

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

### STOCK DEFINITION AND GEOGRAPHIC RANGE

There are two species of pilot whales in the western 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 two species in U.S. Atlantic waters is complex and requires additional information on seasonal spatial distribution. 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; Bloch *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 separation 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). 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

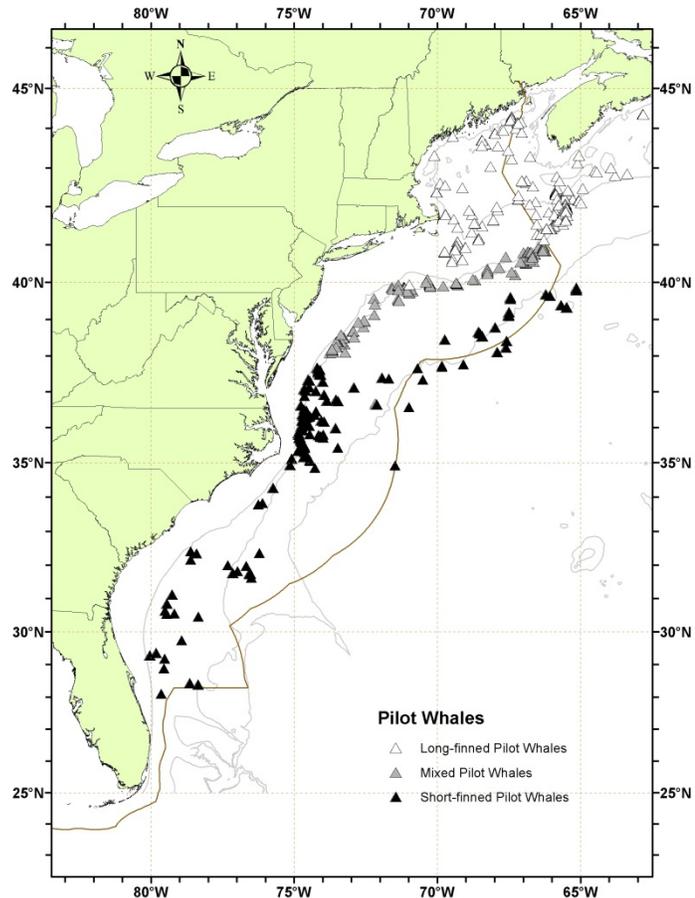


Figure 1. Distribution of long-finned (open symbols), short-finned (black symbols), and possible mixed (gray symbols; could be either species) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007 and 2011. The inferred distribution 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.

pilot whales, while north of ~42°N most pilot whale sightings are expected to be long-finned pilot whales (Figure 1).

## POPULATION SIZE

The best available estimate for long-finned pilot whales in the western North Atlantic is 5,636 (CV=0.63; Table 1; Palka 2012). This estimate is from summer 2011 surveys covering waters from central Virginia to the lower Bay of Fundy. It should be noted, however, that these surveys did not include areas of the Scotian Shelf where the highest densities of pilot whales were observed in the summer of 2006, therefore they represent an underestimate of the overall abundance of this stock. 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. As recommended in the GAMMS II Workshop Report (Wade and Angliss 1997), estimates older than eight years are deemed unreliable for the determination of the current PBR. Due to changes in survey methodology, these historical data should not be used to make comparisons with more current estimates.

### 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 tracklines 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 tracklines 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 long-finned pilot whales from this survey as 5,636 (CV=0.63).

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 25× bigeye binoculars. A total of 4,445 km of tracklines 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 where only short-finned pilot whales are expected to occur.

### 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. 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 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 and surveys 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 recorded a mix of both species along the shelf break, and the sightings in offshore waters near the Gulf Stream were predicted to consist predominantly of short-finned pilot whales (Garrison and Rosel 2017). The abundance estimate for long-finned pilot whales from the northeast summer 2011 vessel survey was 5,636 (CV=0.63; Palka 2012). The summer 2011 aerial survey of the Gulf of Maine to the Bay of Fundy did not include areas of the Scotian Shelf where the highest densities of pilot whales were observed in the summer of 2006, therefore the 2011 summer surveys are an underestimate of the overall abundance of this stock.

Month/Year	Area	$N_{best}$	CV
Jun-Aug 2011	central Virginia to Lower Bay of Fundy	5,636	0.63

#### 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 5,636 animals (CV=0.63). The minimum population estimate for long-finned pilot whales is 3,464.

