

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

STOCK DEFINITION AND GEOGRAPHIC RANGE

There are 2 species of pilot whales in the western North Atlantic - the long-finned pilot whale, *Globicephala melas melas*, and the short-finned pilot whale, *G. macrorhynchus*. These species are difficult to differentiate at sea and cannot be reliably visually identified during either abundance surveys or observations of fishery mortality without high-quality photographs (Rone and Pace 2012); therefore, the ability to separately assess the 2 species in U.S. Atlantic waters is complex and requires additional information on seasonal spatial distribution. Undifferentiated pilot whales (*Globicephala* sp.) in the western North Atlantic occur primarily near the continental shelf break ranging from Florida to the Nova Scotia Shelf (Mullin and Fulling 2003). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; Rone and Pace 2012). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whales have occasionally been observed stranded as far north as Massachusetts. The latitudinal ranges of the two species therefore remain uncertain, although south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of ~42°N most pilot whale sightings are expected to be long-finned pilot whales (Figure 1). In addition, short-finned pilot whales are documented 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), and they are also known from the wider Caribbean. A May 2011 mass stranding of 23 short-finned pilot whales in the Florida Keys has been considered to be Gulf of Mexico stock whales based on stranding location, yet two tagged and released individuals from this stranding travelled directly into the Atlantic (Wells *et al.* 2013). Studies are currently being conducted at the Southeast Fisheries Science Center to evaluate genetic population structure in short-finned pilot whales. Pending these results, the *Globicephala macrorhynchus* population occupying U.S. Atlantic waters is considered separate from both the northern Gulf of Mexico stock and short-finned pilot whales occupying

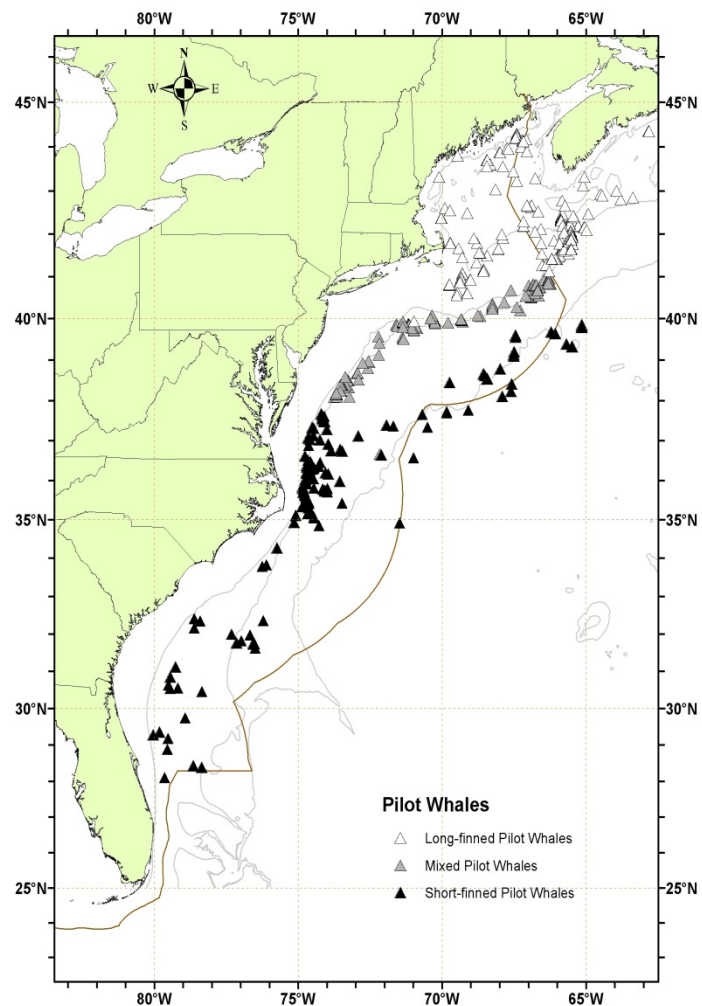


Figure 1. Distribution of long-finned (open symbols), short-finned (black symbols), and possibly mixed (gray symbols; could be either species) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007 and 2011. The inferred distribution of the two species is preliminary and is valid for June-August only. Isobaths are the 100-m, 1,000-m, and 4,000-m depth contours.

Caribbean waters.

