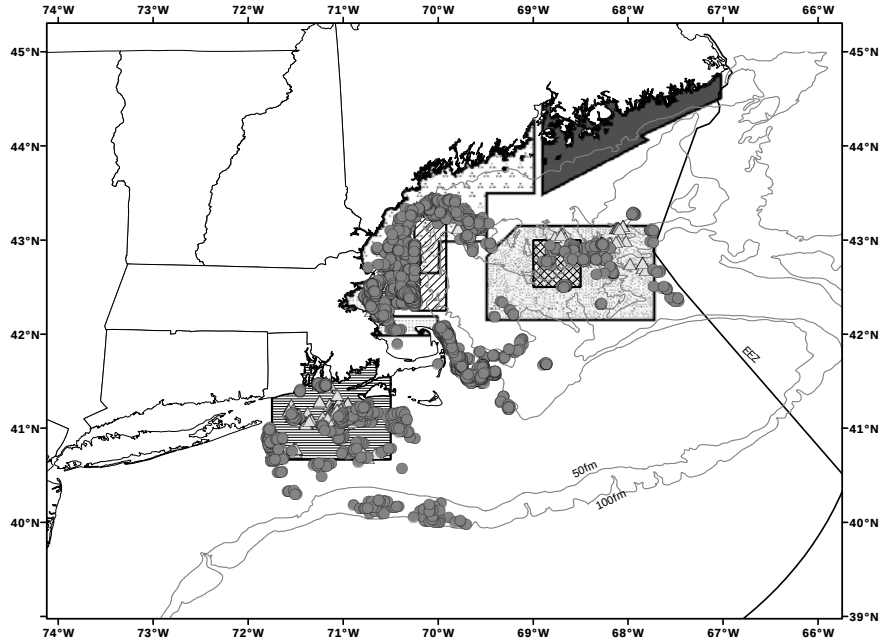
Figure 5. 2005 Northeast sink gillnet observed hauls (A) and observed takes (B)

Observed hauls not within the timeframe of the pinger regulated areas
Observed hauls within the timeframe of the pinger regulated areas

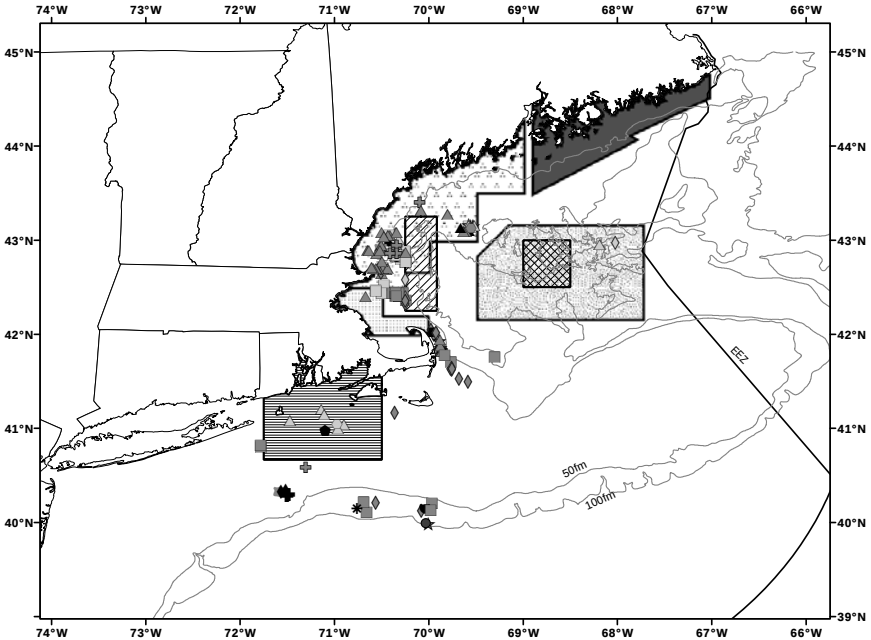
Observed incidental takes not within the timeframe of the pinger regulated areas
- white-sided dolphin
- common dolphin
- harbor porpoise
- risso's dolphin
- harbor porpoise/gray seal
- harbor porpoise/harbor seal
- harbor porpoise/harp seal
- harbor porpoise/unknown seal
- harbor porpoise/unknown seal/gray seal
- gray seal
- harbor seal
- harp seal
- unknown seal
- gray seal/unknown dolphin
- harbor seal/gray seal
- unknown seal/gray seal

Observed incidental takes within the timeframe of the pinger regulated areas
- common dolphin
- harbor porpoise
- unknown dolphin
- unknown porpoise/dolphin
- harbor porpoise/harbor seal
- gray seal
- harbor seal
- unknown seal

- Western Gulf Of Maine Closed Area
- Cape Cod South Pinger Regulated Time/Area Closure
- Cashes Ledge Time/Area Closure
- Massachusetts Bay Pinger Regulated Time/Area Closure
- Mid Coast Pinger Regulated Time/Area Closure
- Northeast Time/Area Closure
- Offshore Pinger Regulated Time/Area Closure



(A)

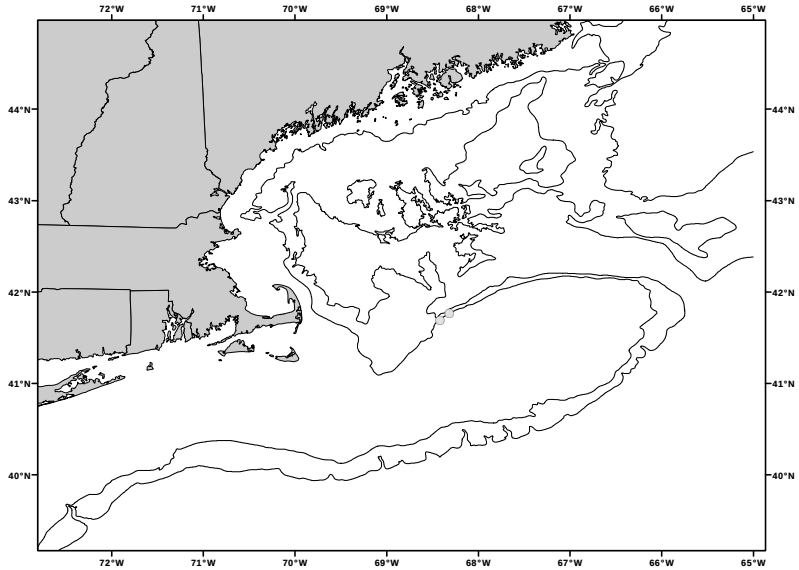


(B)

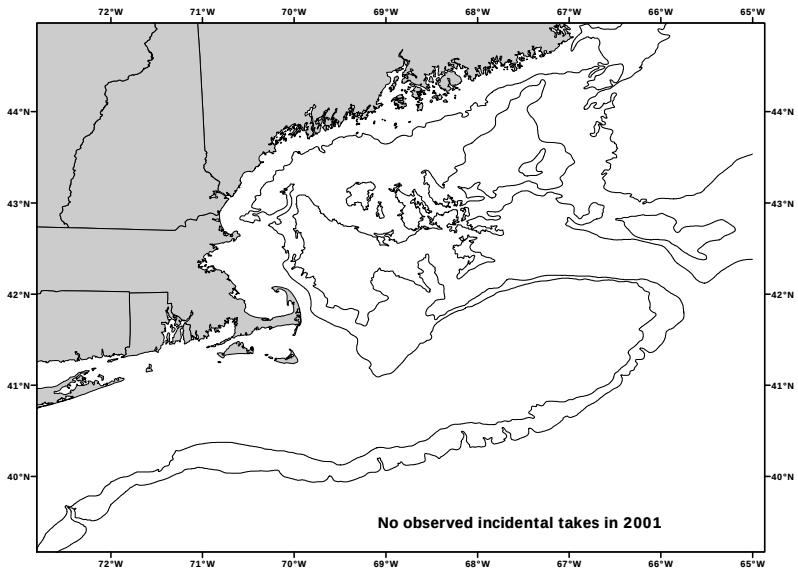
Figure 21. 2001 New England mid-water trawl observed tows (A)
And observed incidental takes (B)

Observed tows

Atlantic herring

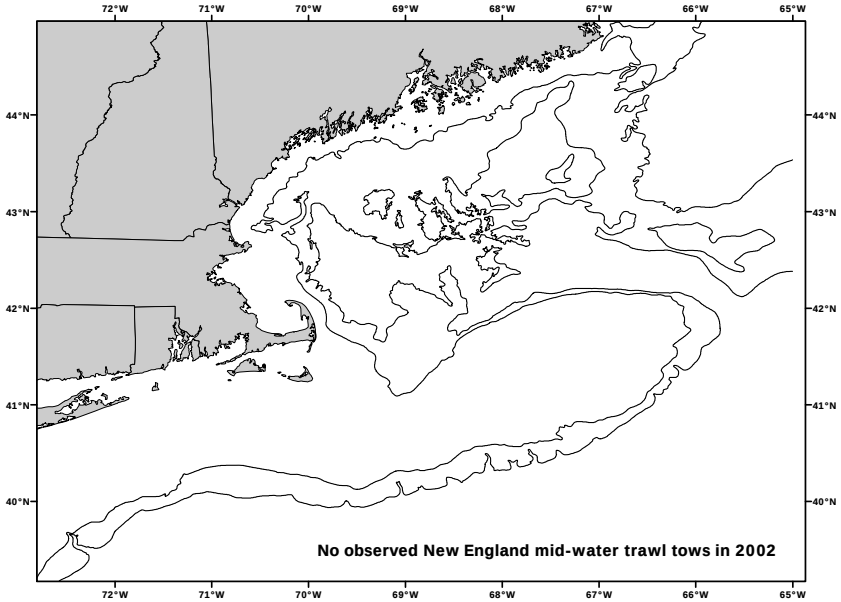


(A)

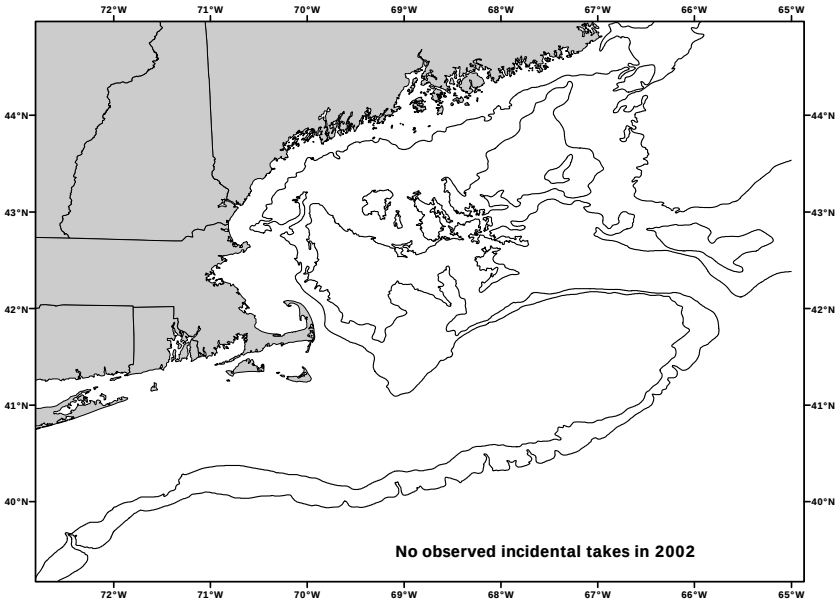


(B)