#### 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. melas* from summer 2011 surveys (5,636; CV=0.63). 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 long-finned pilot whales is 3,464. The maximum productivity rate is 0.04, the default value for cetaceans. The “recovery” factor is 0.5 because this stock is of unknown status relative to optimum sustainable population (OSP) and 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 35.

#### ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Total annual observed average fishery-related mortality or serious injury during 2010–2014 was 38 for long-finned pilot whales (CV=0.15; see Table 2). In bottom trawls and mid-water trawls and in the gillnet fisheries, mortalities were more generally observed north of 40°N latitude and in areas expected to have only long-finned pilot whales. Takes in these fisheries were therefore attributed to the long-finned pilot whales. Takes in the pelagic longline fishery were partitioned according to a logistic regression model (Garrison and Rosel 2017).

#### Fishery Information

The commercial fisheries that could potentially interact with this stock in the Atlantic Ocean are the Category I northeast sink gillnet and the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fisheries; and the

Category II northeast bottom trawl and northeast mid-water trawl (including pair trawl) fisheries. Detailed fishery information is reported in Appendix III.

### **Earlier Interactions**

Historically, fishery interactions have been documented with pilot whales in the Atlantic pelagic drift gillnet fishery, Atlantic tuna pair trawl and tuna purse seine fisheries, northeast and mid-Atlantic gillnet fisheries, northeast and mid-Atlantic bottom trawl fisheries, northeast midwater trawl fishery, and the pelagic longline fishery. See Appendix V for more information on historical takes.

### **Northeast Sink Gillnet**

One pilot whale was caught in this fishery in 2010. According to modeled species distribution, this whale was a long-finned pilot whale. See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

### **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 (Garrison 2007). During 2010–2013, all observed interactions and estimated bycatch in the pelagic longline fishery 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 melas*') 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). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

### **Northeast Bottom Trawl**

In addition to takes observed by fisheries observers, the Marine Mammal Authorization Program (MMAP) (<http://www.nmfs.noaa.gov/pr/interactions/mmap/>) included 2 self-reported incidental takes (mortalities) in trawl gear off Maine and Rhode Island during 2011. Self-reported takes were not used in the estimation process and are not reported in Table 2. Fishery-related bycatch rates for years 2010–2014 were estimated using an annual stratified ratio-estimator (Lyssikatos 2015). These mortality estimates replace the 2008–2011 annual estimates reported in the 2013 stock assessment report that were generated using a different method described in Rossman (2010). See Table 2 for bycatch estimates and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

### **Northeast Mid-Water Trawl (Including Pair Trawl)**

In September 2011, one pilot whale was taken in the northeast mid-water trawl fishery on the northern flank of Georges Bank. Another pilot whale was taken in a mid-water trawl in 2012. Three were taken in 2013 near the western edge of Georges Bank. Four were taken in 2014. Using model-based predictions and at-sea identification, these takes have all been assigned as long-finned pilot whales. 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 (NMFS unpublished data). Estimated annual fishery-related mortalities were 0 in 2010 (Table 2). Expanded estimates of fishery mortality for 2011–2014 are not available, and so for those years the raw number is provided. See Table 2 for bycatch estimates

and observed mortality and serious injury for the current 5-year period, and Appendix V for historical bycatch information.

## CANADA

Unknown numbers of long-finned pilot whales have been taken in Newfoundland, Labrador, and Bay of Fundy groundfish gillnets; Atlantic Canada and Greenland salmon gillnets; and Atlantic Canada cod traps (Read 1994).

Table 2. Summary of the incidental mortality and serious injury of long-finned pilot whales (*Globicephala melas melas*) 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 (Est. CVs) and the mean of the combined estimates (CV in parentheses). These are minimum observed counts as expanded estimates are not available.

