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 2002). Sightings of these animals in the western North Atlantic occur in oceanic waters (Figure 1; Mullin and Fulling 2003; SEFSC unpublished data). 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, Wursig *et al.* 2000), and sightings of either species are often categorized as *Kogia* sp. Diagnostic morphological characters have been useful in distinguishing the two *Kogia* species (Barros and Duffield 2003; Handley 1966), 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 when such measurements are obtainable (Barros and Duffield 2003). Duffield *et al.* (2003) propose using the molecular weights of myoglobin and hemoglobin, as determined by blood or muscle tissues of stranded animals, as a quick and robust way to provide species confirmation.

Using hematological as well as stable-isotope data, Barros *et al.* (1998) speculated that dwarf sperm whales may have a more pelagic distribution than pygmy sperm whales, and/or dive deeper during feeding bouts. This behavior may result in differential exposure to marine debris, collision with vessels and other anthropogenic activities between the two *Kogia* species.

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.

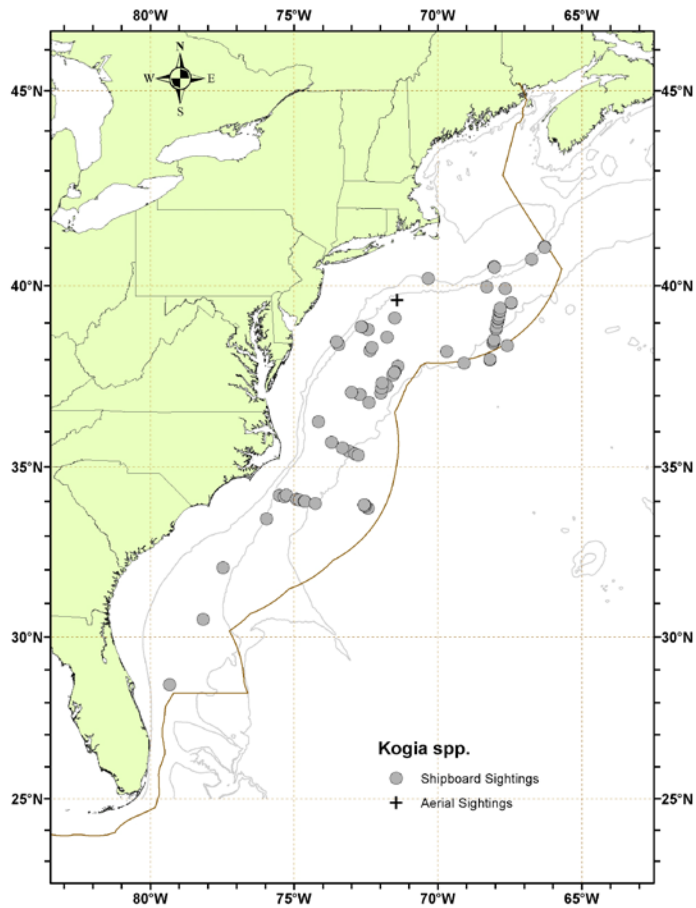

Figure 1. *Distribution of* Kogia *spp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summers in 2004 and 2011. Isobaths are the 100-m, 1,000-m and 4,000-m depth contours.*

POPULATION SIZE

Total numbers of pygmy sperm whales off the U.S. and Canadian Atlantic coast are unknown, although estimates from selected regions of the 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*. The best abundance estimate for *Kogia* spp. is 3,785 (CV=0.47; Table 1). 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 a corrected estimate could be 2-4 times larger.

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. 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. 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).

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. 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 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. 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. 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 *Kogia* spp. is 2,598. 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 this stock is of unknown status. PBR for western North Atlantic *Kogia* spp. is 26.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

The estimated annual average fishery-related mortality or serious injury for *Kogia* sp. during 2007-2011 was 3.4 (CV=1.0; Table 2).

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

The commercial fishery that could potentially interact with this stock in the Atlantic Ocean is the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagic longline fishery (Appendix III). Pelagic swordfish, tunas and billfish are the targets of the longline fishery. Total estimated annual average fishery-related mortality and serious injury during 2007-2011 was unknown for 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. Estimated serious injuries of *Kogia* attributable to the pelagic longline fishery in the mid-Atlantic Bight region during quarter 4 of 2011 were 17.0 (CV=1.0; Garrison and Stokes 2012)**.** The annual average serious injury and mortality for *Kogia* sp. attributable to the Atlantic pelagic longline fishery for the 5-year period from 2007 to 2011 was 3.4 animals (CV=1.0; Table 2).