Figure 22. 2002 New England mid-water trawl observed tows (A) and observed incidental takes (B)



(A)

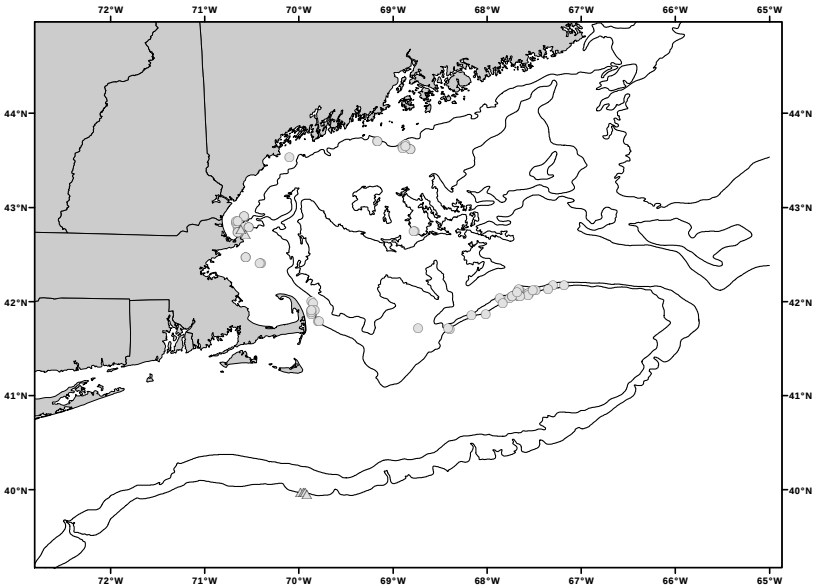


(B)

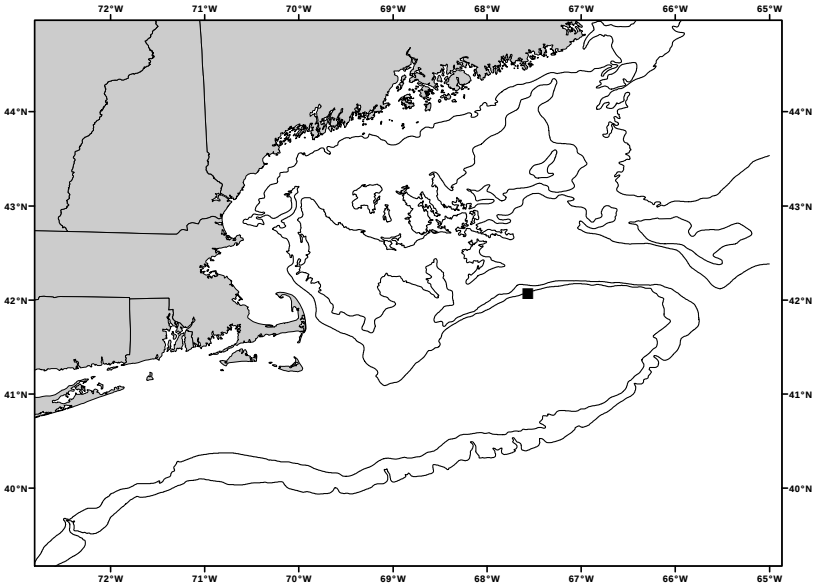
Figure 23. 2003 New England mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

- Atlantic herring
- mixed finfish
- white-sided dolphin



(A)

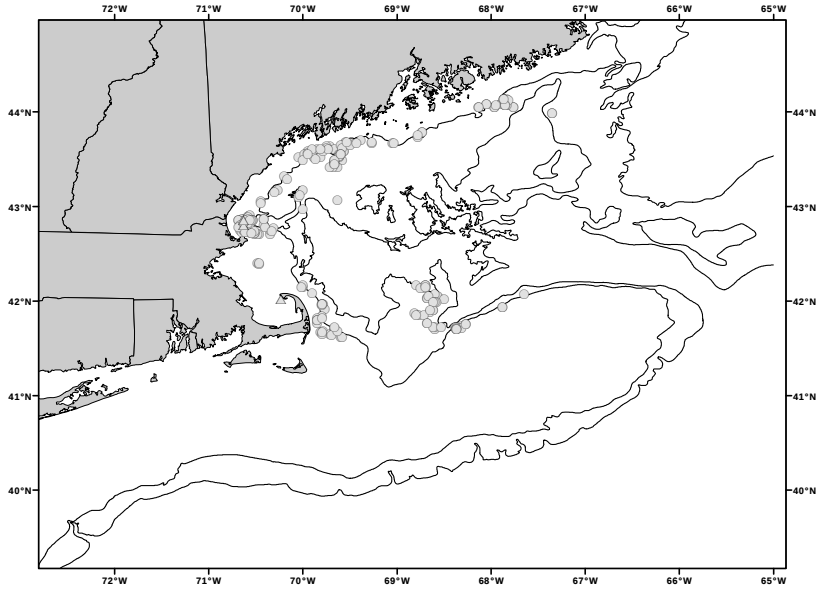


(B)

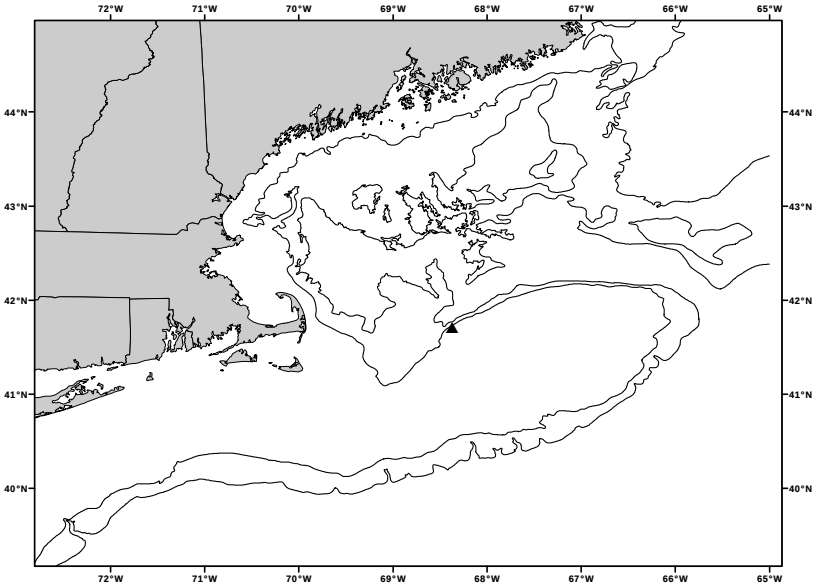
Figure 24. 2004 New England mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

- Atlantic herring
- mixed finfish
- longfin pilot whale



(A)

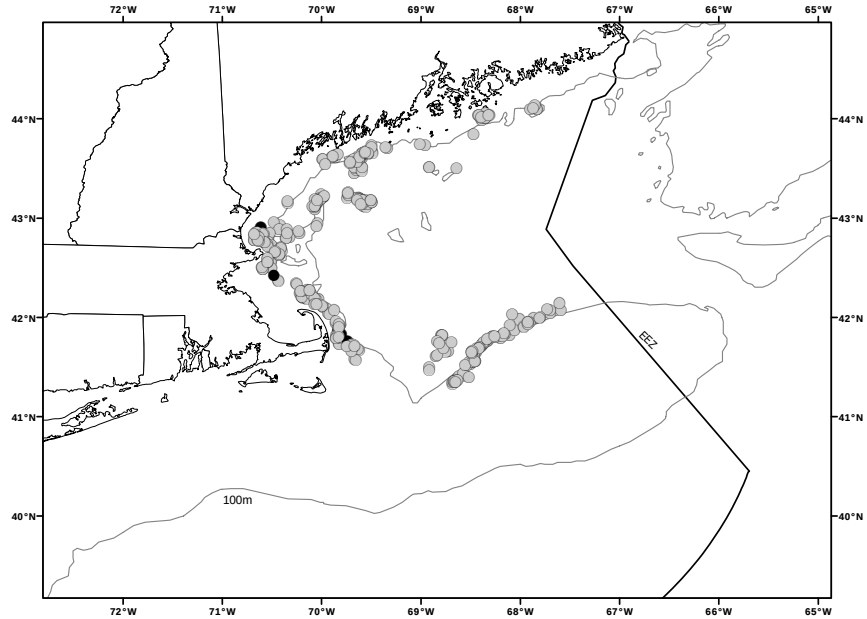


(B)

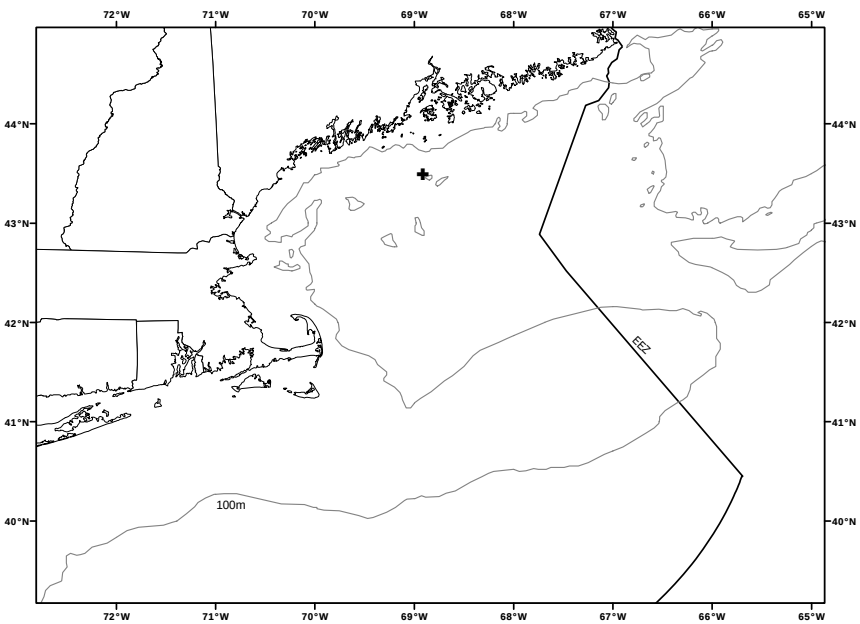
Figure 25. 2005 New England mid-water trawl observed tows (A) and observed incidental takes (B)

Observed tows

- Atlantic herring
- herring, nk
- sea scallop
- white-sided dolphin



(A)



(B)

Figure LPG1. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2001. 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.

