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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are 2 species of pilot whales in the western Atlantic—the long-finned pilot whale, *Globicephala melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea; therefore, the ability to separately assess the 2 stocks in U.S. Atlantic waters is limited. The long-finned pilot whale is distributed from North Carolina to North Africa (and the Mediterranean) and north to Iceland, Greenland and the Barents Sea (Sergeant 1962; Leatherwood *et al.* 1976; Abend 1993; Buckland *et al.* 1993; Abend and Smith 1999). The stock structure of the North Atlantic population is uncertain (ICES 1993; Fullard *et al.* 2000). Morphometric (Bloch and Lastein 1993) and genetic (Siemann 1994; Fullard *et al.* 2000) studies have provided little support for stock structure across the Atlantic (Fullard *et al.* 2000). However, 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.

In U.S. Atlantic waters, pilot whales (*Globicephala* sp.) are distributed principally along the continental shelf edge off the northeastern 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associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Waring *et al.* 1992; NMFS unpublished data). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Cape Hatteras, North Carolina, and New Jersey (Payne and Heinemann 1993;Garrison *et al.* in prep.).

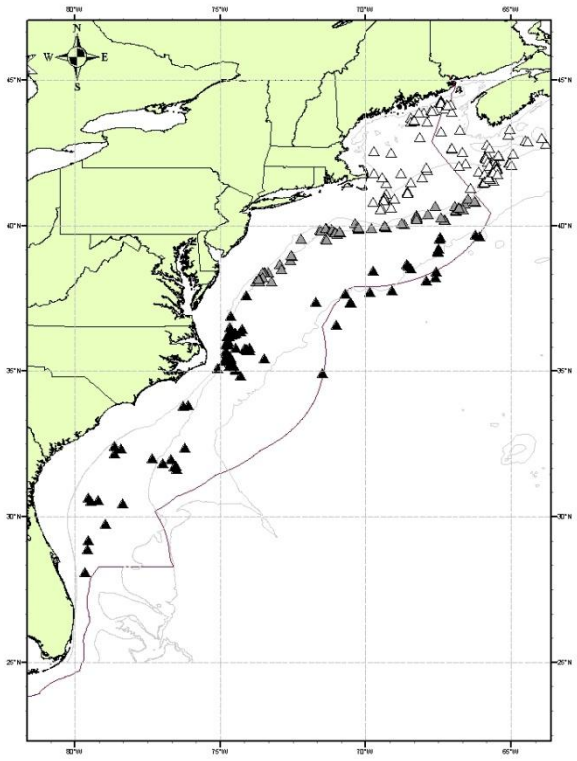

Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possible mixed (gray symbols) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006 and 2007. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are at the 100-m, 1,000-m, and 4,000-m depth contours.*

POPULATION SIZE

The total number of long-finned pilot whales off the eastern U.S. and Canadian Atlantic coast is unknown, although several abundance estimates are available from selected regions for select time periods. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sighting data are reported as *Globicephala* sp. Sightings from vessel and aerial surveys were strongly concentrated along the continental shelf break; however, pilot whales were also observed over the continental slope in waters associated with the Gulf Stream (Figure 1). Combined abundance estimates for the 2 species have previously been derived from line-transect surveys. The best available abundance estimates are from surveys conducted during the summer of 2004. These survey data have been combined with an analysis of the spatial distribution of the 2 species based on genetic analyses of biopsy samples to derive separate abundance estimates (Garrison *et al.*, in prep.). The resulting abundance estimate for long-finned pilot whales in U.S. waters is

12,619 (CV=0.37).

Earlier estimates

Please see appendix IV for earlier estimates and descriptions of abundance surveys. As recommended in the GAMMS Workshop Report (Wade and Angliss 1997), if estimates are older than 8 years PBR is undetermined. 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 for *Globicephala* sp.

