PYGMY SPERM WHALE (*Kogia breviceps*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The pygmy sperm whale (*Kogia breviceps*) is distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989; McAlpine 2009). Sightings of *Kogia* whales in the western North Atlantic occur in oceanic waters (Figure 1; Mullin and Fulling 2003; Roberts *et al.* 2015). Stranding records exist from Florida to Maine, but there are no stranding records for the east Canadian coast (Willis and Baird 1998).

Pygmy sperm whales and dwarf sperm whales (*K. sima*) are difficult to differentiate at sea (Caldwell and Caldwell 1989; Bloodworth and Odell 2008; McAlpine 2009), and sightings of either species are often categorized as *Kogia* sp. When measurements can be obtained, diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Handley 1966; Barros and Duffield 2003), thus enabling researchers to use stranding data in distributional and ecological studies. Specifically, the distance from the snout to the center of the blowhole in proportion to the animal's total length, as well as the height of the dorsal fin in proportion to the animal's total length, can be used to differentiate between the two *Kogia* species (Handley 1966; Barros and Duffield 2003).

In addition to similarities in appearance, dwarf sperm whales and pygmy sperm whales demonstrate similarities in their foraging ecology. Staudinger *et al.* (2014) conducted diet and stable isotope analyses on stranded pygmy and dwarf sperm whales from the mid-Atlantic coast and found that the two species shared the same primary prey and fed in similar habitats.

Across its geographic range, including the western North Atlantic, the population biology of dwarf sperm whales is inadequately known (Staudinger *et al.* 2014). The western North Atlantic pygmy sperm whale population is being considered a separate stock for management purposes, although there is currently no information to differentiate this stock from the northern Gulf of Mexico stock(s). Additional morphological, genetic and/or behavioral data are needed to provide further information on stock delineation.

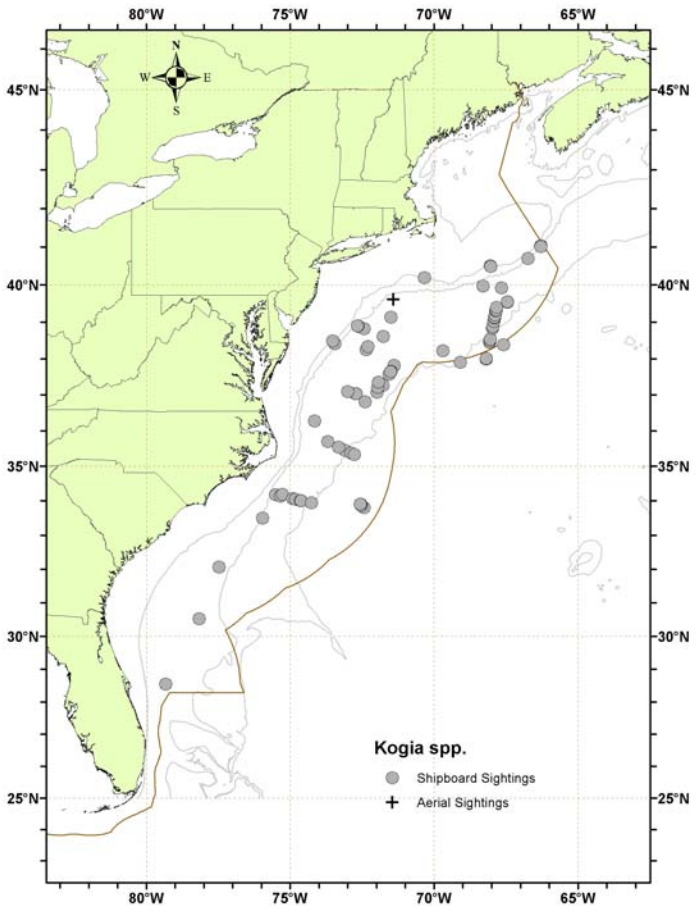

Figure 1. *Distribution of* Kogia *spp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers in 2004 and 2011. Isobaths are the 100-m, 1,000-m and 4,000-m depth contours.*

POPULATION SIZE

Total numbers of pygmy sperm whales off the U.S. Atlantic coast are unknown, although abundance estimates from selected regions of pygmy sperm whale habitat do exist for select time periods. Because *K. breviceps* and *K. sima* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia* combined. The best abundance estimate for *Kogia* spp. in the western North Atlantic is 3,785 (CV=0.47; Table 1; Palka 2012; Garrison 2016). This estimate is from summer 2011 surveys covering waters from central Florida to the lower Bay of Fundy. This estimate is almost certainly negatively biased. One component of line transect estimates is *g(0)*, the

probability of seeing an animal on the transect line. Estimating *g(0)* is difficult because it consists of accounting for both perception bias (i.e., at the surface but missed) and availability bias (i.e., below the surface while in range of the observers), and many uncertainties (e.g., group size and diving behavior) can confound both (Marsh and Sinclair 1989; Barlow 1999). The best estimate was corrected for perception bias (see below) but not availability bias and is therefore an underestimate.

