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the mid-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; NMFS unpublished data).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. 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 Caribbean waters.

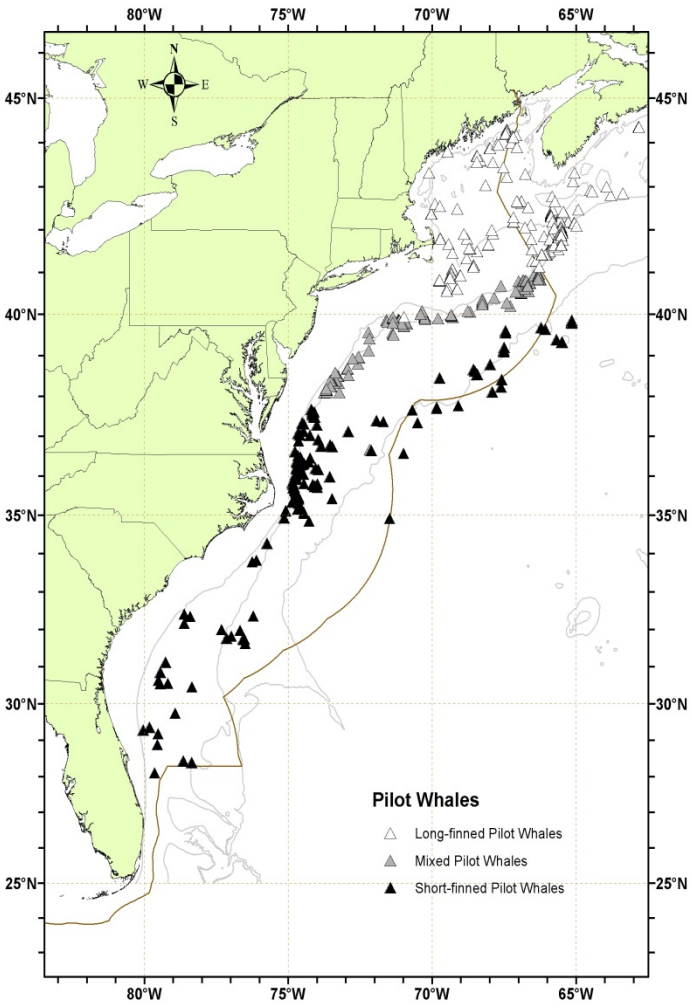

Figure 1. *Distribution of long-finned (open symbols), short-finned (black symbols), and possibly mixed (gray symbols; could be either species) pilot whale sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers of 1998, 1999, 2002, 2004, 2006, 2007 and 2011. The inferred distribution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

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 *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 macrorhnychus* 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 2008-2012 was 140 short-finned pilot whales (CV=0.21; Table 2). All bycatch from the pelagic longline fishery in the Atlantic was assigned to the short-finned pilot whale stock. 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 and in the gillnet fisheries, mortalities are more generally observed north of 40°N latitude and in areas expected to have a higher proportion of long-finned pilot whales. Takes and bycatch estimates for these fisheries are attributed to the long-finned pilot whale stock.

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

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

Pelagic Longline

Most of the estimated marine mammal bycatch in the U.S. pelagic longline fishery was recorded in U.S. Atlantic EEZ waters between South Carolina and Cape Cod (Garrison 2007). Pilot whales are frequently observed to feed on hooked fish, particularly big-eye tuna (NMFS unpublished data). Between 1992 and 2012, 204 pilot whales were observed released alive, including 123 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, Garrison and Stokes 2013). 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 short-finned pilot whales in the U.S. Atlantic (excluding the Gulf of Mexico) attributable to this fishery was 0 in 2008-2010, 19 (CV=1.00) in 2011, and 0 in 2012. The estimated serious injuries were 98 (CV=0.42) in 2008, 17 (CV=0.70) in 2009, 127 (CV=0.78) in 2010, 286 (CV=0.29) in 2011, and 170 (CV=0.33) in 2012. The average annual total mortality and serious injury in 2008-2012 was 140 pilot whales (CV=0.21) (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.