POPULATION SIZE

The best available estimate for short-finned pilot whales in the western North Atlantic is 21,515 (CV=0.37; Table 1; Palka 2012; Garrison 2016). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy. 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). The best available abundance estimates are from aerial and shipboard surveys conducted during the summer of 2011 because these are the most recent surveys covering the full range of pilot whales in U.S. Atlantic waters. Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sightings data are reported as *Globicephala* sp. 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 and Rosel 2017).

Earlier Estimates

Please see Appendix IV for a summary of abundance estimates including earlier estimates and survey descriptions. Due to changes in survey methodology, these historical data should not be used to make comparisons with more current estimates. In addition, as recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than 8 years are deemed unreliable for the determination of a current PBR.

Recent surveys and abundance estimates for *Globicephala* sp.

An abundance estimate of 11,865 (CV=0.57) *Globicephala* sp. was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of trackline over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. Pilot whales were not observed during the aerial portion of the survey. The shipboard portion covered 3,811 km of trackline between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. Exclusive Economic Zone (EEZ). Both sighting platforms used a double-platform data collection procedure, which allows estimation of abundance corrected for perception bias of the detected species (Laake and Borchers 2004). Estimation of the abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). The vessel portion of this survey included habitats where both short-finned and long-finned pilot whales occur. A logistic regression (see next section) was used to estimate the abundance of short-finned pilot whales from this survey as 4,569 (CV=0.57).

An abundance estimate of 16,946 (CV=0.43) *Globicephala* sp. was generated from a shipboard survey conducted concurrently (June–August 2011) in waters between central Virginia and central Florida (Garrison 2016). This shipboard survey included shelf-break and inner continental slope waters deeper than the 50-m depth contour within the U.S. EEZ. The survey employed two independent visual teams searching with 25x150 “bigeye” binoculars. A total of 4,445 km of trackline was surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break north of Cape Hatteras, North Carolina, with a lower number of sightings over the continental slope in the southern portion of the survey. Estimation of pilot whale abundance was based on the independent observer approach assuming point independence (Laake and Borchers 2004) and calculated using the mark-recapture distance sampling option in the computer program Distance (version 6.0, release 2, Thomas *et al.* 2009). This survey included habitats that are expected to exclusively contain short-finned pilot whales.

Spatial Distribution and Abundance Estimates for *Globicephala macrorhynchus*

Pilot whale biopsy samples 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. Samples from stranded specimens that were morphologically identified to species were used to assign clades in the phylogeny to species and thereby identify all survey samples. The probability of a sample being from a short-finned (or long-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 short-finned pilot whale was near 0 at water temperatures <22°C, and near 1 at temperatures >25°C. The probability of a short-finned pilot whale also increased with increasing water depth. Spatially, during summer months, this regression

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 occurs primarily along the shelf break off the coast of New Jersey between 38°N and 40°N latitude (Garrison and Rosel 2017). This model was used to partition the abundance estimates from surveys conducted during the summer of 2011. The sightings from the southeast shipboard survey covering waters from Florida to central Virginia were predicted to consist entirely of short-finned pilot whales. The aerial portion of the northeast surveys covered the Gulf of Maine and the Bay of Fundy where the model predicted that only long-finned pilot whales would occur, but no pilot whales were observed. The vessel portion of the northeast survey included waters along the shelf break and waters further offshore extending to the U.S. EEZ. Pilot whales were observed in both areas during the survey. Along the shelf break, the model predicted a mixture of both species, but the sightings in offshore waters near the Gulf Stream were predicted to consist predominantly of short-finned pilot whales (Garrison and Rosel 2017). The best abundance estimate for short-finned pilot whales is thus the sum of the southeast survey estimate (16,946; CV=0.43) and the estimated number of short-finned pilot whales from the northeast vessel survey (4,569; CV=0.57). The best available abundance estimate is thus 21,515 (CV=0.37).

Month/Year	Area	N_{best}	CV
Jun–Aug 2011	central Virginia to Lower Bay of Fundy	4,569	0.57
Jun–Aug 2011	central Florida to central Virginia	16,946	0.43
Jun–Aug 2011	central Florida to lower Bay of Fundy (COMBINED)	21,515	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 western North Atlantic *Globicephala macrorhynchus* is 21,515 animals (CV=0.37). The minimum population estimate is 15,913.

