

## 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; 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the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; NMFS unpublished data). 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. 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 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). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy.

Because long-finned and short-finned pilot whales are difficult to distinguish at sea, sightings data are reported as

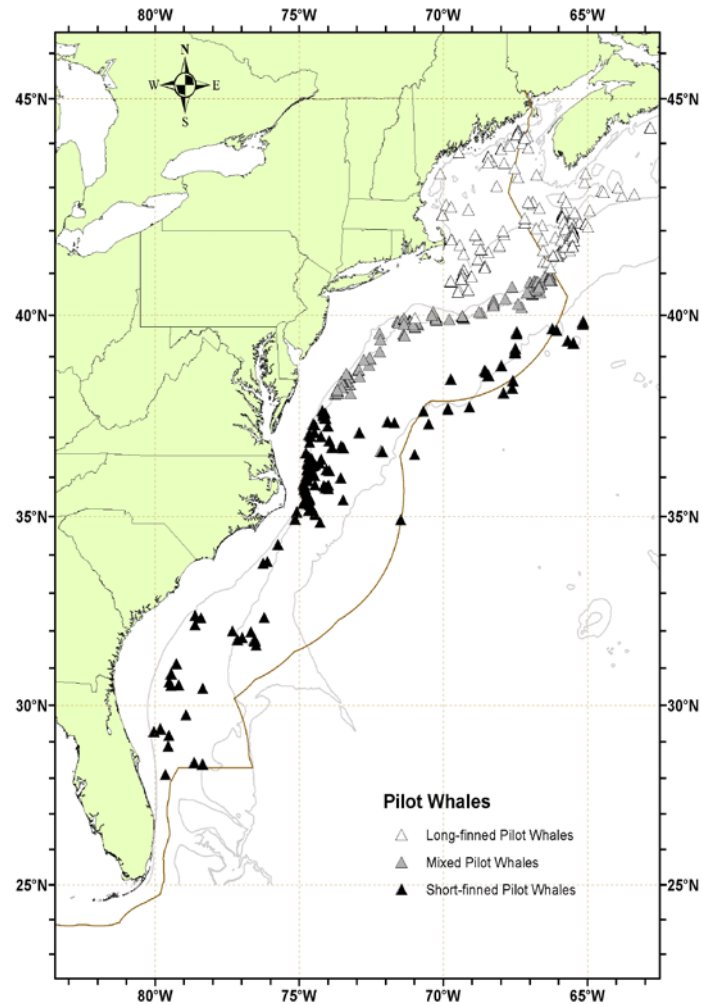


Figure 1. Distribution of long-finned (open symbols), short-finned (black symbols), and possibly mixed (gray symbols; could be either species) pilot whale sightings during the summers of 1998, 1999, 2002, 2004, 2006, 2007 and 2011. The inferred distribution of the two species is preliminary and is valid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

*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 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. 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 (NMFS unpublished data).

#### **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.

#### **Recent surveys and abundance estimates for *Globicephala* sp.**

An abundance estimate of 26,535 (CV=0.35) *Globicephala* sp. was obtained from an aerial survey conducted in August 2006 that covered 10,676 km of trackline in the region from the 2,000-m depth contour on the southern edge of Georges Bank north to the upper Bay of Fundy and to the entrance of the Gulf of St. Lawrence (Table 1; NMFS unpublished data). This survey covered habitats that are expected to exclusively contain long-finned pilot whales.

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). This survey covered habitats that are expected to exclusively contain long-finned pilot whales.

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. 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. 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. The estimated abundance of short-finned pilot whales from this survey was 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. 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 25x 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 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). 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. 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 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. 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).

Table 1. Summary of abundance estimates for the western North Atlantic short-finned pilot whale 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 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. The statistical power to detect a trend in abundance for this stock is poor due to the relatively imprecise abundance estimates and long survey interval. For example, the power to detect a precipitous decline in abundance (i.e., 50% decrease in 15 years) with estimates of low precision (e.g., CV > 0.30) remains below 80% ( $\alpha = 0.30$ ) unless surveys are conducted on an annual basis (Taylor *et al.* 2007).

#### 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, 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 short-finned pilot whale is 159.