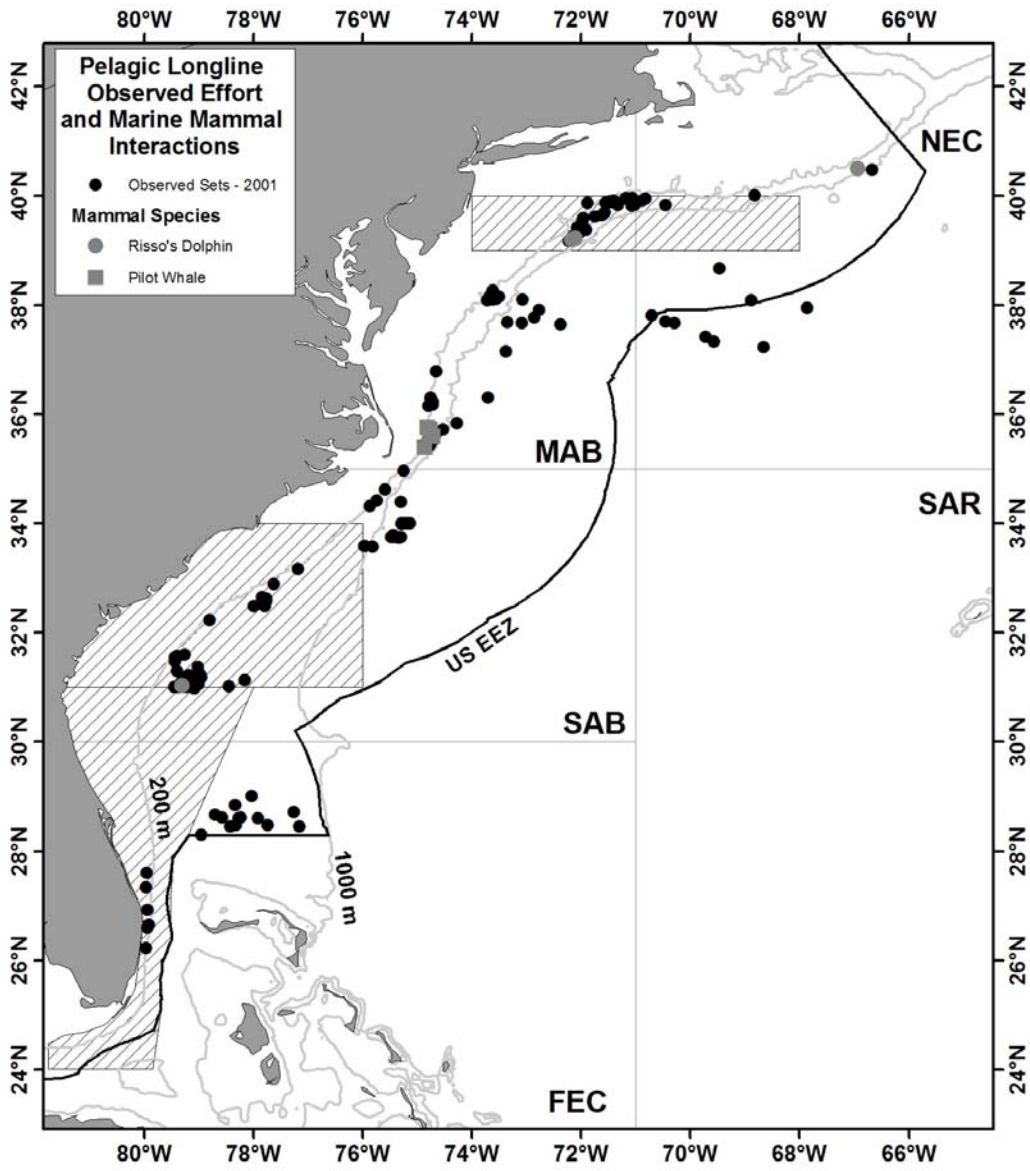


Figure LPG2. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2002. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

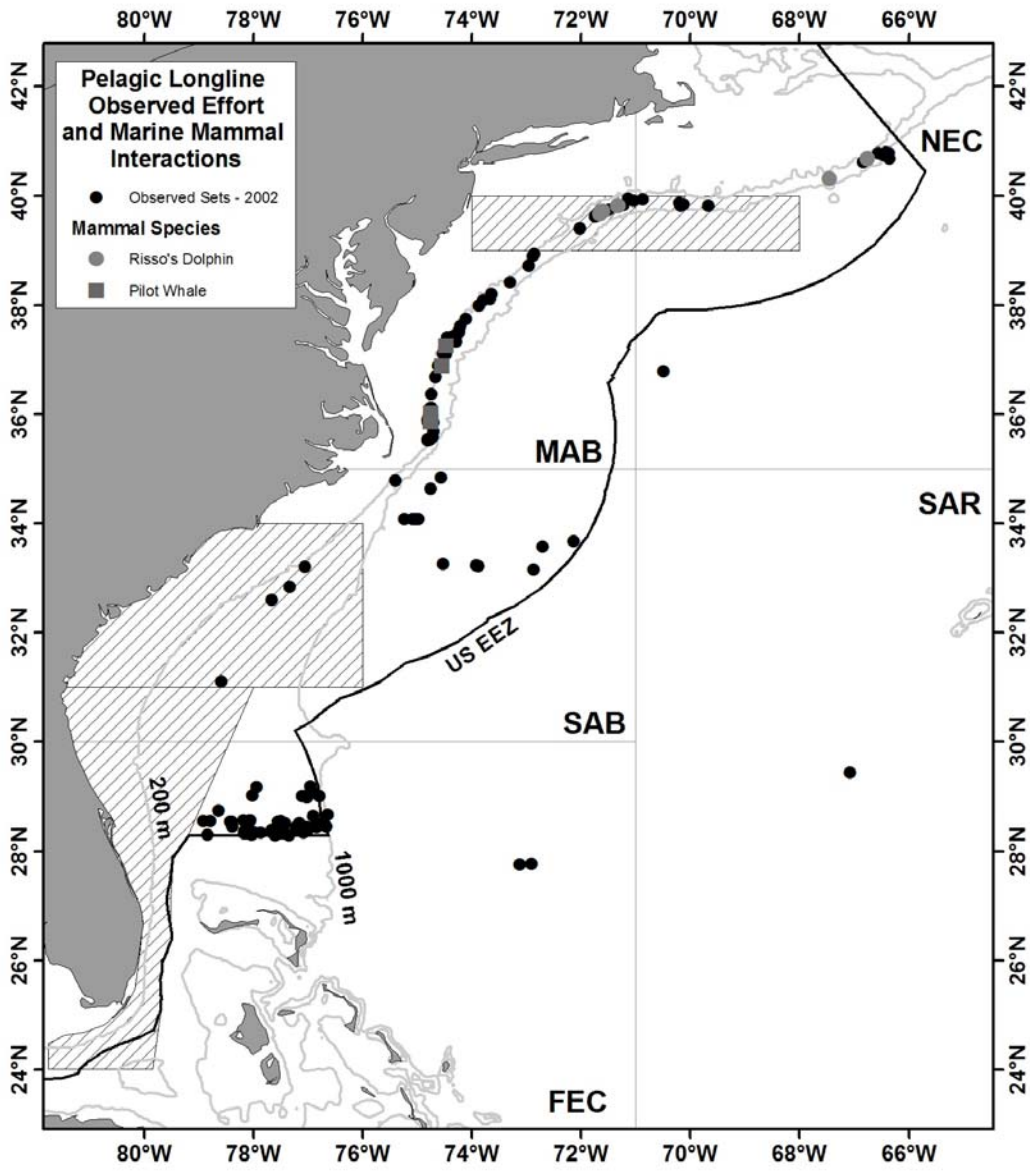


Figure LPG3. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2003. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

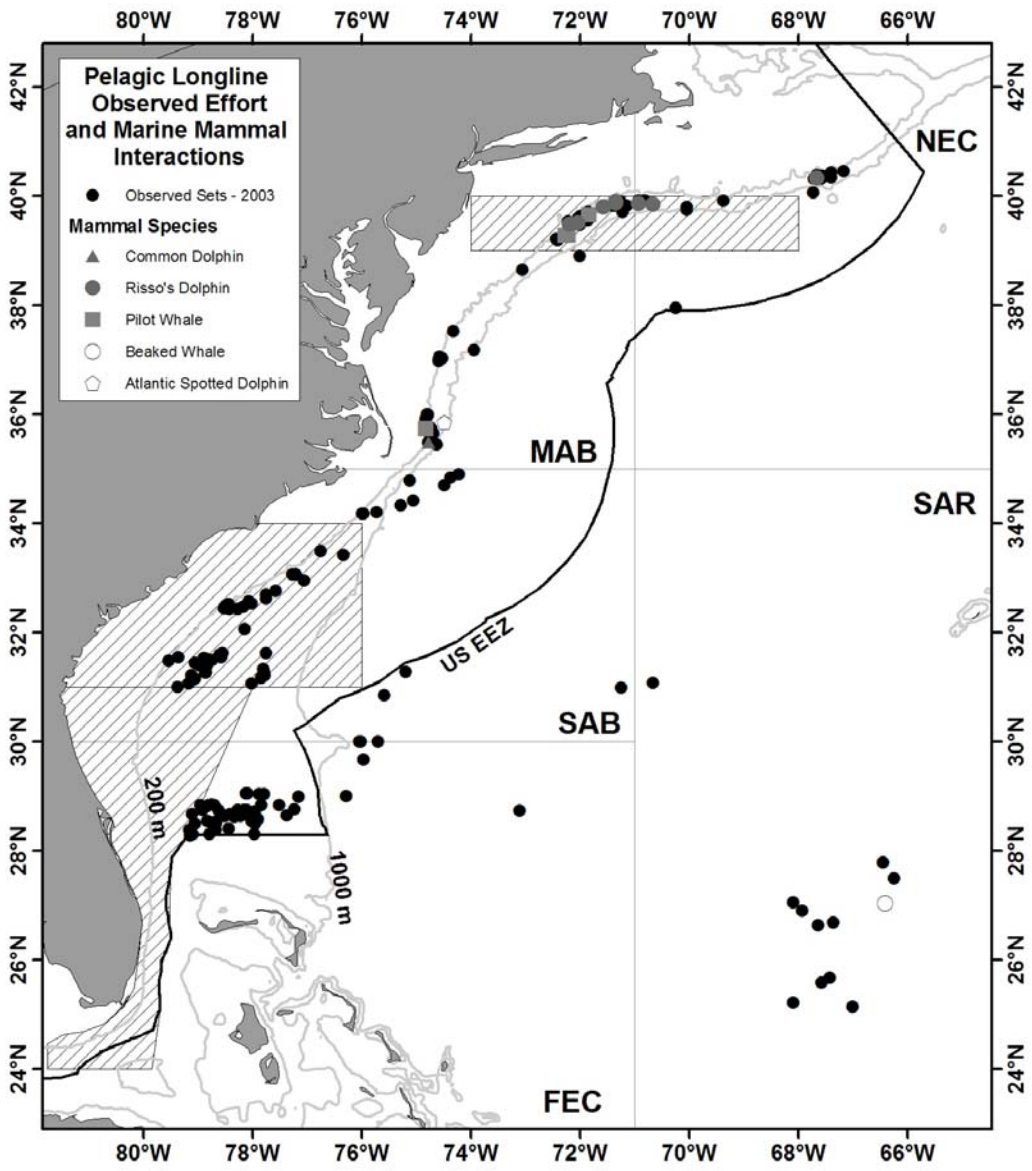


Figure LPG4. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2004. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