Table 2. Summary of the incidental mortality and serious injury of short-finned pilot whales (*Globicephala macrorhynchus*) 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[a]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	08-12	Obs. Data Logbook	.07, .10, .08, .09, .07	2,5,5, 18, 14	0,0,0,1, 0	80, 17, 127, 286, 170	0,0,0, 19, 0	80,17, 127, 305, 170	.50,.70,.78, .29, .33	140 (.21)
TOTAL										140 (.21)

[a] 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.

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 2008-2012, 46 short-finned pilot whales (*Globicephala macrorhynchus*), 37 long-finned pilot whales (*Globicephala melas melas*), and 7 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, 2008-2012. 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	2008			2009			2010			2011			2012			TOTALS		
	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp	SF	LF	Sp
Nova Scotia[a]	0	0	0	0	0	15	0	0	11	0	0	19	0	0	3	0	0	48
Newfoundland and Labrador[b]	0	0	2	0	0	1	0	0	1	0	0	8	0	0	6	0	0	18
Maine	0	1	0	0	3	0	0	0	0	0	1	0	0	1	0	0	6	0
Massachusetts[c]	0	1	0	0	4	0	0	2	0	3	4	0	0	3	0	3	14	0
Rhode Island	0	2	0	0	2	0	0	0	0	0	2	0	0	0	0	0	6	0
New York	0	5	0	0	1	0	0	0	0	0	1	0	0	1	0	0	8	0
New Jersey	0	1	0	1	1	0	0	0	0	1	0	1	0	0	0	2	2	1
Delaware	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Virginia[d]	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	1	2
North Carolina[d]	3	0	1	2	0	0	1	0	0	1	0	0	1	0	0	8	0	1
South Carolina[d]	0	0	1	0	0	0	0	0	1	0	0	0	3	0	1	3	0	3
Florida[e]	0	0	0	0	0	0	4	0	0	2	0	0	23	0	0	29	0	0

TOTALS - U.S. & EEZ	3	10	2	4	11	0	5	2	3	7	8	1	27	6	1	46	37	7

[a] Data supplied by Nova Scotia Marine Animal Response Society (pers. comm.). Strandings in 2011 include one mass stranding on 6-8 whales (one of which died) and 2 animals with ropes tied around their tail stocks.
[b] (Ledwell and Huntington 2009, 2010, 2011, 2012, 2013). 2011 included 2 mom/calf pairs. Not included in 2011 total was group of 6 pilot whales shepherded out of a narrow channel.

[c] One of the 2009 animals was classified as a fishery interaction. One of the 2010 animals released alive.
[d] Signs of fishery interaction observed on a short-finned pilot whale stranded in North Carolina Feb 2010. Signs of fishery interaction observed on one short-finned pilot whale in North Carolina and two in South Carolina in 2012.

[e] One of the 2010 animals released alive.

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

During 2008-2012, several human and/or fishery interactions were documented in stranded pilot whales. 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 interaction, two of them in South Carolina and one in North Carolina.

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 2008–2012 average annual human-related mortality and serious injury does not exceed PBR. The total 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.

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. and L. Stokes. 2013. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2012. NOAA Tech. Memo. NMFS-SEFSC-655. 62 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. Pages 108-189 *in*: Advanced distance sampling, S.T. Buckland, D.R. Andersen, K.P. Burnham, J.L. Laake, and L. Thomas, (eds.), 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 or 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.

Ledwell, W. and J. Huntington 2012. Incidental entrapments in fishing gear and stranding reported to and responded to by the Whale Release and Strandings Group in Newfoundland and Labrador and a summary of the Whale Release and Strandings program during 2012. Report to Fisheries and Oceans Canada, St. John's, Newfoundland, Canada. 18 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.

Rossman, 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.

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.

Wells, R.S., E.M. Fougeres, A.G. Cooper, R.O. Stevens, M.Brodsky, R. Lingenfelser, C. Dold, and D.C. Douglas 2013. Movements and dive patterns of short-finned pilot whales (*Globicephala macrorhynchus*) released from a mass stranding in the Florida Keys. Aq. Mamm. 39(1):61–72.

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.