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

Total annual estimated average fishery-related mortality or serious injury during 2007-2011 was 162 pilot

whales (CV=0.18; Table 2). Of these, 119 (CV=0.24) were from the pelagic longline fishery and thus are assigned to short-finned pilot whales exclusively. The total annual human caused mortality of short-finned pilot whales cannot be determined. The highest bycatch rates of undifferentiated pilot whales in the pelagic longline fishery were observed during September–November along the mid-Atlantic coast (Garrison 2007). Biopsy samples and photo-identification data collected during October–November 2011 in this region indicated that all of the animals observed within the region of pelagic longline bycatch during these months were short-finned pilot whales (NMFS unpublished data). During the remainder of the year, pilot whale bycatch in the pelagic longline fishery was likewise restricted to waters where short-finned pilot whales are expected to occur almost exclusively. Therefore, it is likely that the bycatch of pilot whales in the pelagic longline fishery is restricted to short-finned pilot whales. In bottom trawls and mid-water trawls, mortalities are more generally observed north of 40°N latitude and in areas expected to have a higher proportion of long-finned pilot whales. However, analyses to partition mortality estimates from these fisheries between the two species have not been conducted. Mortality and serious injury estimates for bottom and mid-water trawl fisheries are thus presented only for the 2 species combined.

### **New Serious Injury Guidelines**

NMFS updated its serious injury designation and reporting process, which uses guidance from previous serious injury workshops, expert opinion, and analysis of historic injury cases to develop new criteria for distinguishing serious from non-serious injury (Angliss and DeMaster 1998; Andersen *et al.* 2008; NOAA 2012). NMFS defines serious injury as an “*injury that is more likely than not to result in mortality*”. Injury determinations for stock assessments revised in 2013 or later incorporate the new serious injury guidelines, based on the most recent 5-year period for which data are available.

### **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%) were 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. 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 pursuing 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 from 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 in 1998 (CV=1.10).

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 was 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, and 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). These estimates should, however, be viewed with caution due to the extremely low (<1%) observer coverage. After 1999 this fishery was 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 from 1996-1998, and 228 (CV=1.03) in 1999. After 1999 this fishery was 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 the earlier fishery interactions see Waring *et al.* (2007).

#### **Northeast Sink Gillnet**

One pilot whale (unidentified to species) was caught in this fishery in 2010. The expanded bycatch estimate was 3 (CV=0.82) in 2010, resulting in a 2007-2011 annual average serious injury and mortality of 1 (CV=0.82).

#### **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 (Garrison 2007). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2011, 185 pilot whales were observed released alive, including 109 that were considered seriously injured, and 6 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; Garrison and Stokes 2012a; Garrison and Stokes 2012b). 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 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, 0 in 2007-2010, and 19 (CV=1.00) in 2011. 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), 74 in 2004 (CV=0.42), 212 in 2005 (CV=0.21), 169 in 2006 (CV=0.31), 57 (CV=0.47) in 2007, 98 (CV=0.42) in 2008, 17 (CV=0.70) in 2009, 127 (CV=0.78) in 2010, and 280 (CV=0.29) in 2011. The average annual total mortality and serious injury in 2007-2011 was 119 pilot whales (CV=0.24) (Table 2). Available seasonal biopsy data and genetic analyses indicate that pilot whale bycatch in the pelagic longline fishery is restricted to short-finned pilot whales.

#### **Mid-Atlantic Bottom Trawl**

Seven pilot whales were observed taken in the mid-Atlantic bottom trawl fishery during 2000-2006. No pilot whales were observed taken during 2007-2011. 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, 37 (CV=0.38) in 2007, 24 (CV=0.36) in 2008, 23 (CV=0.35) in 2009, and 22 (CV=0.35) in 2010. Expanded estimates of fishery mortality for

2011 are not available, and mortalities have not been assigned to species. The 2007-2010 average mortality attributed to the mid-Atlantic bottom trawl was 29 animals (CV=0.19; Table 2).