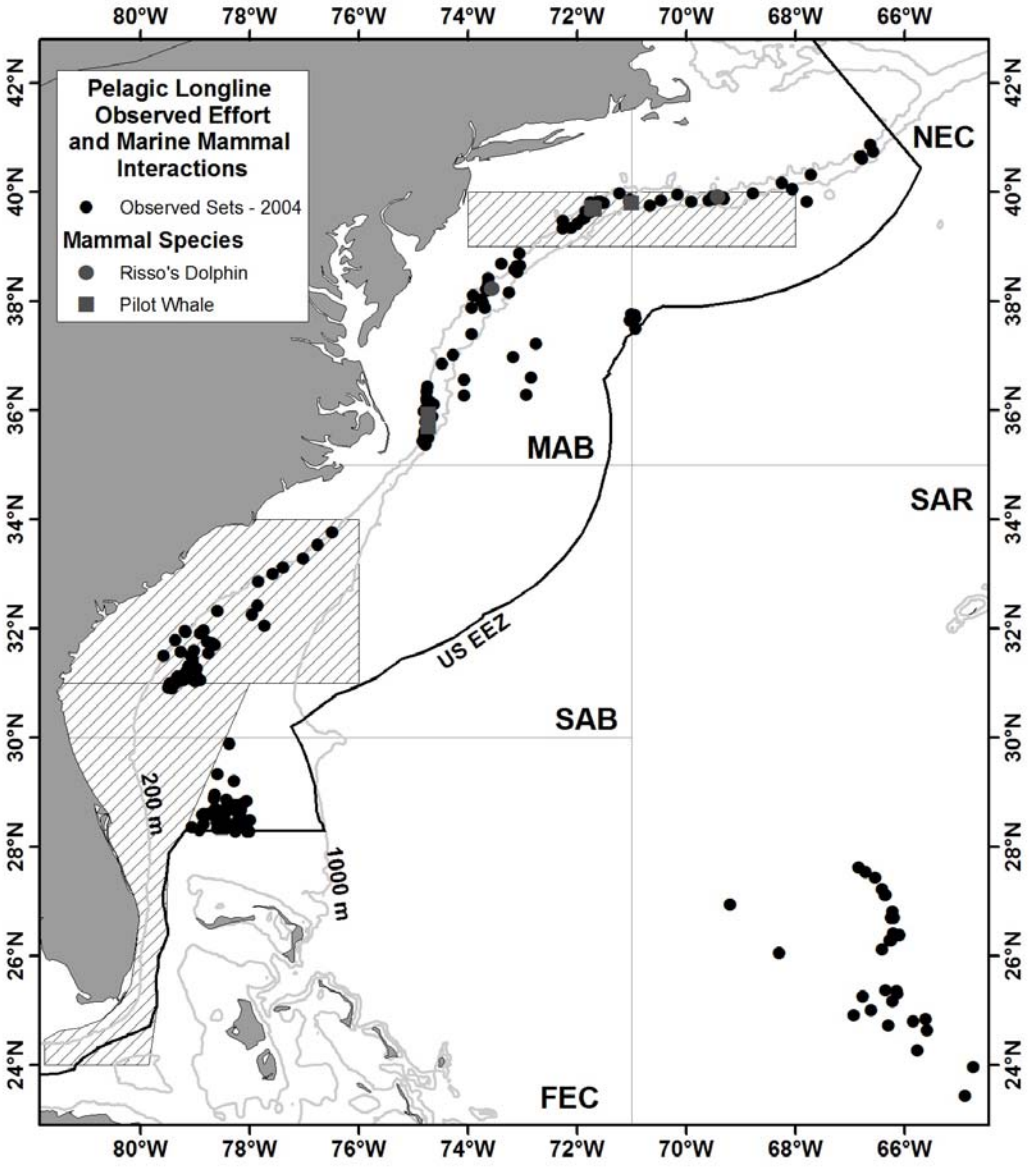


Figure LPG5. Observed sets and marine mammal interactions in the Pelagic longline fishery along the U.S. Atlantic coast during 2004. The boundaries of the Florida East Coast (FEC), South Atlantic Bight (SAB), Mid-Atlantic Bight (MAB), Northeast Coastal (NEC), and Sargasso Sea (SAR) fishing areas are shown. Seasonal closed areas instituted in 2001 under the HMS FMP are shown as hatched areas.

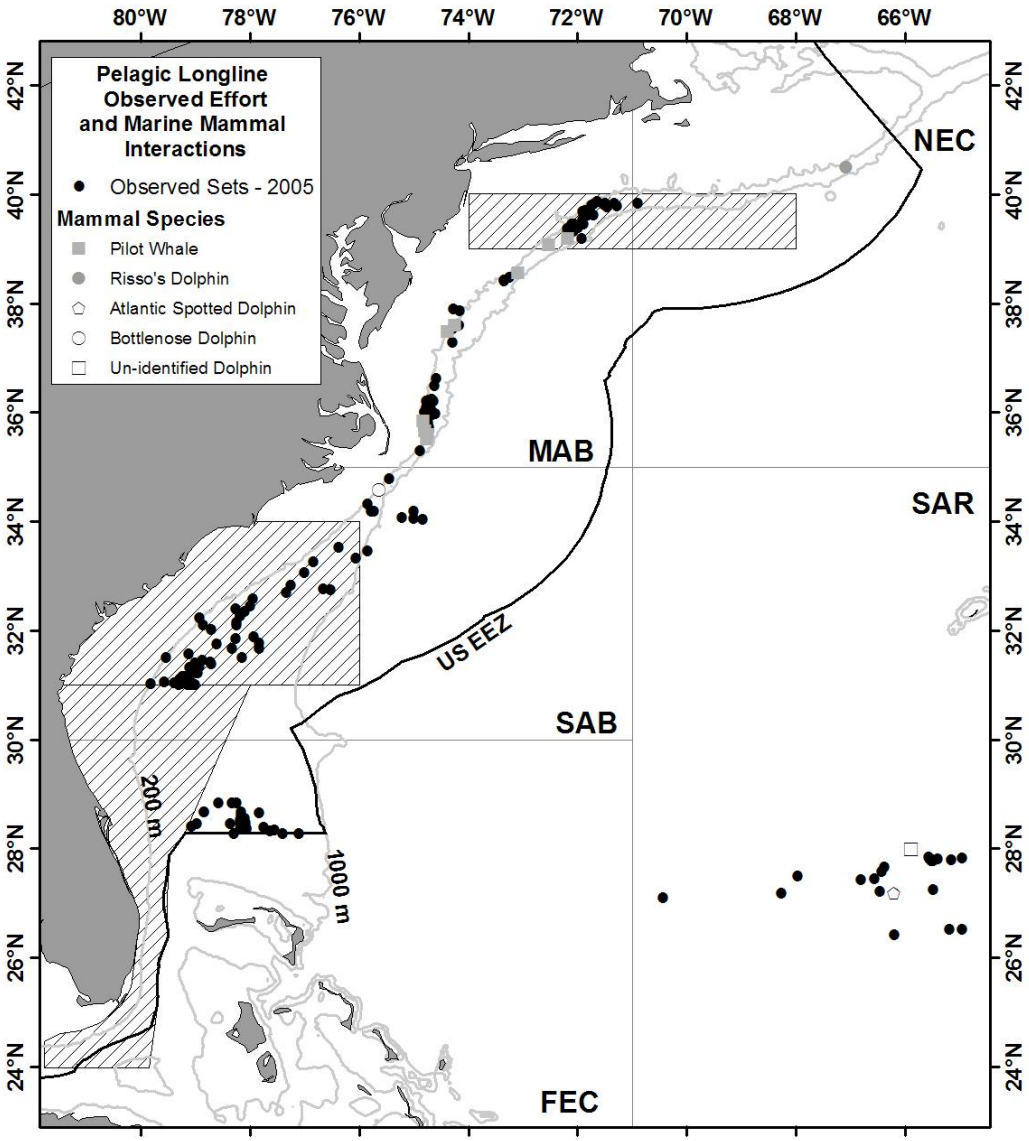


Figure LPG6. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2001. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown.

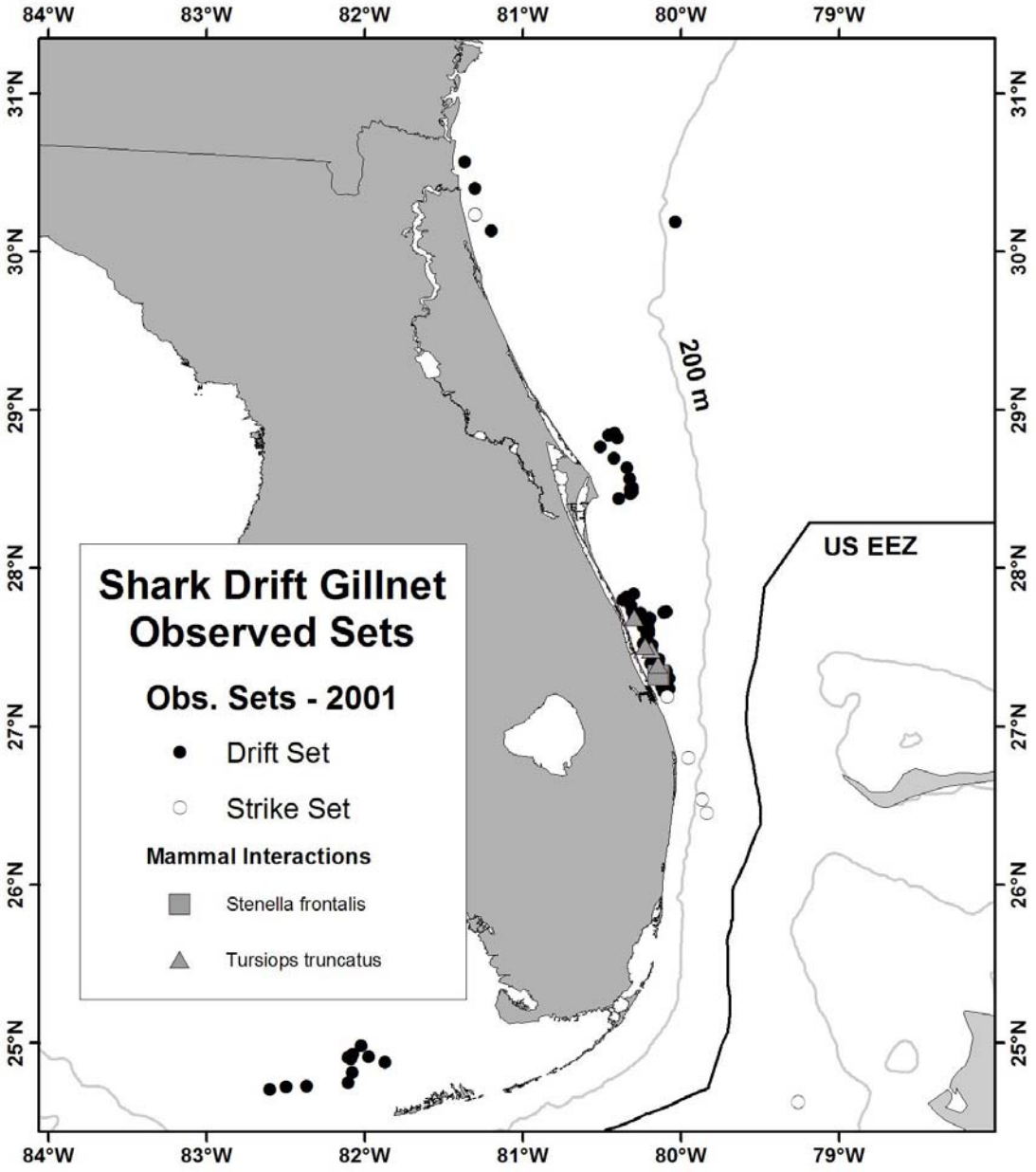


Figure LPG7. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2002. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown.