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

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

A shipboard survey of the U.S. Atlantic outer continental shelf and continental slope (water depths >50 m) between Florida and Maryland (27.5ºN and 38ºN latitude) was conducted during June-August 2004. The survey employed 2 independent visual teams searching with 25× bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the mid-Atlantic. The survey included 5,659 km of trackline, and collected a total of 473 cetacean sightings. Sightings were most frequent in waters north of Cape Hatteras, North Carolina, along the shelf break. Data were corrected for visibility bias *g(0)* and group-size bias and analyzed using line-transect distance analysis (Palka 1995; Buckland *et al.* 2001). The resulting abundance estimate for *Globicephala* sp. between Florida and Maryland was 21,056 animals (CV=0.54; Garrison *et al.* in press).

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 abundance estimate of 6,134 (95% CI=2,774-10,573) pilot whales was generated from the Canadian Trans-North Atlantic Sighting Survey (TNASS) in July-August 2007. This aerial survey covered the area from northern Labrador to the Scotian Shelf, providing full coverage of the Atlantic Canadian coast. Estimates from this survey have not yet been corrected for availability and perception biases (Lawson and Gosselin 2009).

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

Month/Year	Area	N_{best}	CV
Aug 2002	S. Gulf of Maine to Maine	5,408	0.56
Jun-Aug 2004	Maryland to the Bay of Fundy	15,728	0.34
Jun-Aug 2004	Florida to Maryland	21,056	0.54
Jun-Aug 2004	Florida to Bay of Fundy (COMBINED)	36,784	0.34
Aug 2006	S. Gulf of Maine to upper Bay of Fundy to Gulf of St. Lawrence	26,535	0.35
July-Aug 2007	N. Labrador to Scotian Shelf	6,134	0.28

Spatial Distribution and Abundance Estimates for *Globicephala melas*

Biopsy samples from pilot whales were collected during summer months (June-August) from South Carolina to the southern flank of Georges Bank between 1998 and 2007. These samples were identified to species using genetic analysis of mitochondrial DNA sequences. A portion of the mtDNA genome was sequenced from each biopsy sample collected in the field, and genetic species identification was performed through phylogenetic reconstruction of the haplotypes. Stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all samples (Garrison *et al.*, in prep). Based upon the date and location of sample collection, the probability of a sample being from a long-finned (or short-finned) pilot whale was evaluated as a function of sea-surface temperature and water depth using logistic regression. This analysis indicated that the probability of a sample coming from a long-finned pilot whale was near 1 at water temperatures < 22°C, and near 0 at temperatures >25°C. The probability of a long-finned pilot whale also decreased with increasing water depth. Spatially, during summer months, this habitat model predicts that all pilot whales observed in offshore waters near the Gulf Stream are most likely short-finned pilot whales. The area of overlap between the 2 species occurred primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude. This habitat model was used to partition the abundance estimates from surveys conducted during the summer of 2004. The survey covering waters from Florida to Maryland was predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast survey covering the Gulf of Maine and the Bay of Fundy and surveys conducted in Canadian waters were predicted to consist entirely of long-finned pilot whales. The vessel portion of the northeast survey contained a mix of both species, with the sightings in offshore waters near the Gulf Stream predicted to consist of short-finned pilot whales. The best abundance estimate for long-finned pilot whales is thus the sum of the northeast aerial survey estimate (11,038 [CV=0.40], Palka 2006) and the estimated number of long-finned pilot whales from the southeast vessel survey (1,581 [CV=0.86]). The best available abundance estimate is thus 12,619 (CV=0.37) (Palka 2006; Garrison *et al.*, in prep; Garrison *et al.*, in press).

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 long-finned pilot whales is 12,619 animals (CV=0.37). This reflects only the portion of the long-finned pilot whale population occupying U.S. waters. This is consistent with guidelines for assessment of trans-boundary stocks since the available mortality estimates are also restricted to U.S. waters. The minimum population estimate for long-finned pilot whales is 9,333.