### **Northeast Bottom Trawl**

Seven pilot whales were observed taken in the Northeast bottom trawl fishery during 2004-2006. New serious injury criteria were applied to all observed interactions retroactive back to 2007 (Waring *et al.* 2014). Observed serious injuries and mortalities of pilot whales included 4 in 2007, 5 in 2008, 3 in 2009, 10 in 2010, and 12 in 2011. In addition to takes observed by fisheries observers, the Marine Mammal Authorization Program (MMAP) included 2 self-reported incidental takes (mortalities) of pilot whales in bottom trawl gear off Maine and Massachusetts during 2008, and 2 self-reported incidental takes (mortalities) in rule trawl and otter trawl gear off Maine and Rhode Island during 2011. These reports do not contribute to the estimate of mortality from the observer program. 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, 9 (CV=0.35) in 2009, and 9 (CV=0.35) in 2010. Expanded estimates of fishery mortality for 2011 are not available, and mortalities have not been assigned to species. The 2007–2010 average mortality attributed to the northeast bottom trawl was 10 animals (CV=0.18; 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. In September 2011, one pilot whale was taken in the mid-water trawl fishery on the northern flank of Georges Bank. 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 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: 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 to 2010 (Table 2; NMFS unpublished data). Expanded estimates of fishery mortality for 2011 are not available, and mortalities have not been assigned to species. The average annual estimated mortality during 2007-2010 was 4 (CV=0.61; Table 2).

### **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 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 unknown in 2002, 0 in 2003 to 2006, 12.1 (CV=0.99) in 2007, and 0 in 2008-2011 (Table 2). The average annual estimated mortality during 2007-2011 was 2.4 (CV=0.99; Table 2). Mortalities have not been assigned to species.

## **CANADA**

Unknown numbers of long-finned 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 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 (Hooker *et al.* 1997). During the 1991-1996 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 1 record of incidental catch in the offshore Greenland halibut fishery that involved 1 long-finned pilot whale in 2001 although no expanded bycatch estimate was calculated (Benjamins *et al.* 2007).

Table 2. Summary of the incidental mortality and serious injury of pilot whales ( <i>Globicephala</i> 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	Data Type <sup>a</sup>	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Northeast Sink Gillnet	07-11	Obs. Data, Logbook, Dealer Data	.07, .05, .04, .17, .19	0, 0, 0, 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	1 (.82)
Northeast Bottom Trawl <sup>b</sup>	07-11	Obs. Data Logbook	.06, .08, .09, .16, .26	1,0,2,0,3	3,5,1,6,9	na	na	12,10,9,9, na	.35,.34,.34, .35, na	10 (.18)
Mid-Atlantic Bottom Trawl <sup>b</sup>	07-11	Obs. Data Logbook	.03, .03, .05, .06, .08	0,0,0,0,0	0,0,0,0,0	0,0,0,0,0	36,24,23, 22, na	36,24,23,22, na	.38,.36,.36, .35,na	29 (.19)
Northeast Mid-Water Trawl - Including Pair Trawl <sup>c</sup>	07-11	Obs. Data Dealer Data VTR Data	.08, .20, .42, .41, .17	0,0,0,0,0	0,6,0,0,1	0,0,0,0,0	0,16,0,0, na	0,16,0,0, na	0,.61,0,0, na	4 (.61)
Mid-Atlantic Mid-Water Trawl - Including Pair Trawl <sup>c</sup>	07-11	Obs. Data Dealer Data VTR Data	.04, .13, .13, .25, .41	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	0.99,0,0,0, 0	2.4 (0.99)
Pelagic Longline <sup>c</sup>	07-11	Obs. Data Logbook	.07, .07, .10, .08, .09	5,2,5,5,18	0,0,0,0,1	57, 98, 17, 127, 280	0,0,0,0, 19	57,98,17, 127, 299	.65,.42,.70, .78,.29	119 (.24)
TOTAL										162 (.18)

<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) and the Southeast Pelagic Longline Observer Program. The NEFOP collects landings data (Weighout), and total landings are used as a measure of total effort for the coastal gillnet fishery. Total observer coverage reported for gillnet and bottom trawl gear in the year 2010 includes samples collected from traditional fisheries observers in addition to fishery at-sea monitors. For 2010 only the NEFOP observed data were reported in this table, since the at-sea monitoring program just started in May 2010.

<sup>b</sup> Estimates have not been generated for bottom trawl fisheries for 2011. Average annual mortality represents the four year average (2007-2010) for these fisheries. MA and NE bottom trawl fishery mortality estimates presented for 2007-2010 are a product of bycatch rates estimated from a GLM using observer data from 2000 to 2005 and reported effort from 2007-2010. Documentation of methods used to estimate cetacean bycatch mortality is available in Rossman (2010).