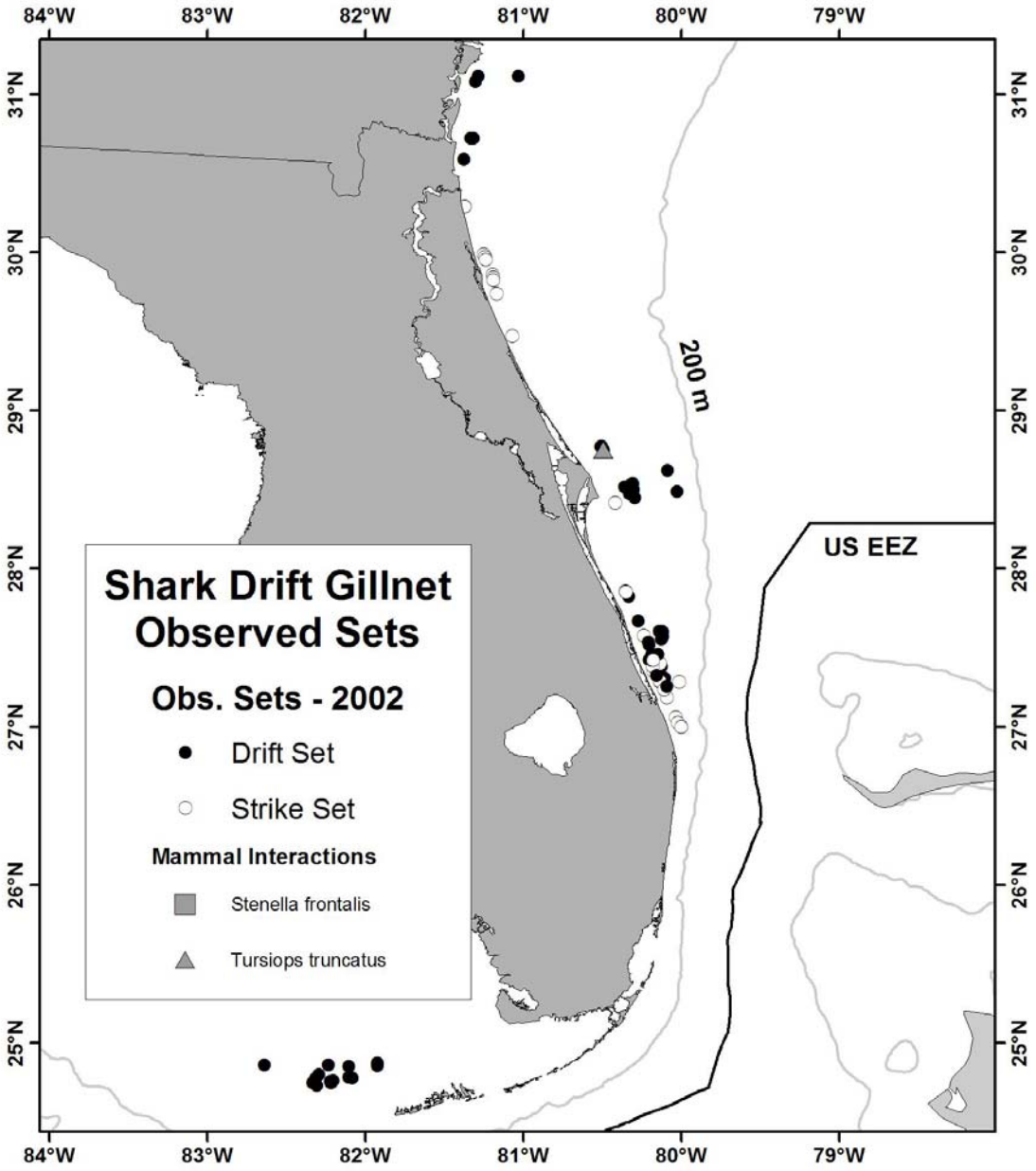


Figure LPG8. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2003. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown.

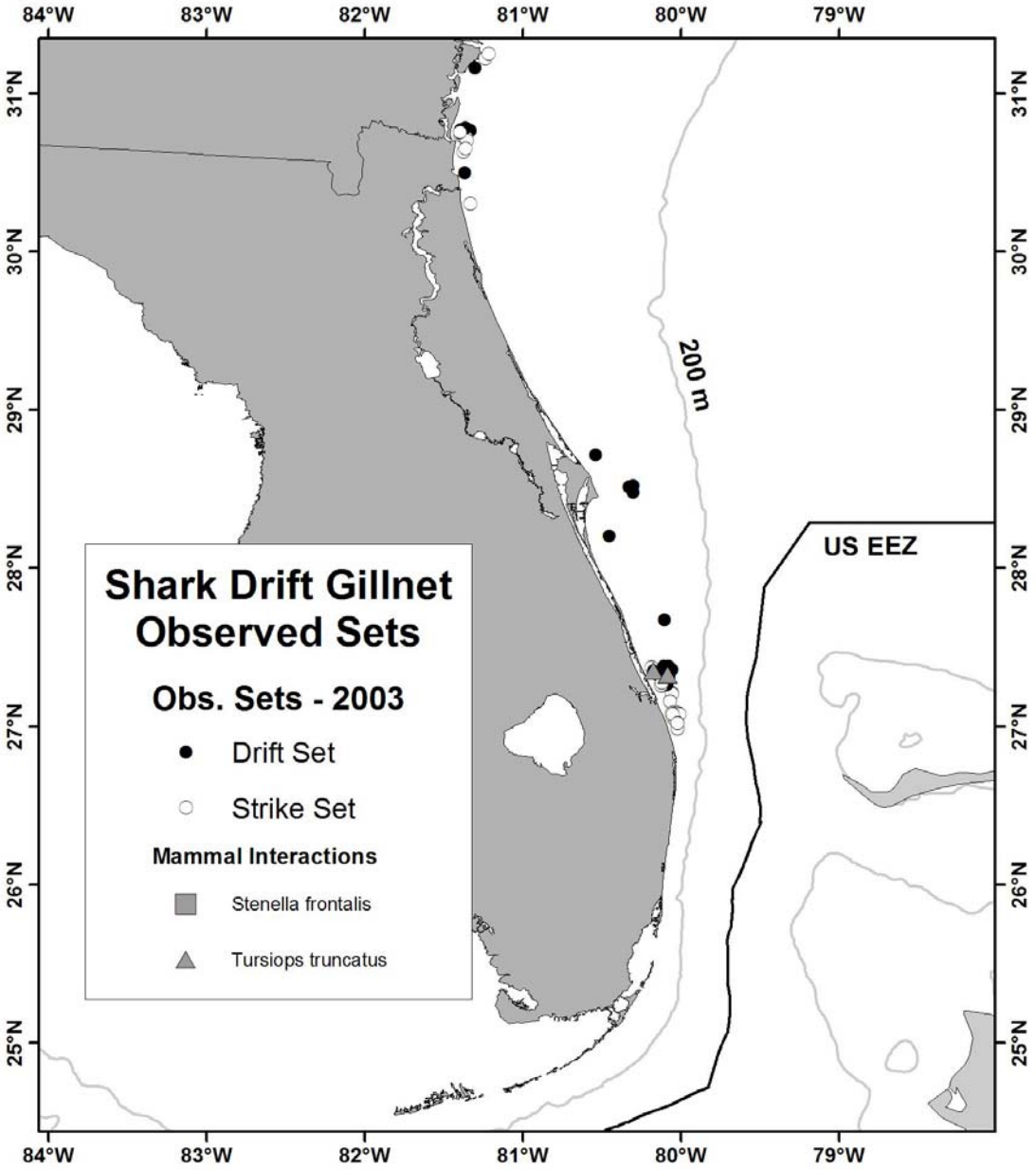


Figure LPG9. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2004. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown. No interactions with marine mammals were observed.

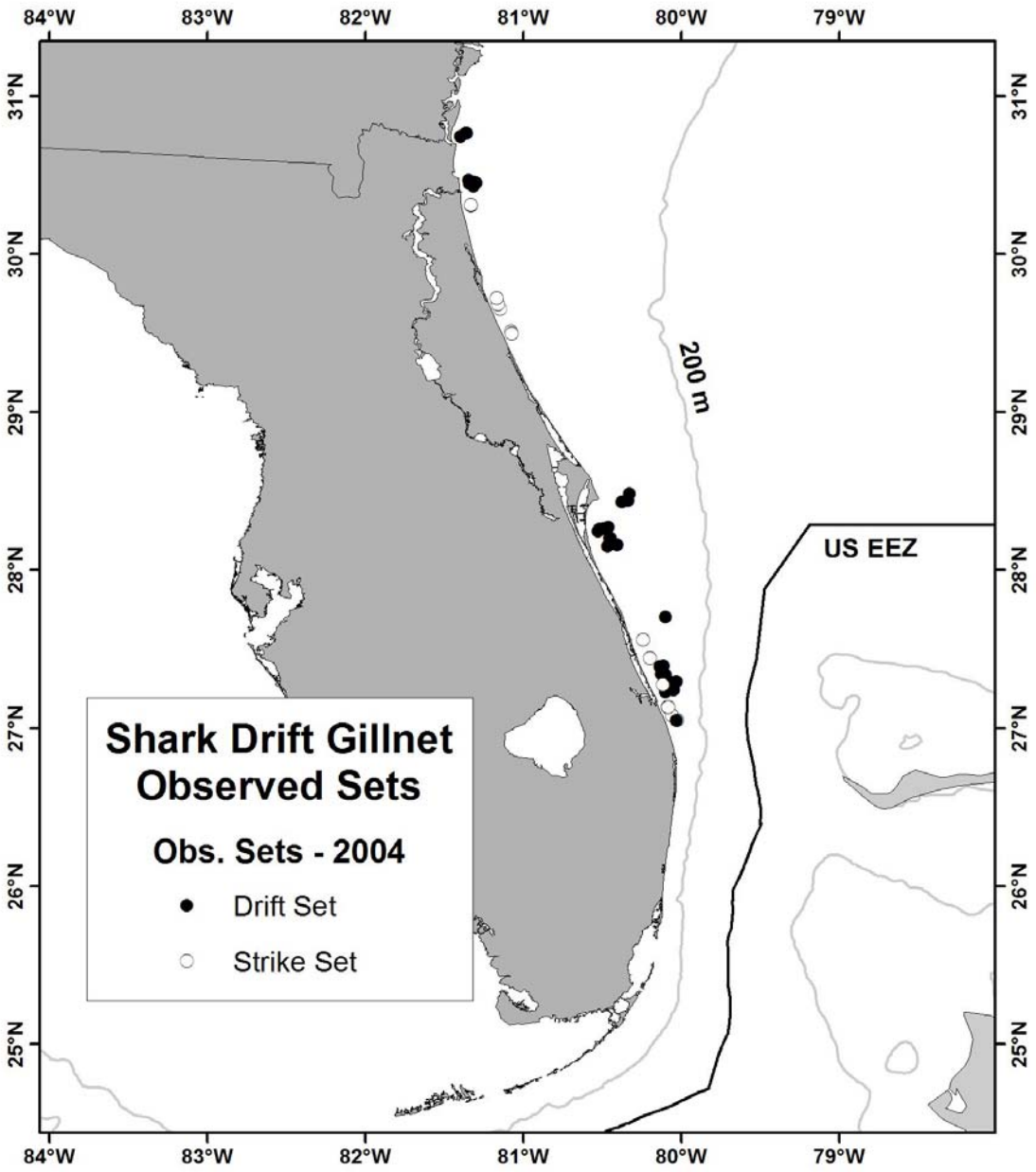


Figure LPG10. Observed sets and marine mammal interactions in the Shark drift gillnet fishery off Florida and Georgia during 2005. Fishery effort is restricted to during winter months north of 27º51' N, and the majority of observer coverage occurs during this period. Both drift and "strike" sets by observed vessels are shown. No interactions with marine mammals were observed.