Current Population Trend

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

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates are unknown for this stock. Life history parameters that could be used to estimate net productivity obtained from animals taken in the Newfoundland drive fishery include: calving interval 3.3 years; lactation period about 21-22 months; gestation period 12 months; births mainly from June to November; length at birth of 177 cm; mean length at sexual maturity of 490 cm for males and 356 cm for females; age at sexual maturity of 12 years for males and 6 years for females; mean adult length of 557cm for males and 448 cm for females; and maximum age of 40 for males and 50 for females (Sergeant 1962; Kasuya *et al.* 1988). Analysis of data from animals taken in the Faroe Islands drive fishery produced higher values for all parameters (Bloch *et al.* 1993; Desportes *et al.* 1993; Martin and Rothery 1993). These differences are likely related, at least in part, to larger sample sizes and different analytical techniques.

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

POTENTIAL BIOLOGICAL REMOVAL

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size for long-finned pilot whales is 9,333. The maximum productivity rate is 0.04, the default value for cetaceans. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.5 because the CV of the average

mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic long-finned pilot whale is 93.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The total annual human caused mortality of long-finned pilot whales cannot be determined. The highest bycatch rates in the pelagic longline fishery area were observed during September – October along the mid-Atlantic coast (Garrison 2007). In bottom trawls, most mortalities were observed in the same area between July and November (Rossman 2009). The model used to derive abundance estimates uses data restricted to the warmest months of the year (June-August), and there are currently very few data available for the potential area of overlap during the fall. Therefore, it is not possible to partition mortality estimates between the 2 species because there are very few available genetic samples from the area of overlap and season where most mortality occurs. Mortality and serious injury estimates are thus presented only for the 2 species combined. Total annual estimated average fishery-related mortality or serious injury during 2005-2009 was 162 pilot whales (CV=0.15; Table 2). Of this, it is most likely that the mortality due to the pelagic longline fishery, the Northeast midwater trawl fishery, and the Northeast groundfish fishery have the most direct impact on long-finned pilot whales.

Fishery Information

Detailed fishery information is reported in Appendix III. Total fishery-related mortality and serious injury cannot be estimated separately for the 2 species of pilot whales in the U.S. Atlantic EEZ because of the uncertainty in species identification by fishery observers. The Atlantic Scientific Review Group advised adopting the risk-averse strategy of assuming that either species might have been subject to the observed fishery-related mortality and serious injury.

Earlier Interactions

Prior to 1977, there was no documentation of marine mammal bycatch in distant-water fleet (DWF) activities off the northeastern coast of the U.S. A fishery observer program, which has collected fishery data and information on incidental bycatch of marine mammals, was established in 1977 with the implementation of the Fisheries Conservation and Management Act (FCMA).

During 1977-1991, observers in this program recorded 436 pilot whale mortalities in foreign-fishing activities (Waring *et al.* 1990; Waring 1995). A total of 391 pilot whales (90%) was taken in the mackerel fishery, and 41 (9%) occurred during *Loligo* and *Illex* squid-fishing operations. This total includes 48 documented takes by U.S. vessels involved in joint-venture fishing operations. Two animals were also caught in both the hake and tuna longline fisheries (Waring *et al.* 1990).

Between 1989 and 1998, 87 mortalities were observed in the large pelagic drift gillnet fishery. The annual fishery-related mortality (CV in parentheses) was 77 in 1989 (0.24), 132 in 1990 (0.24), 30 in 1991 (0.26), 33 in 1992 (0.16), 31 in 1993 (0.19), 20 in 1994 (0.06), 9.1 in 1995 (0), 11 in 1996 (0.17), no fishery in 1997 and 12 in 1998 (0). This fishery was permanently closed in 1999.

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 1 interaction, the net was pursed around 1 pilot whale, the rings were released and the animal escaped alive, condition unknown. This set occurred east of the Great South Channel and just north of the Cultivator Shoals region on Georges Bank. In a second interaction, 5 pilot whales were encircled in a set. The net was opened prior to pursing to let the whales swim free, apparently uninjured. This set occurred on the Cultivator Shoals region on Georges Bank. No trips were observed during 1997 through 1999. Four trips were observed in September 2001, with no marine mammals observed taken during these trips.