<sup>c</sup> 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. Expanded estimates for 2011 are not available for these fisheries.

### 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 2007-2011, 21 short-finned pilot whales (*Globicephala macrorhynchus*), 41 long-finned pilot whales (*Globicephala melas melas*), and 6 pilot whales not specified to the species level (*Globicephala* sp.) were reported stranded between Maine and Florida, including the Exclusive Economic Zone (EEZ) (Table 3).

Table 3. Pilot whale (*Globicephala macrorhynchus* [SF], *Globicephala melas melas* [LF] and *Globicephala* sp. [Sp]) strandings along the Atlantic coast, 2007-2011. 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	2007			2008			2009			2010			2011			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia <sup>a</sup>	0	0	2	0	0	0	0	0	15	0	0	11	0	0	19	0	0	47
Newfoundland and Labrador <sup>b</sup>	0	0	1	0	0	2	0	0	1	0	0	1	0	0	8	0	0	13
Maine <sup>c</sup>	0	1	0	0	1	0	0	3	0	0	0	0	0	1	0	0	6	0
Massachusetts <sup>d</sup>	0	6	0	0	1	0	0	4	0	0	2	0	3	4	0	3	17	0
Rhode Island	0	0	0	0	2	0	0	2	0	0	0	0	0	2	0	0	6	0
New York <sup>e</sup>	0	2	0	0	5	0	0	1	0	0	0	0	0	1	0	0	9	0
New Jersey	0	1	0	0	1	0	1	1	0	0	0	0	1	0	1	2	3	1
Delaware	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Virginia	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
North Carolina <sup>f</sup>	0	0	0	3	0	1	2	0	0	1	0	0	1	0	0	7	0	1
South Carolina	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	2
Florida <sup>g</sup>	0	0	0	0	0	0	0	0	0	4	0	0	2	0	0	6	0	0
TOTALS - U.S. & EEZ	0	10	0	3	10	2	4	11	0	5	2	3	7	8	1	19	41	6

<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.

<sup>b</sup> (Ledwell and Huntington 2006; 2007; 2008; 2009; 2010; 2012; Ledwell *et al.* 2011). 2011 included 2 mom/calf pairs. Not included in 2011 total was group of 6 pilot whales shepherded out a narrow channel.

<sup>c</sup> Long-finned pilot whale stranded in Maine in 2007 released alive.



- <sup>d</sup> One of the strandings in 2007 classified as human interaction due to attempts to herd the animal to deeper water. One of the 2008 animals classified as a fishery interaction due to line markings and cut flukes. One of the 2009 animals was classified as a fishery interaction. One of the 2010 animals released alive. One of the strandings in 2011 was classified as a human interaction due to attempts by public to push the animal back into the water.
- <sup>e</sup> Two of the 2008 strandings were classified as human interactions.
- <sup>f</sup> Signs of fishery interaction observed on a short-finned pilot whale stranded in Feb 2010.
- <sup>g</sup> One of the 2010 animals released alive.

Short-finned pilot whales strandings (*Globicephala macrorhynchus*) have been reported as far north as Nova Scotia (1990), Block Island, Rhode Island (2001), and Cape Cod, Massachusetts (2011), 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. This animal has subsequently been sequenced and mitochondrial DNA analysis supports the long-finned pilot whale identification. Recent long-finned pilot whale strandings were from New Jersey northward (Table 3).

During 2007-2011, several human and/or fishery interactions were documented in stranded pilot whales. In 2008, 1 Massachusetts stranding mortality was deemed a fishery interaction due to line markings and cut flukes. Also in 2008, 2 of the 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 fishery interaction because it had a piece of monofilament line in its stomach. 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 short-finned pilot whale is not listed as threatened or endangered under the Endangered Species Act, and the western North Atlantic stock is not considered strategic under the Marine Mammal Protection Act. The total U.S. fishery-related mortality and serious injury for short-finned pilot whales is unknown, since it is not possible to fully partition mortality estimates between the long-finned and short-finned pilot whales, and mortality estimates for the bottom and mid-water trawl fisheries are not available for 2011. The total mortality and serious injury attributed to short-finned pilot whales in the pelagic longline fishery exceeds 10% of the calculated PBR and therefore cannot be considered to be insignificant and approaching zero mortality and serious injury rate. It is unknown if total fishery mortality exceeds PBR. While this is not currently a strategic stock, the inability to partition mortality estimates in the midwater and bottom trawl fisheries between the species limits the ability to adequately assess the status of this stock, and there is a risk that fishery mortality approaches PBR if a significant portion of the mortality in the trawl fisheries impacts short-finned pilot whales. 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.