Current Population Trend

A trend analysis has not been conducted for this stock. There are 2 abundance estimates for *Globicephala* spp. from summer 1998 (14,909; CV=0.26) and summer 2004 surveys (31,139; CV=0.27), and 1 abundance estimate of *G. macrorhynchus* from summer 2011 surveys (21,515; CV=0.37). Because the 1998 and 2004 surveys did not derive separate abundance estimates for each pilot whale species, comparisons to the 2011 estimate are inappropriate.

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 short-finned pilot whales is 15,913. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor is 0.5 because the stock’s status relative to optimum sustainable population (OSP) is unknown and the CV of the average mortality estimate is less than 0.3 (Wade and Angliss 1997). PBR for the western North Atlantic short-finned pilot whale is 159.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated mean annual fishery-related mortality and serious injury during 2010–2014 due to the pelagic longline fishery was 192 short-finned pilot whales (CV=0.17; Table 2). The total annual fishery-related mortality and serious injury for this stock during 2010–2014 is unknown because in addition to observed takes in the pelagic

longline fishery, there was a self-reported take in the unobserved hook and line fishery in 2013.

During 2010–2013, all observed interactions and estimated bycatch was assigned to the short-finned pilot whale stock because the observed interactions all occurred at times and locations where available data indicated that long-finned pilot whales were very unlikely to occur. Specifically, the highest bycatch rates of undifferentiated pilot whales were observed during September–November along the mid-Atlantic coast (south of 40°N; Garrison 2007), and biopsy data collected in this area during October–November 2011 indicated that only short-finned pilot whales occurred in this region (Garrison and Rosel 2017). Similarly, all genetic data collected from interactions in the pelagic longline fishery have indicated interactions with short-finned pilot whales. However, during 2014, 4 pilot whale interactions (all serious injuries) occurred along the southern flank of Georges Bank. No samples were collected from these animals. Therefore, the logistic regression model (described above in 'Spatial Distribution and Abundance Estimates for *Globicephala macrorhynchus*') was applied to estimate the probability that these 2014 interactions were from short-finned vs. long-finned pilot whales (Garrison and Rosel 2017). Due to high water temperatures (approximately 25°C) along the southern flank of Georges Bank at the time of the observed takes, these interactions were estimated to have a >80% probability of coming from short-finned pilot whales. The estimated probability was used to apportion the estimated serious injury and mortality from 2014 in the pelagic longline fishery between the short-finned and long-finned pilot whale stocks. The estimated serious injury and mortality for the short-finned pilot whale was 233 (CV=0.24), and that for long-finned pilot whales was 9.6 (CV=0.43; Garrison and Stokes 2016).

In bottom trawl, mid-water trawl, and gillnet fisheries, mortalities were observed north of 40°N latitude and in areas expected to have only long-finned pilot whales. Takes and bycatch estimates for these fisheries are therefore attributed to the long-finned pilot whale stock.

Fishery Information

The commercial fisheries that interact, or that potentially could interact, with this stock in the Atlantic Ocean are the Category I Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline and Atlantic Highly Migratory Species longline fisheries; and the Category III U.S. Atlantic tuna purse seine and Atlantic Ocean, Gulf of Mexico, Caribbean commercial passenger fishing vessel (hook and line) fisheries. All recent gillnet and trawl interactions have been assigned to long-finned pilot whales using model-based predictions. Detailed fishery information is reported in Appendix III.

Earlier Interactions

See Appendix V for information on historical takes.

Longline

The large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ, and pelagic swordfish, tunas and billfish are the target species. The estimated annual average serious injury and mortality attributable to the Atlantic Ocean large pelagics longline fishery for the 5-year period from 2010 to 2014 was 192 short-finned pilot whales (CV=0.17; Table 2). During 2010–2014, 69 serious injuries were observed in the following fishing areas of the North Atlantic: Florida East Coast, Mid-Atlantic Bight, Northeast Coastal, and South Atlantic Bight. During 2010–2014, 1 mortality was observed (in 2011) in the Mid-Atlantic Bight fishing area (Garrison and Stokes 2012a,b; 2013; 2014; 2016).

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 (Garrison 2007). January–March observed bycatch was concentrated on the continental shelf edge northeast of Cape Hatteras, North Carolina. During April–June, bycatch was recorded in this area as well as north of Hydrographer Canyon in water over 1,000 fathoms (1830 m) deep. During the July–September period, observed 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, New Jersey and Cape Hatteras, North Carolina.