No pilot whales were taken in observed mid-Atlantic coastal gillnet trips during 1993-1997. One pilot whale was observed taken in 1998, and none were observed taken 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 attributed to this fishery was 7 (CV=1.10) in 1998.

One pilot whale take was observed in the *Illex* squid portion of the southern New England/mid-Atlantic squid, mackerel, butterfish trawl fisheries in 1996 and 1 in 1998. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was 45 in 1996 (CV=1.27), 0 in 1997, 85 in 1998 (CV=0.65) and 0 in

1999. However, these estimates should be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery is included as a component of the mid-Atlantic bottom trawl fishery.

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

There was 1 observed take in the southern New England/mid-Atlantic bottom trawl fishery reported in 1999. The estimated fishery-related mortality for pilot whales attributable to this fishery was 0 in 1996-1998, and 228 (CV=1.03) in 1999. After 1999 this fishery has been included as a component of the mid-Atlantic bottom trawl fishery.

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

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

Pelagic Longline

Most of the estimated marine mammal bycatch in the U.S. pelagic longline fishery was recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Johnson *et al.* 1999; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2008, 154 pilot whales were released alive, including 83 that were considered seriously injured, and 5 mortalities were observed (Johnson *et al.* 1999; Yeung 2001; Garrison 2003; Garrison and Richards 2004; Garrison 2005; Fairfield Walsh and Garrison 2006; Fairfield Walsh and Garrison 2007; Fairfield and Garrison 2008; Garrison *et al.* 2009; Garrison and Stokes 2010). 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 (1830 m) deep 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 (37- and 92-m) isobaths between Barnegat Bay and Cape Hatteras.

The estimated fishery-related mortality to pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was: 127 in 1992 (CV=1.00), 0 from 1993-1998, 93 in 1999 (CV=1.00), 24 in 2000 (CV=1.00), 20 (CV=1.00) in 2001, 2 (CV=1.00) in 2002, 0 in 2003-2005, 16 (CV=1.00) in 2006 and 0 in 2007. The estimated serious injuries were 40 (CV=0.71) in 1992, 19 (CV=1.00) in 1993, 232 (CV=0.53) in 1994, 345 (CV= 0.51) in 1995 including 37 estimated short-finned pilot whales (CV=1.00), 0 from 1996 to 1998, 288 (CV=0.74) in 1999, 109 (CV=1.00) in 2000, 50 in 2001 (CV=0.58), 51 in 2002 (CV=0.48), 21 in 2003 (CV=0.78), 74 in 2004 (CV=0.42), 212 (CV=0.21) in 2005, 169 (CV=0.47) in 2006, 57 (CV=0.47) in 2007, 98 (CV=0.42) in 2008 and 17 (CV=0.70) in 2009. The average 'combined' annual mortality in 2005-2009 was 114 pilot whales (CV=0.20) (Table 2).

An experimental fishery was conducted on 6 vessels operating in the Gulf of Mexico and off the U.S. East Coast in 2005, with 100% observer coverage achieved. During this experiment, different hook-baiting techniques with standardized gangion and float line lengths were used, and hook timers and time-depth recorders were attached to the gear. The fishing techniques and gear employed during this experimental fishery do not represent those used during "normal" fishing efforts, and are thus presented separately in Table 2. Three pilot whales were released alive during this experimental fishery, including 1 that was seriously injured (Fairfield Walsh and Garrison 2006).

Mid-Atlantic Bottom Trawl

Two pilot whales were observed taken in the mid-Atlantic bottom trawl in 2000, 4 in 2005, 1 in 2006, 0 in 2007, 0 in 2008, and 0 in 2009. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 47 (CV=0.32) in 2000, 39 (CV=0.31) in 2001, 38 (CV=0.36) in 2002, 31 (CV=0.31) in 2003, 35 (CV=0.33) in 2004, 31 (CV=0.31) in 2005, 37 (CV=0.34) in 2006, 36 (CV=0.38) in 2007, 24 (CV=0.36) in 2008 and 23 (CV=0.35) in 2009. The 2005-2009 average mortality attributed to the mid-Atlantic bottom trawl was 30 animals (CV=0.16) (Table 2).