## REFERENCES CITED

- Andersen, M.S., K.A. Forney, T.V.N. Cole, T. Eagle, R. Angliss, K. Long, L. Barre, L. Van Atta, D. Borggaard, T. Rowles, B. Norberg, J. Whaley and L. Engleby. 2008. Differentiating serious and non-serious injury of marine mammals: report of the serious injury technical workshop, 10-13 September 2007, Seattle, WA. NOAA Tech. Memo. NMFS-OPR-39. 94 pp.

- 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, MD. NOAA Tech. Memo. NMFS-OPR-13. 48 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 Tech. Memo. NMFS-OPR-6. 73 pp.
- Benjamins, S., J. Lawson and G. Stenson. 2007. Recent harbor porpoise bycatch in Newfoundland, Canada's gillnet fisheries. *J. Cetacean Res. Manage.* 9(3): 189-200.
- 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. Poll. Bull.* 40: 1090-1099.
- Fairfield, C.P. and L.P. Garrison. 2008. Estimated bycatch of marine mammals and sea turtles in the US Atlantic pelagic longline fleet during 2007. NOAA Tech. Memo. NMFS-SEFSC-572. 62 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. NMFS-SEFSC-539. 52 pp.
- Fairfield Walsh, C. and L.P. Garrison. 2007. Estimated bycatch of marine mammals and turtles in the U.S. Atlantic pelagic longline fleet during 2006. NOAA Tech. Memo. NMFS-SEFSC-560. 54 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. 2007. Interactions between marine mammals and longline fishing gear in the U.S. Atlantic Ocean between 1992 and 2004. *Fish. Bull.* 105: 408-417.
- 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.
- Garrison, L.P. and L. Stokes. 2010. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2009. NOAA Tech. Memo. NMFS-SEFSC-603. 63 pp.
- Garrison, L.P. and L. Stokes. 2012a. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2010. NOAA Tech. Memo. NMFS-SEFSC-624. 59 pp.
- Garrison, L.P. and L. Stokes. 2012b. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2011. NOAA Tech. Memo. NMFS-SEFSC-632. 61 pp.
- Garrison, L.P., L. Stokes and C. Fairfield. 2009. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Tech. Memo. NMFS-SEFSC-591. 63 pp.
- 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, (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. .
- 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.
- 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.
- Laake, J.L. and D.L. Borchers. 2004. Methods for incomplete detection at distance zero, In: Advanced distance sampling, edited by S. T. Buckland, D. R. Andersen, K. P. Burnham, J. L. Laake, and L. Thomas, pp. 108–189, Oxford University Press, New York.
- Lawson, J.W. and J.-F. Gosselin. 2009. Distribution and preliminary abundance estimates for cetaceans seen during Canada's Marine Megafauna Survey - A component of the 2007 TNASS. *Can. Sci. Advisory Sec. Res. Doc.* 208/031. 33 pp.
- 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.
- Ledwell, W. and J. Huntington. 2007. Whale and leatherback sea turtle entrapment in fishing gear in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2006. Report to the Department of Fisheries and Oceans. St. John's, Newfoundland, Canada. 3 pp.
- Ledwell, W. and J. Huntington. 2008. Incidental entrapments in fishing gear reported in 2007 in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program. A report to the Department of Fisheries and Oceans, Canada-Newfoundland and Labrador region. St. John's, Newfoundland, Canada. 20