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of short-finned pilot whales within high seas waters of the Atlantic Ocean have been observed or reported thus far.

See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical estimates of annual mortality and serious injury.

Table 2. Summary of the incidental mortality and serious injury of short-finned pilot whales (*Globicephala macrorhynchus*) by the pelagic longline 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 annual observed serious injury and mortality recorded by on-board observers, the annual estimated serious injury and mortality, the combined annual estimates of serious injury and mortality (Estimated Combined Mortality), the estimated CV of the combined annual mortality estimates (Est. CVs) and the mean of the combined mortality estimates (CV in parentheses).

Fishery	Years	Vessels ^a	Data Type ^b	Observer Coverage ^c	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	2010 – 2014	80, 83, 82, 79, 78	Obs. Data, Logbook	.08, .09, .07, .09, .10	5, 18, 14, 13, 19	0, 1, 0, 0, 0	127, 286, 170, 124, 233	0, 19, 0, 0, 0	127, 305, 170, 124, 233	.78, .29, .33, .32, .24	192 (.17)

^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 (NEFOP) and the Southeast Pelagic Longline Observer Program.

^c Proportion of sets observed

Hook and Line

During 2010–2014, there was 1 self-reported take (in 2013) in which a short-finned pilot whale was hooked and entangled by a charterboat fisherman. The animal was released alive but considered seriously injured (Maze-Foley and Garrison 2016).

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 2010–2014, 45 short-finned pilot whales (*Globicephala macrorhynchus*) and 6 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Massachusetts and Florida, including the EEZ (Table 3).

Table 3. Short-finned pilot whale (*Globicephala macrorhynchus* [SF] and *Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2010–2014. 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	2010		2011		2012		2013		2014		TOTALS	
	SF	Sp	SF	Sp	SF	Sp	SF	Sp	SF	Sp	SF	Sp
Massachusetts	0	0	3	0	0	0	0	0	0	0	3	0
New Jersey	0	0	1 ^a	1	0	0	0	0	0	0	1	1
Virginia	0	2	0	0	0	0	0	0	0	0	0	2
North Carolina	1 ^b	0	1 ^b	0	1 ^b	0	0	0	3	0	6	0
South Carolina	0	1	0	0	3 ^c	1	1	0	2	0	6	2
Florida	4	0	2	0	23	0	0	0	0	0	29	0

TOTALS	5	3	7	1	27	1	1	0	5	0	45	5
^a Signs of human interaction were observed for this short-finned pilot whale stranding. ^b Signs of fishery interaction were observed for these short-finned pilot whale strandings. ^c Signs of fishery interaction were observed for 2 of these short-finned pilot whale strandings.												

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported as far north as Block Island, Rhode Island (2001), and Cape Cod, Massachusetts (2011), although the majority of the strandings occurred from North Carolina southward (Table 3).

During 2010–2014, several human interactions, including some that were fishery interactions, were documented in stranded pilot whales along the U.S. Atlantic coast. A short-finned pilot whale stranded in North Carolina in 2010 had evidence of longline interaction. In 2011, a short-finned pilot whale in North Carolina was classified as a fishery interaction and a short-finned pilot whale in New Jersey was found with a healed but abscessed bullet wound. In 2012, 3 short-finned pilot whales had evidence of fishery interactions, 2 of them in South Carolina and 1 in North Carolina. During 2013–2014, no evidence of human interactions was documented for stranded pilot whales.

Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury, particularly for offshore species such as pilot whales, because not all of the whales that die or are seriously injured in human interactions wash ashore, or, if they do, they are not all recovered (Peltier *et al.* 2012; Wells *et al.* 2015). Additionally, not all carcasses will show evidence of human interaction, entanglement or other fishery-related interaction due to decomposition, scavenger damage, etc. (Byrd *et al.* 2014). Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interaction.

HABITAT ISSUES

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 in 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 short-finned pilot whale is not listed as threatened or endangered under the Endangered Species Act, but the western North Atlantic stock is considered strategic under the MMPA because the mean annual human-caused mortality and serious injury exceeds PBR. Total U.S. fishery-related mortality and serious injury attributed to short-finned pilot whales exceeds 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 relative to OSP in the U.S. Atlantic EEZ is unknown. There are insufficient data to determine the population trends for this stock.

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