Northeast Bottom Trawl

Two pilot whales were observed taken in the Northeast bottom trawl in 2004, 4 in 2005, 1 in 2006, 4 in 2007, 5 in 2008, and 3 in 2009. The estimated fishery-related mortality to pilot whales in the U.S. Atlantic attributable to this fishery was: 18 (CV=0.29) in 2000, 30 (CV=0.27) in 2001, 22 (CV=0.26) in 2002, 20 (CV=0.26) in 2003, 15 (CV=0.29) in 2004, 15 (CV=0.30) in 2005, 14 (CV=0.28) in 2006, 12 (CV=0.35) in 2007,10 (CV=0.34) in 2008, and 9 (CV=0.35) in 2009. The 2005-2009 average mortality attributed to the northeast bottom trawl was 12 animals (CV=0.14) (Table 2).

Northeast Mid-Water Trawl (Including Pair Trawl)

In Sept 2004 a pilot whale was observed taken in the paired mid-water trawl fishery on the northern edge of Georges Bank (off Massachusetts) in a haul that was targeting (and primarily caught) herring. In April 2008, six pilot whale takes were observed in the single mid-water trawl fishery in hauls targeting mackerel and located on the southern edge of Georges Bank. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed takes per observed hours the gear was in the water) for each year, where the paired and single Northeast mid-water trawls were pooled and only hauls that targeted herring or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (Palka, pers. comm.). Estimated annual fishery-related mortalities were: unknown in 2001-2002, 0 in 2003, 5.6 (CV=0.92) in 2004, 0 in 2005 to 2007, 16 (CV=0.61) in 2008 and 0 in 2009 (Table 2; Palka pers. comm.). The average annual estimated mortality during 2005-2009 was 3 (CV=0.61).

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

In March 2007 a pilot whale was observed bycaught in the single mid-water fishery in a haul targeting herring that was south of Rhode Island. Due to small sample sizes, the ratio method was used to estimate the bycatch rate (observed pilot whale takes per observed hours the gear was in the water) for each year, where the paired and single Mid-Atlantic mid-water trawls were pooled and only hauls that targeted herring or mackerel were used. The VTR herring and mackerel data were used to estimate the total effort (Palka, pers. comm.). Estimated annual fishery-related mortalities were unknown in 2002, 0 in 2003 to 2006, 12.1 (CV=0.99) in 2007, 0 in 2008 and 0 in 2009 (Table 2; Palka pers. comm.). The average annual estimated mortality during 2005-2009 was 2.4 (CV=0.99).

CANADA

Unknown numbers of long-finned 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 was 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, 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 1 record of incidental catch in the offshore Greenland halibut fishery that involved 1 long-finned pilot whale in 2001; no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury of pilot whales (*Globicephala* sp.) by commercial fishery including the years sampled (Years), the 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	Data Type [a]	Observer Coverage [b]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Estimated CVs	Mean Annual Mortality
Mid-Atlantic Bottom Trawl[c]	05-09	Obs. Data Dealer	.03, .02, .03, .03, .05	0, 0, 0, 0, 0	4, 1, 0, 0, 0	0, 0, 0, 0, 0	31, 37, 36, 24, 23	31, 37, 36, 24, 23	.31, .34, .38, .36, .36	30 (.16)
Northeast Bottom Trawl[c]	05-09	Obs. Data Dealer Data VTR Data	.12, .06, .06, .08, .05	0, 0, 0, 0, 0	4, 1, 4, 5, 3	0, 0, 0, 0, 0	15, 14, 12, 10, 9	15, 14, 12, 10, 9	.30, .28, .35, .34, .35	12 (.14)
Mid-Altlantic Mid-Water Trawl - Including Pair Trawl[d]	05-09	Obs. Data Dealer Data VTR Data	.08, .09, .04, .13, .13	0, 0, 0, 0, 0	0, 0, 1, 0, 0	0, 0, 0, 0, 0	0, 0, 12, 0, 0	0, 0, 12, 0, 0	0, 0, 0.99, 0, 0	2.4 (.99)
Northeast Mid-Water Trawl - Including Pair Trawl [d]	05-09	Obs. Data Dealer Data VTR Data	.20, .03, .08, .20, .42	0, 0, 0, 0, 0	0, 0, 0, 6, 0	0, 0, 0, 0, 0	0, 0, 0, 16, 0	0, 0, 0, 16, 0	0, 0, 0, .61, 0	3 (.61)
Pelagic Longline	05-09	Obs. Data Logbook	.06, .07, .07, .07, .10	9, 12, 5, 5, 2	0, 1, 0, 0, 0	212, 169, 57, 98, 17	0, 16, 0, 0, 0	212, 185, 57, 98, 17	.21, .47, .65, .42, .70	114 (.20)
2005 Pelagic Longline experimental fishery[e]	05	Obs. Data	1	1	0	1	0	1	0	1(0)
TOTAL										162 (.15)