- pp.
- Ledwell, W. and J. Huntington. 2009. Incidental entrapments in fishing gear and strandings reported to the whale release and strandings group in Newfoundland and Labrador and a summary of the Whale Release and Strandings Program during 2008. A report to the Department of Fisheries and Oceans Canada, Newfoundland and Labrador region. St. John's, Newfoundland, Canada. 29 pp.
- Ledwell, W. and J. Huntington. 2010. Whale, leatherback sea turtles, and basking sharks entrapped in fishing gear in Newfoundland and Labrador and a summary of the strandings, sightings and education work during 2009-2010. A preliminary report to Fisheries and Oceans Canada, Newfoundland and Labrador region, St. John's, Newfoundland, Canada. 23 pp.
- Ledwell, W., J. Huntington and N. Kelly. 2011. Incidental entanglements of cetaceans and leatherback sea turtles in fishing gear reported during 2010-2011 and a summary of the Whale Release and Strandings Group activities. Report to the Department of Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 28 pp.
- Ledwell, W. and J. Huntington. 2012. Incidental entanglements of cetaceans and leatherback sea turtles in fishing gear reported during 2011-2012 and a summary of the Whale Release and Strandings Group activities. Report to the Department of Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 17 pp.
- Lens, S. 1997. Interactions between marine mammals and deep water trawlers in the NAFO regulatory area. ICES [Int. Counc. Explor. Sea] C.M. 1997/Q:08: 10.
- Muir, D.C.G., R. Wagemann, 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(5): 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. 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, (eds.) Cetaceans, sea turtles and seabirds in the northern Gulf of Mexico: Distribution, abundance and habitat associations. Volume II: Technical report. Minerals Management Service, Gulf of Mexico OCS Region, New Orleans. OCS Study MMS 96-0027.
- Nielsen, J.B., F. Nielsen, P.-J. Jorgensen and P. Grandjean. 2000. Toxic metals and selenium in blood from pilot whales (*Globicephala melas*) and sperm whales (*Physeter catodon*). Mar. Poll. Bull. 40: 348-35.
- NMFS. 1993. Status of fishery resources off the northeastern United States for 1993. National Marine Fisheries Service. NOAA Tech. Memo. NMFS-F/NEC-101. 140 pp.
- NOAA. 2012. Federal Register 77:3233. National policy for distinguishing serious from non-serious injuries of marine mammals. Available from: <http://www.nmfs.noaa.gov/op/pds/documents/02/238/02-238-01.pdf>
- 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. Comm. (Special Issue) 14: 51-68.
- Read, A.J. 1994. Interactions between cetaceans and gillnet and trap fisheries in the northwest Atlantic. Rep. Int. Whal. Comm. (Special Issue) 15: 133-147.
- Rossmann, M.C. 2010. Estimated bycatch of small cetaceans in northeast US bottom trawl fishing gear during 2000-2005. J. Northw. Atl. Fish. Sci. 42: 77-101.
- Taruski, A.G., C.E. Olney and H.E. Winn. 1975. Chlorinated hydrocarbons in cetaceans. J. Fish. Res. Board Can 32(11): 2205-2209.
- Taylor, B.L., M. Martinez, T. Gerrodette, J. Barlow and Y.N. Hrovat. 2007. Lessons from monitoring trends in abundance in marine mammals. Mar. Mamm. Sci. 23(1): 157-175.
- Thomas, L., J.L. Laake, E. Rexstad, S. Strindberg, F.F.C. Marques, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, M.L. Burt, S.L. Hedley, J.H. Pollard, J.R.B. Bishop and T.A. Marques. 2009. Distance 6.0. Release 2. [Internet]. University of St. Andrews (UK): Research Unit for Wildlife Population Assessment. Available from: <http://www.ruwpa.st-and.ac.uk/distance/>
- Wade, P.R. and R.P. Angliss. 1997. Guidelines for assessing marine mammal stocks: Report of the GAMMS Workshop April 3-5, 1996, Seattle, Washington. NOAA Tech. Memo. NMFS-OPR-12. 93 pp.
- Waring, G.T. 1995. Fishery and ecological interactions for selected cetaceans off the Northeast USA. Ph.D. thesis, University of Massachusetts, Amherst, MA. 260 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. 88(2): 347-360.
- Waring, G.T., E. Josephson, C.P. Fairfield and K. Maze-Foley, eds. 2007. U.S. Atlantic and Gulf of Mexico marine

- mammal stock assessments – 2006. NOAA Tech. Memo. NMFS-NE-201.
- Waring, G.T., M.C. Rossman and F.W. Wenzel 2014. Serious injury determinations for small cetaceans and seals caught in commercial fisheries off the northeast U.S. coast, 2007–2011, Northeast Fish. Sci. Cent. Ref. Doc.
- 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. NOAA Tech. Memo. NMFS-SEFSC-467. 43 pp.