Fishery	Years	Data Type <sup>a</sup>	Observer Coverage <sup>b</sup>	Observed Serious Injury <sup>d</sup>	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Northeast Sink Gillnet	10-14	Obs. Data, Logbook, Dealer Data	.17, .19, .15, .11, .18	0, 0, 0, 0, 0	1, 0, 0, 0, 0	0, 0, 0, 0, 0	3, 0, 0, 0, 0	3, 0, 0, 0, 0	82, 0, 0, 0, 0	0.6 (0.82)
Northeast Bottom Trawl <sup>b</sup>	10-14	Obs. Data, Logbook	.16, .26, .17, .15	1,3,3,0, 1	9,9,7,4, 4	6, 12, 10, 0, 6	24, 43, 23, 16, 25	30, 55, 33, 16, 32	.43, .18, .32, .42, .44	33.2 (0.15)
Northeast Mid-Water Trawl - Including Pair Trawl <sup>c</sup>	10-14	Obs. Data, Dealer Data, VTR Data	.41, .17, .45, .37, .42	0, 0, 0, 0, 0	0,1, 1, 3, 4	0, 0, 0, 0, 0	.0, 1, 1, 3, 4	0, 1, 1, 3, 4	na, na, na, na, na	1.8 (na)
Pelagic Longline Fishery	10-14	Obs. Data, Logbook Data	.08, .09, .07, .09, .10	0,0,0,0,1	0,0,0,0,0	0,0,0,0,9.6	0,0,0,0,0	0,0,0,0,0,9.6	na, na, na, na, .43	1.9 (0.43)
TOTAL										38 (0.15)

<sup>a</sup> Observer data (Obs. Data) are used to measure bycatch rates and the data are collected within the Northeast Fisheries Observer Program (NEFOP). NEFSC collects landings data (unallocated Dealer Data and Allocated Dealer Data) which are used as a measure of total landings and mandatory Vessel Trip Reports (VTR) (Trip Logbook) are used to determine the spatial distribution of landings and fishing effort. Total landings are used as a measure of total effort for the coastal gillnet fishery.

<sup>b</sup> The observer coverages for the northeast sink gillnet fishery are ratios based on tons of fish landed. Northeast bottom trawl and northeast mid-water trawl fishery coverages are ratios based on trips. Total observer coverage reported for gillnet and bottom trawl gear in the years starting in 2010 include samples collected from traditional fisheries observers in addition to fishery at-sea monitors through the Northeast Fisheries Observer Program (NEFOP). For 2010 only the NEFOP observed data were reported in this table, since the at-sea monitoring program just started in May 2010. Both at-sea monitor and traditional fisheries observer data were used for 2011 and onwards

<sup>c</sup> Expanded estimates for 2010–2014 are not available for this fishery.

<sup>d</sup> Waring et al. 2014,2015, Wenzel *et al.* 2015, 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. From 2010 to 2014, 27 long-finned pilot whales (*Globicephala melas melas*), and 5 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including the EEZ (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 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 at the time was only moderate. A genetic sample from this animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification.

During 2010–2014, several human and/or fishery interactions were documented in stranded pilot whales within the U.S. EEZ. Two long-finned pilot whale stranding mortalities in 2011 in Massachusetts were classified as human interaction cases, one due to onlookers trying to refloat the animal, and another with tow rope around the tail most likely tied on postmortem.

Table 3. Pilot whale <i>Globicephala melas melas</i> [LF] and <i>Globicephala</i> sp. [Sp]) strandings along the Atlantic coast, 2010-2014. Strandings which were not reported to species have been reported as <i>Globicephala</i> 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	
	LF	Sp	LF	Sp								
Nova Scotia <sup>a</sup>	0	11	0	19	0	3	15	0	0	0	15	33
Newfoundland and Labrador <sup>b</sup>	0	1	0	8	0	6	1	1	0	1	1	17
Maine	0	0	1	0	1	0	0	0	2	0	4	0
Massachusetts <sup>c</sup>	2	0	4		3		3		1		13	0
Rhode Island	0	0	2	0	0	0	0	0	0	0	2	0
New York	0	0	1	0	1	0	2	0	1	0	5	0
New Jersey	0	0	0	1	0	0	1	0	0	0	1	1
Maryland	0	0	0	0	0	0	1	0	0	0	1	0
Virginia	0	2	0	0	1	0	0	0	0	0	1	2
South Carolina	0	1	0	0	0	1	0	0	0	0	0	2
TOTALS - U.S. & EEZ	2	3	8	1	6	1	7	0	4	0	27	5

<sup>a</sup> Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.). Strandings in 2011 include one mass stranding of 6-8 whales (one of which died) and 2 animals with ropes tied around their tail stocks. Strandings in 2013 include one fishery entanglement (bait net) and one mass stranding of 4 animals.

<sup>b</sup> (Ledwell and Huntington 2010, 2011, 2012, 2013, 2014). 2011 included 2 mom/calf pairs. Not included in 2011 total was group of 6 pilot whales shepherded out of a narrow channel.

<sup>c</sup> One of the 2010 animals released alive.

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 long-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 for long-finned pilot whales 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 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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