[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] 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.

[c] NE and MA bottom trawl mortality estimates reported for 2007 to 2009 are a product of GLM estimated bycatch rates (utilizing observer data collected from 2000 to 2005) and 2007 to 2009 effort. Complete documentation of methods used to estimate cetacean bycatch mortality are described in Rossman (2010).

[d] Within each of the fisheries (Northeast and Mid-Atlantic), the paired and single trawl data were pooled. Ratio estimation methods were used within each fishery and year to estimate the total the annual bycatch.

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

Other Mortality

Pilot whales have a propensity to mass strand throughout their range, but the role of human activity in these events is unknown. Between 2 and 168 pilot whales have stranded annually, either individually or in groups, along

the eastern U.S. seaboard since 1980 (NMFS 1993, stranding databases maintained by NMFS NER, NEFSC and SEFSC). From 2004 to 2008, 44 short-finned pilot whales (*Globicephala macrorhynchus*), 68 long-finned pilot whales (*Globicephala melas melas*), and 11 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including Puerto Rico and the Exclusive Economic Zone (EEZ) (Table 3). This includes 1 mass stranding of 18 long-finned pilot whales (including 1 pregnant female) as part of a multi-species mass stranding in Barnstable County, Massachusetts, on 10 December 2005 (Fehring and Wells 1976; Irvine *et al.* 1979; Odell *et al.* 1980).

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.

An 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 was involved in this UME.

A UME mass stranding of 33 short-finned pilot whales, including 5 pregnant females, near Cape Hatteras, North Carolina, occurred from 15-16 January 2005. Gross necropsies were conducted and samples were collected for pathological analyses (Hohn *et al.* 2006), but no single cause for the UME was determined.

Short-finned pilot whales strandings 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 have been reported stranded as far south as Florida, where 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. This animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification. Most of the remaining long-finned pilot whale strandings were from North Carolina northward (Table 3).

During 2005-2009, several human and/or fishery interactions were documented in stranded pilot whales. During a UME in Dare, North Carolina, in January 2005, 6 of the 33 short-finned pilot whales which mass stranded had fishery interaction marks (specifics not given) that were healed and determined not to be the cause of death. A short-finned pilot whale stranded in May 2005 in North Carolina had net marks around the leading edge of the dorsal fin from the top to bottom, and had net marks on both fluke lobes. Two long-finned pilot whales stranded in Virginia in April 2005, 1 with a line on its flukes and another with human interactions noted but specifics not given. Of the 2006 stranding mortalities, 2 were reported as exhibiting signs of human interaction, 1 in Massachusetts and 1 in Virginia. In 2008, 1 Massachusetts stranding mortality was deemed a fishery interaction due to line markings and cut flukes. The 2 New York strandings of long-finned pilot whales were classified as human interactions. One long-finned pilot whale that stranded in Massachusetts in 2009 was classified as a human interaction because it had a piece of monofilament line in its stomach.