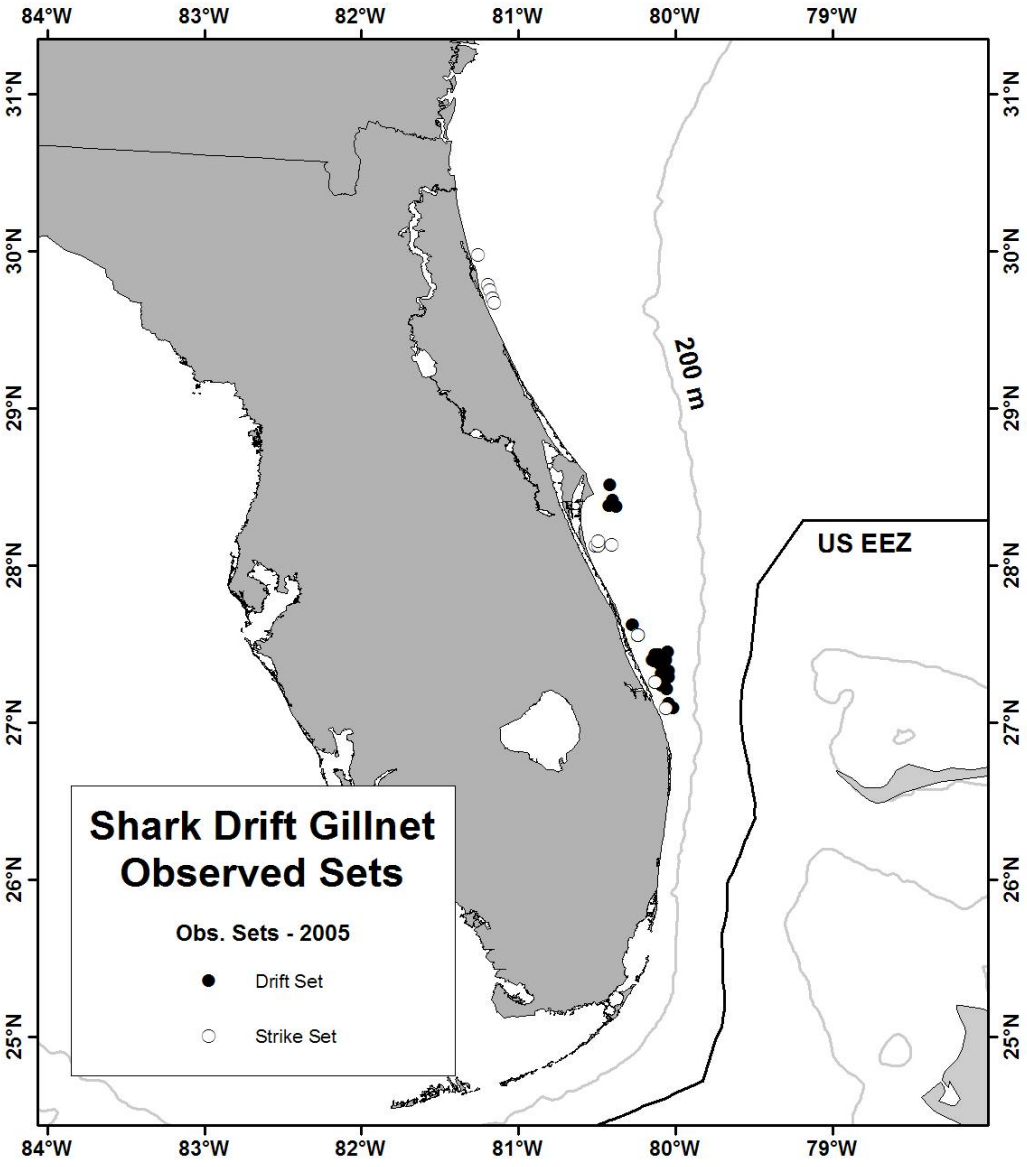


Figure LPG11. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2001. No marine mammal interactions were observed. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

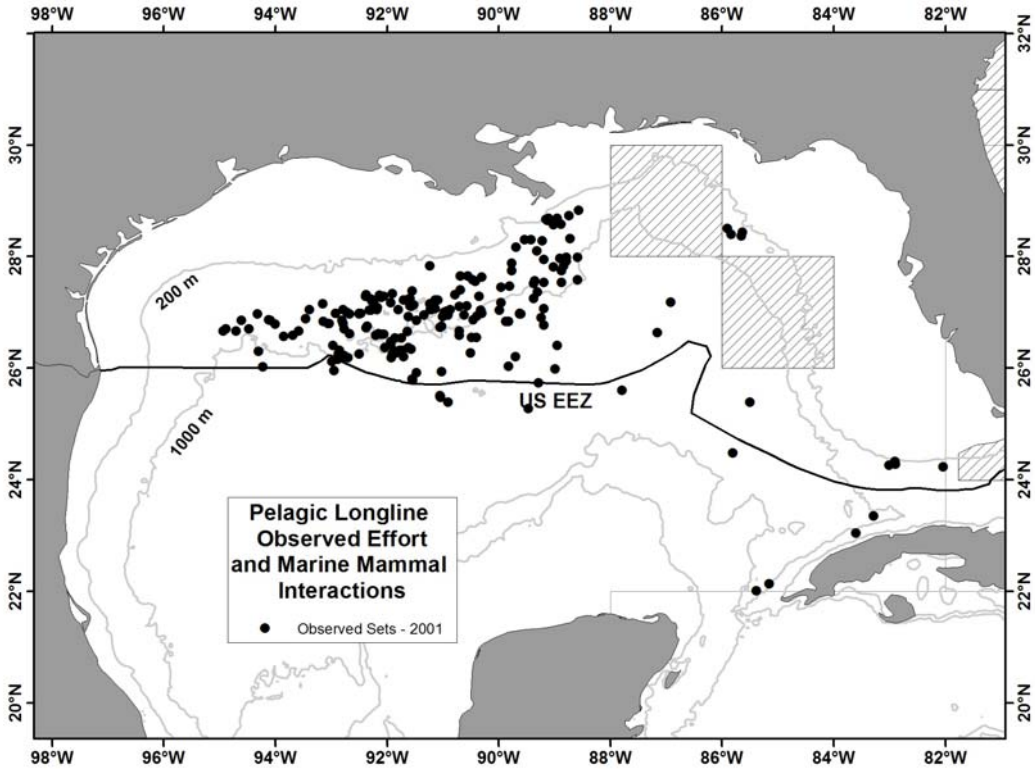


Figure LPG12. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2002. No marine mammal interactions were observed. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

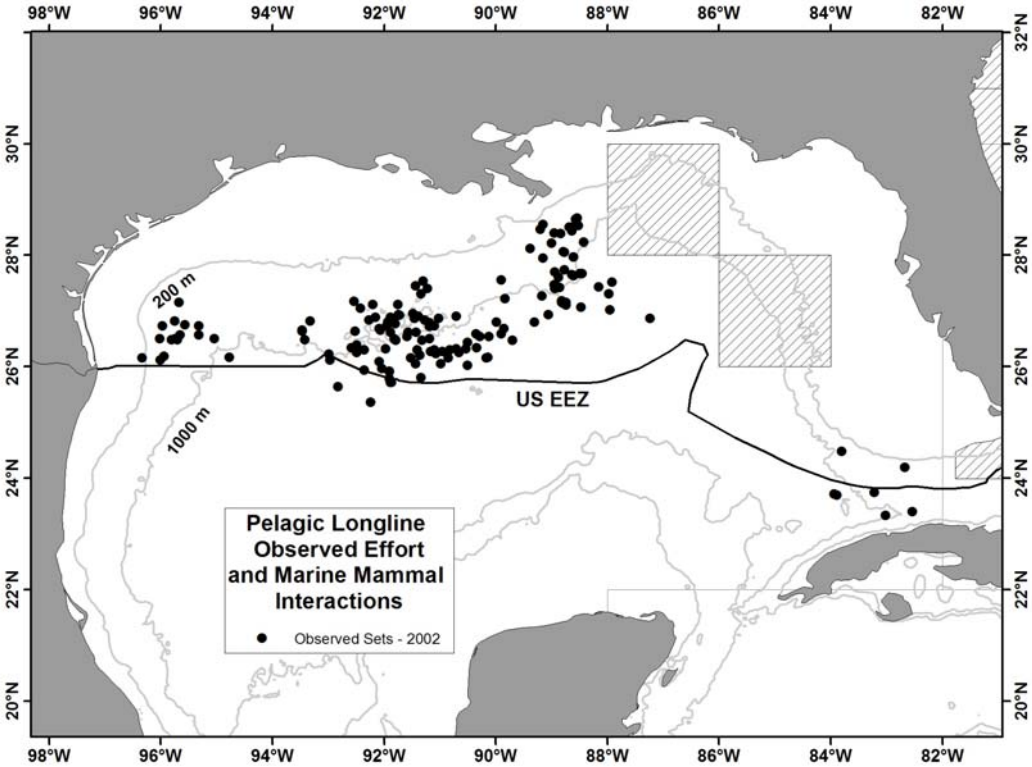


Figure LPG13. Observed sets and marine mammal interactions in the Pelagic longline fishery in the Gulf of Mexico during 2003. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