Earlier abundance estimates

Please see Appendix IV for a summary of abundance estimates, including earlier estimates and survey descriptions.

Recent surveys and abundance estimates

An abundance estimate of 1,783 (CV=0.62) *Kogia* spp. was generated from aerial and shipboard surveys conducted during June–August 2011 between central Virginia and the lower Bay of Fundy (Palka 2012). The aerial portion covered 6,850 km of trackline over waters north of New Jersey between the coastline and the 100-m depth contour through the U.S. and Canadian Gulf of Maine, and up to and including the lower Bay of Fundy. The shipboard portion covered 3,811 km of trackline between central Virginia and Massachusetts in waters deeper than the 100-m depth contour out to beyond the U.S. EEZ. Both sighting platforms used a double-platform data collection procedure, which allowed 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).

An abundance estimate of 2,002 (CV=0.69) *Kogia* spp. 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 25x bigeye binoculars. A total of 4,445 km of trackline were surveyed, yielding 290 cetacean sightings. The majority of sightings occurred along the continental shelf break with generally lower sighting rates over the continental slope. 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).

Table 1. Summary of abundance estimates for the western North Atlantic *Kogia* spp. with 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	1,783	0.62
Jun–Aug 2011	central Florida to central Virginia	2,002	0.69
Jun–Aug 2011	central Florida to lower Bay of Fundy (COMBINED)	3,785	0.47

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 *Kogia* spp. is 3,785 (CV=0.47). The minimum population estimate for *Kogia* spp. is 2,598 animals.

Current Population Trend

A trend analysis has not been conducted for this stock. There are 3 abundance estimates for *Kogia* spp. from: 1) summer 1998 surveys (536; CV=0.45); 2) summer 2004 surveys (395; CV=0.4); and 3) summer 2011 surveys (3,785; CV=0.47). Methodological differences between the estimates need to be evaluated to quantify trends.

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 *Kogia* spp. is 2,598. The maximum productivity rate is 0.04, the default value for cetaceans. The recovery factor is 0.40 because the CV of the average mortality estimate is greater than 0.8 (Wade and Angliss 1997). PBR for western North Atlantic *Kogia* spp. is 21.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury for *Kogia* sp. during 2010–2014 was 3.5 (CV=1.0; Table 2).

Fishery Information

The commercial fisheries that interact, or that could potentially interact, with this stock in the Atlantic Ocean are the Category I Atlantic Highly Migratory Species longline and Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fisheries (Appendix III).

The large pelagics longline fishery operates in the U.S. Atlantic (including Caribbean) and Gulf of Mexico EEZ. Pelagic swordfish, tunas and billfish are the targets of the large pelagics longline fishery. Total estimated annual average fishery-related mortality and serious injury during 2010–2014 was unknown for Atlantic pygmy sperm whales because species-specific mortality estimates could not be made. However, there was 1 report of a *Kogia* sp. seriously injured by the pelagic longline fishery during quarter 4 of 2011 in the mid-Atlantic Bight region. Estimated total serious injury of *Kogia* attributable to the pelagic longline fishery during 2011 was 17.4 (CV=1.0; Garrison and Stokes 2012b). The annual average serious injury and mortality for *Kogia* sp. attributable to the Atlantic large pelagics longline fishery for the 5-year period from 2010 to 2014 was 3.5 animals (CV=1.0; Table 2) (Garrison and Stokes 2012a,b; 2013; 2014; 2016).

The Atlantic Highly Migratory Species longline fishery operates outside the U.S. EEZ. No takes of pygmy sperm whales or *Kogia* sp. within high seas waters of the Atlantic Ocean have been observed or reported thus far.