Table 3. Pilot whale (*Globicephala macrorhynchus* [SF], *Globicephala melas melas* [LF] *and Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2005-2009. Strandings that 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	2005			2006			2007			2008			2009			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	2	0	0	3	0	0	2	0	0	0	0	0	15	0	0	22
Newfoundland and Labrador[b]	0	2	0	0	0	3	0	0	1	0	0	2	0	0	1	0	2	7
Maine[c]	0	2	0	0	1	0	0	1	0	0	1	1	0	3	0	0	8	1
New Hampshire	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Massachusetts[d]	0	22	0	0	2	0	0	6	0	0	1	1	0	4	0	0	35	1
Rhode Island	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	4	0

New York	0	1	0	0	0	0	0	2	0	0	2	0	0	1	0	0	6	0
New Jersey	0	0	2	1	0	0	0	1	0	0	1	0	1	1	0	2	3	2
Delaware	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Maryland	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0
Virginia[e]	0	4	0	0	2	0	0	0	0	0	0	0	0	0	0	0	6	0
North Carolina[f]	35	1	2	0	0	1	0	0	0	3	0	1	2	0	0	40	1	4
South Carolina	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Florida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEZ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
TOTALS - U.S., Puerto Rico, & EEZ	35	35	4	1	6	1	0	10	0	3	7	4	4	11	0	43	69	9

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

[b] (Ledwell and Huntington 2004; 2006; 2007; 2008; 2009; 2010).

[c] Long-finned pilot whale stranded in Maine in 2007 released alive.

[d] Includes 18 pilot whales which were part of a multi-species mass stranding in Brewster on 10 December 2005. One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water. One of the 2009 animals was classified as a fishery interaction.

[e] One pilot whale stranded in Virginia in 2004 during an Unusual Mortality Event but was not identified to species (decomposed and decapitated). Sign of human interaction (a line on the flukes) observed on 2 animals in 2005, and 1 animal was a pregnant female.

[f] In 2004, 1 short-finned pilot whale (September) and 1 pilot whale (November) not identified to species stranded in North Carolina during an Unusual Mortality Event (UME). A long-finned pilot whale also stranded in February, not related to any UME. 2005 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. Signs of fishery interaction observed on a short-finned pilot whale stranded in May 2005.

In eastern Canada, 37 strandings of long-finned pilot whales (173 individuals) were reported on Sable Island, Nova Scotia, from 1970 to 1998 (Lucas and Hooker 2000). This included 130 animals that mass stranded in December 1976, and 2 smaller groups (<10 each) in autumn 1979 and summer 1992. Fourteen strandings were also recorded along Nova Scotia in 1991-1996 (Hooker *et al.* 1997). Several live mass-strandings occurred in Nova Scotia recently, including 14 in 2000, 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.

Mass strandings of long-finned pilot whales were more frequent several decades ago in Newfoundland when this species was more abundant (Table 4). Recent Newfoundland and Labrador strandings are reported in Table 3.

Table 4. Pilot whale mass strandings along the Newfoundland, Canada coast.

Year	Date	Number of Pilot Whales Stranded	Place in Newfoundland
1979	July 14	135	Pt. au Gaul
1980	October 19	70	Pt. Leamington
	October 25	18	Grand Beach
1982	July 27	23	Grand Bank
	August 18	3	Bonavista
1983	early January	10	Piccadilly
1984	July 15	5	Middle Cove
1990	December 14	4	St. Anthony

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

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

STATUS OF STOCK

The status of long-finned pilot whales relative to OSP in U.S. Atlantic EEZ is unknown. There are insufficient data to determine population trends for this species. The species is not listed under the Endangered Species Act. The total U.S. fishery-related mortality and serious injury for long-finned pilot whales is unknown, since it is not possible to partition mortality estimates between the long-finned and short-finned pilot whales. However, it is most likely 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 total fishery mortality may exceed PBR; however, it is unknown to what extent the pelagic longline fishery in particular impacts this stock. Due to the possibility of exceeding PBR, this should be considered a strategic stock. However, the inability to partition mortality estimates between the species limits the ability to adequately assess the status of this stock.

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