Table 2. Summary of the incidental mortality and serious injury of Atlantic Ocean *Kogia* 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	Vessels [a]	Data Type [b]	Observer Coverage	Observed Serious Injury	Observed Mortality	Estimated Serious Injury	Estimated Mortality	Estimated Combined Mortality	Est. CVs	Mean Annual Mortality
Pelagic Longline	07-11	74,78, 75,79, 83	Obs. Data Logbook	.07, .07, .10, .08, .09	0,0,0,0,1	0,0,0,0,0	0,0,0,0,17	0,0,0,0,0	0,0,0,0,17	NA, NA, NA, NA, 1.00	3.4 (1.0)
TOTAL											3.4 (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).

Earlier Interactions

Between 1992 and 2006, 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

From 2007-2011, at least 146 pygmy sperm whales stranded along the U.S. Atlantic coast and Puerto Rico (Table 3; NOAA National Marine Mammal Health and Stranding Response Database unpublished data, accessed 13 September 2012 (SER) and 9 November 2012 (NER)). In addition, there were 6 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, 2007-2011. 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	2007			2008			2009			2010			2011			TOTALS		
	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp	Ks	Kb	Sp
Maine	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3	0
Massachusetts	0	1	1	0	2	0	1	4	0	1	0	0	0	0	0	2	7	1
New York	0	1	0	0	0	0	0	1	0	0	2	0	0	1	0	0	5	0
New Jersey	0	1	0	0	1	0	0	2	0	0	3	0	1	1	0	1	8	0
Delaware	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
Maryland	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Virginia	2	4	0	2	0	0	0	0	0	0	0	2	1	1	0	5	5	2
North Carolina	5	7	0	1	4	1	1	6	0	3	5	0	2	10	0	12	32	1
South Carolina	1	3	0	0	5	0	1	6	0	1	6	0	1	2	0	4	22	0
Georgia	0	1	0	0	3	0	0	2	0	0	2	1	0	4	0	0	12	1
Florida	1	5	0	3	6	0	1	6	0	3	17	0	2	14	1	10	48	1
Puerto Rico	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	1	0
TOTALS	9	27	1	6	21	1	4	28	0	8	36	3	8	34	1	35	146	6

There were 17 documented strandings of pygmy sperm whales along the U.S. Atlantic coast during 2007-2011 which were classified as human interactions. In Massachusetts in 2007, a pygmy sperm whale was classified as a human interaction because it was pushed off the beach. The animal was last seen swimming with its mother. Two other human interaction cases were documented in 2007—1 in South Carolina and 1 in Virginia (both plastic ingestion). In 2008, 1 animal in Georgia was classified as a human interaction (plastic ingestion). In 2009, there was a fishery interaction stranding mortality in Massachusetts and a human interaction in South Carolina (plastic ingestion). There were 7 strandings classified as 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 classified as 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).

Historical stranding records (1883-1988) of pygmy sperm whales in the southeastern U.S. (Credle 1988) and strandings recorded during 1988-1997 (Barros *et al.* 1998) indicate that this species accounts for about 83% of all *Kogia* sp. strandings in this area. During the period 1990-October 1998, 21 pygmy sperm whale strandings occurred in the northeastern U.S. (Delaware, New Jersey, New York and Virginia), whereas 194 strandings were documented along the U.S. Atlantic coast between North Carolina and the Florida Keys in the same period.

Stranding data probably underestimate the extent of human-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 human interactions. Finally, the level of technical expertise among stranding network personnel varies widely as does the ability to recognize signs of human interactions.

Rehabilitation challenges for *Kogia* sp. are numerous due to limited knowledge regarding even the basic biology of these species. Advances in recent rehabilitation success has potential implications for future release and tracking of animals at sea to potentially provide information on distribution, movements and habitat use of these species (Manire *et al.* 2004).

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 western U.S. Atlantic EEZ relative to OSP is unknown. There are insufficient data to determine population trends for this species.

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