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

Table 2. Summary of the incidental mortality and serious injury of Atlantic Ocean *Kogia* sp. in the pelagic longline commercial fishery including the years sampled (Years), the number of vessels active within the fishery (Vessels), the type of data used (Data Type), the annual observer coverage (Observer Coverage), the annual observed serious injury and mortality recorded by on-board observers, the annual estimated serious injury and mortality, the combined annual estimates of serious injury and mortality (Estimated Combined Mortality), the estimated CV of the combined annual mortality estimates (Est. CVs) and the mean of the combined mortality estimates (CV in parentheses).

Fishery	Years	Vessels [a]	Data Type [b]	Observer Coverage [c]	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	2010–2014	80, 83, 82, 79, 78	Obs. Data Logbook	.08, .09, .07, .09, .10	0,1,0,0,0	0,0,0,0,0	0,17,0,0,0	0,0,0,0,0	0,17,0,0,0	NA, 1.00, NA, NA, NA	3.5 (1.0)
TOTAL											3.5 (1.0)

[a] Number of vessels in the fishery is based on vessels reporting effort to the pelagic longline logbook.
[b] Observer data (Obs. Data) are used to measure bycatch rates, and the data are collected within the Northeast Fisheries Observer Program. Mandatory logbook data were used to measure total effort for the longline fishery. These data are collected at the Southeast Fisheries Science Center (SEFSC).
[c] Proportion of sets observed.

Earlier Interactions

Between 1992 and 2009, 1 *Kogia* sp. was hooked, released alive and considered seriously injured in the pelagic

longline fishery in the Atlantic in 2000 (Yeung 2001).

Other Mortality

During 2010–2014, 142 pygmy sperm whales were reported stranded along the U.S. Atlantic coast and Puerto Rico (Table 3; Northeast Regional Marine Mammal Stranding Network, Southeast Regional Marine Mammal Stranding Network; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 15 June 2015 (SER) and 9 June 2015 (NER)). In addition, there were 11 records of unidentified *Kogia*.

Table 3. Dwarf and pygmy sperm whale (*Kogia sima* (Ks), *Kogia breviceps* (Kb) and *Kogia* sp. (Sp)) strandings along the Atlantic coast, 2010–2014. Strandings that were not reported to species have been reported as *Kogia* sp. The level of technical expertise among stranding network personnel varies, and given the potential difficulty in correctly identifying stranded *Kogia* whales to species, reports to specific species should be viewed with caution.

STATE	2010			2011			2012			2013			2014			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Maine	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Massachusetts	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0
New York	0	2	0	0	1	0	0	1	0	0	2	0	0	1	0	0	7	0
New Jersey	0	3	0	1	1	0	0	1	0	1	1	0	0	1	0	2	7	0
Delaware	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	2	0
Maryland	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2	0
Virginia	0	2	0	1	1	0	1	0	0	1	2	0	1	2	0	4	7	0
North Carolina	3	5	0	2	10	0	0	4	0	3	3	1	3	4	1	11	26	2
South Carolina	1	6	0	1	2	0	1	0	0	2	2	0	0	3	0	5	13	0
Georgia	0	2	1	0	4	0	0	4	0	0	5	1	5	1	0	5	16	2
Florida	3	17	0	2	14	1	0	10	0	0	9	6	0	9	0	5	59	7
Puerto Rico	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0
TOTALS	8	38	1	8	34	1	2	21	0	7	26	8	9	23	1	34	142	11

There were 14 documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 2010–2014 with evidence of human interactions. There were 7 strandings with evidence of human interactions in 2010—3 in Florida, 2 in New Jersey and 2 in South Carolina (1 of them classified as a fishery interaction due to ingested fishing gear, 5 animals ingested plastic, and 1 carcass had some teeth removed by public). In 2011, there were 4 strandings with evidence of human interactions—1 in Virginia (public attempted to move the animal), 1 in Florida (pushed out to sea by public) and 2 in Georgia (plastic ingestion). In 2012 there was 1 stranding in Florida with evidence of human interaction (ingested debris). In 2013 in Georgia there was 1 stranding with evidence of human interaction, and in 2014 in North Carolina there was also 1 stranding with evidence of human interaction (both animals ingested plastic).

Stranding data probably underestimate the extent of human and fishery-related mortality and serious injury because not all of the dolphins 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.

STATUS OF STOCK

Pygmy sperm whales are 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. Total U.S. fishery-related mortality and serious injury for *Kogia* sp. 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 pygmy sperm whales in the U.S. Atlantic EEZ relative to OSP is unknown. There are insufficient data to determine population trends for this species.

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