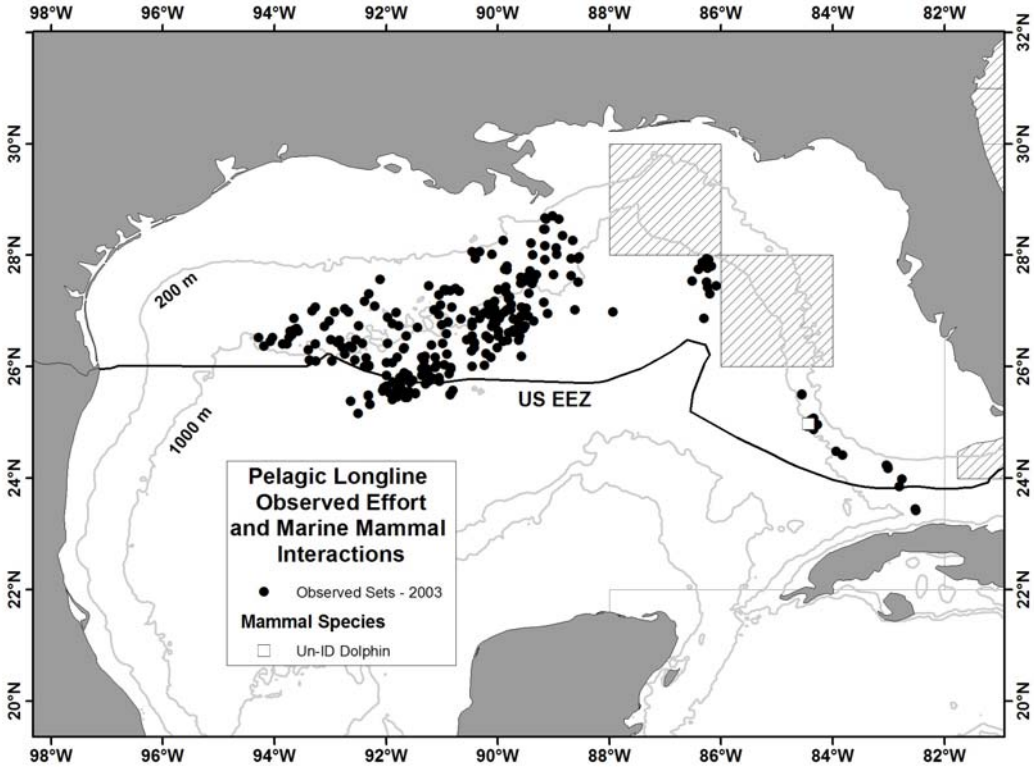


Figure LPG14. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2004. No marine mammal interactions were observed. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

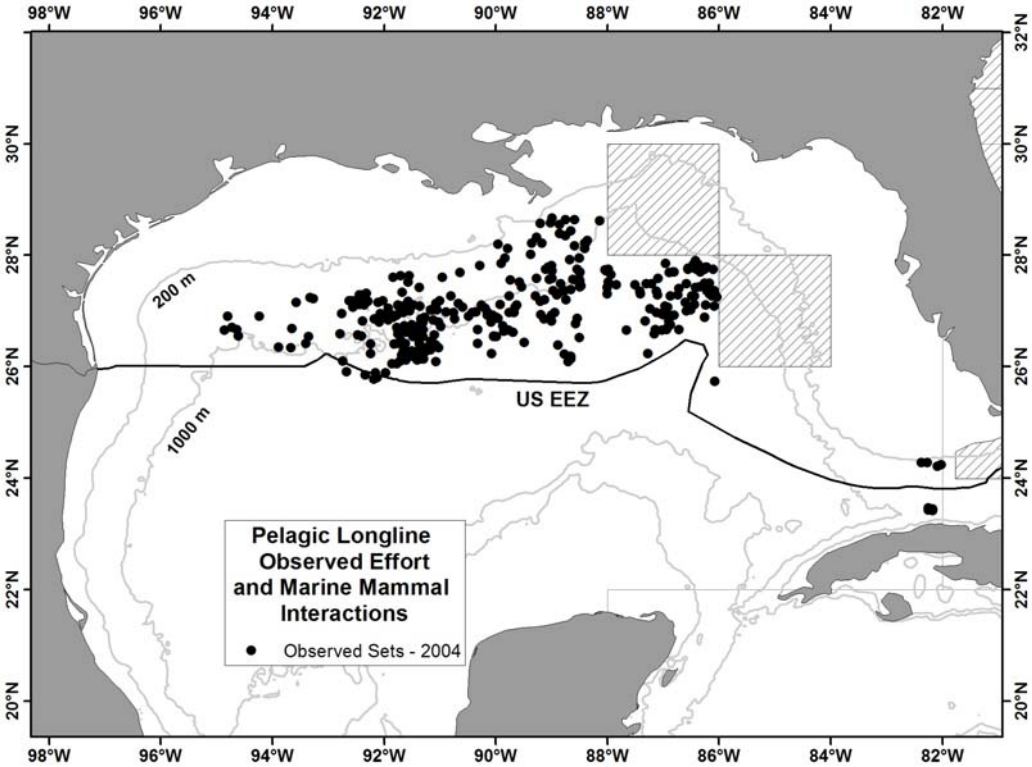


Figure LPG15. Observed sets in the Pelagic longline fishery in the Gulf of Mexico during 2005. Closed areas in the DeSoto canyon instituted in 2001 are shown as hatched areas.

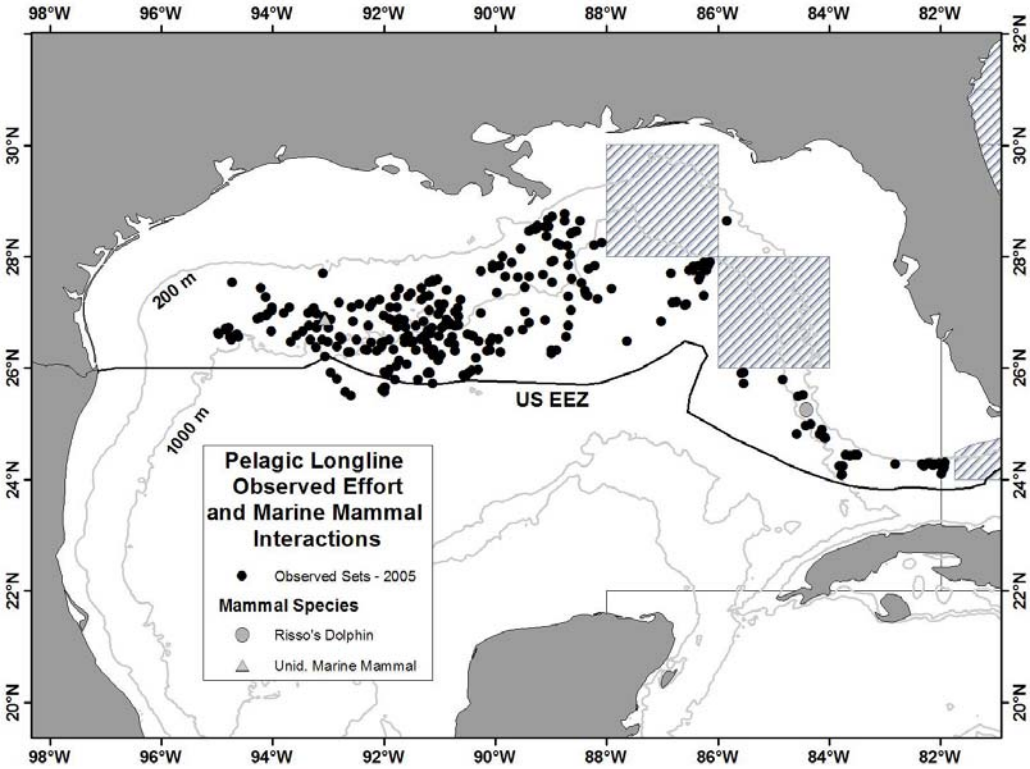
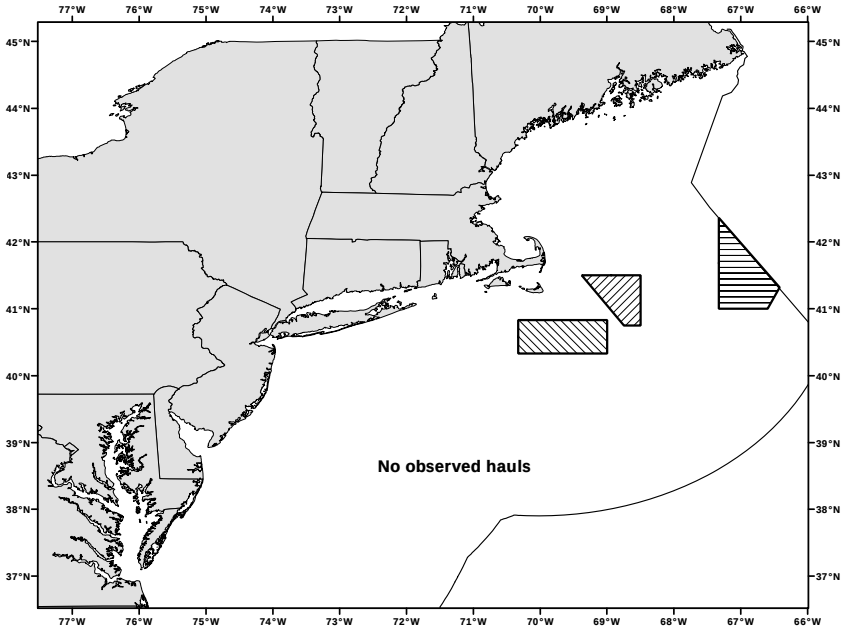
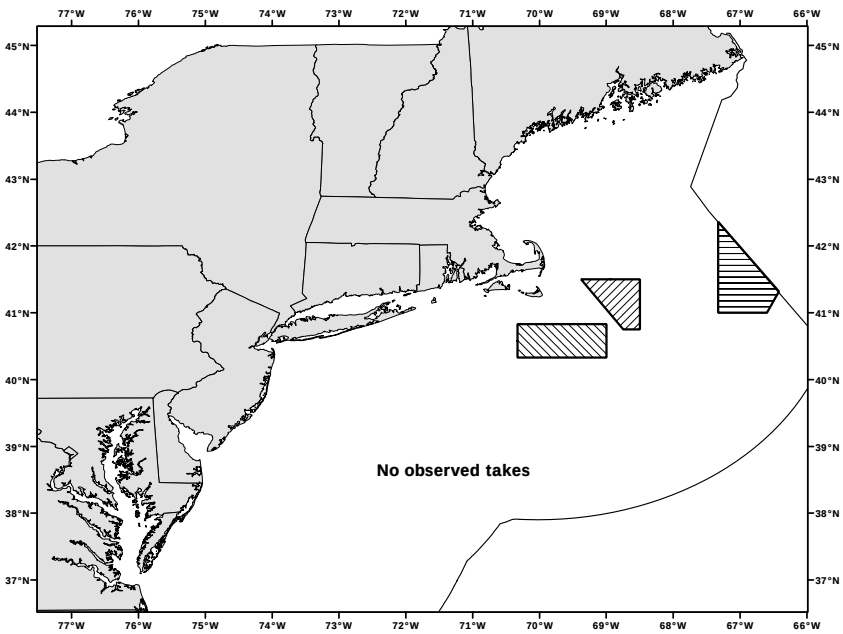


Figure 31. 2001 and 2002 Atlantic herring purse seine observed hauls (A) and observed incidental takes (B)

Observed hauls
Closed Area 1
Closed Area 2
Nantucket Lightship Closed Area



(A)



(A)

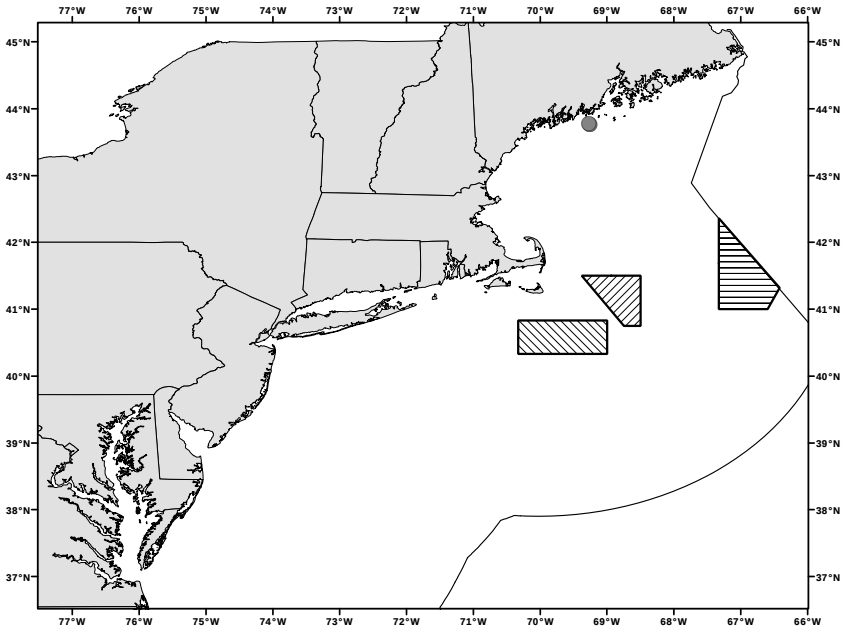
Figure 32. 2003 Atlantic herring purse seine observed hauls (A) and observed incidental takes (B)

Observed hauls

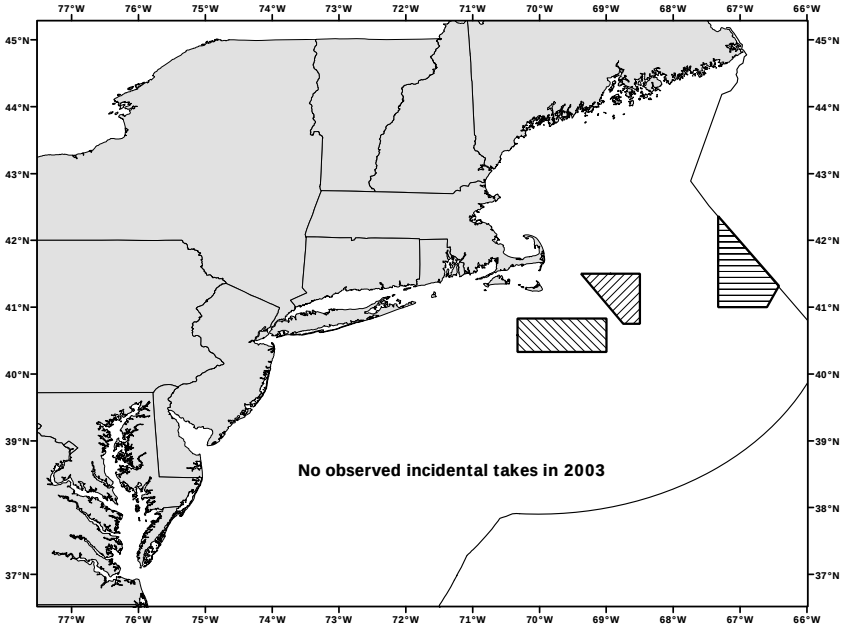
Closed Area 1

Closed Area 2

Nantucket Lightship Closed Area



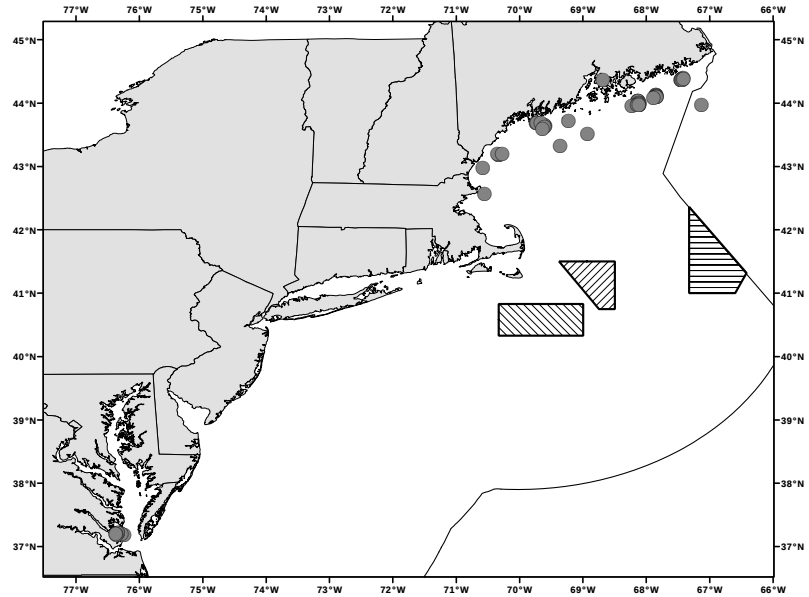
(A)



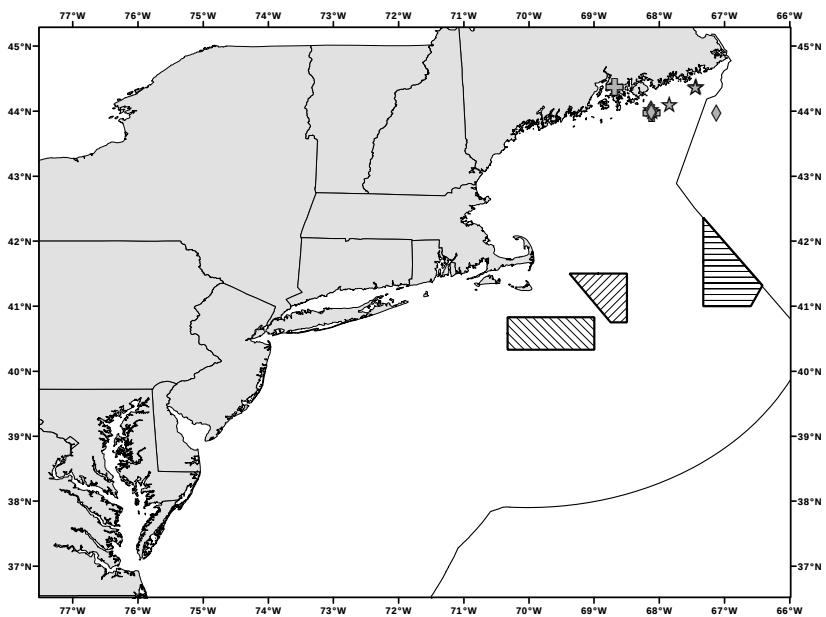
(B)

Figure 33. 2004 Atlantic herring purse seine observed hauls (A) and observed incidental takes (B)

- Observed hauls
- Harbor Seal
- Gray Seal
- Gray Seal/Harbor Seal
- Gray Seal/Unknown Seal
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



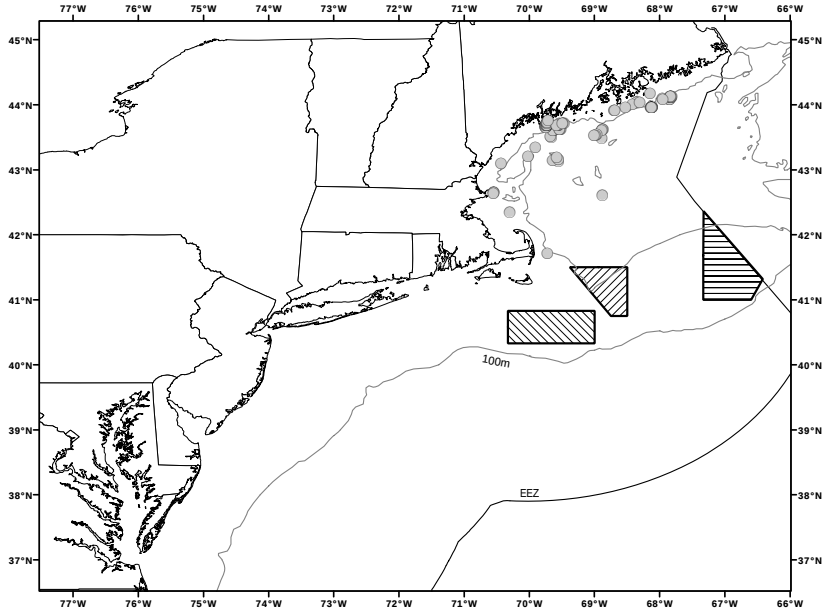
(A)



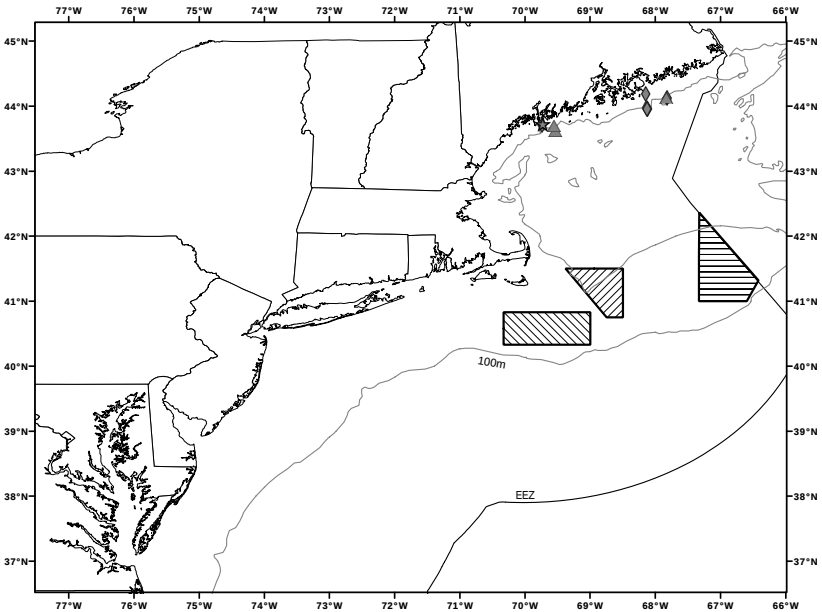
(B)

Figure 34. 2005 Atlantic herring purse seine observed hauls (A) and observed incidental takes (B)

- Observed hauls
- gray seal
- harbor seal
- unknown seal
- harbor seal/gray seal
- Closed Area 1
- Closed Area 2
- Nantucket Lightship Closed Area



(A)



(B)