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DWARF SPERM WHALE (*Kogia sima*): Western North Atlantic Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

The dwarf sperm whale (*Kogia sima*) appears to be distributed worldwide in temperate to tropical waters (Caldwell and Caldwell 1989). There are no stranding records for the east Canadian coast (Willis and Baird 1998). Sightings of these animals in the western North Atlantic occur in oceanic waters (Mullin and Fulling 2003; NMFS unpublished data). Dwarf sperm whales and pygmy sperm whales (*K. breviceps*) 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. There is no information on stock differentiation for the Atlantic population. 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. Diagnostic morphological characters have also been useful in distinguishing the two *Kogia* species (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 when such measurements are obtainable (Barros and Duffield 2003).

POPULATION SIZE

Total numbers of dwarf sperm whales off the U.S. or Canadian Atlantic coast are unknown, although estimates from selected regions of the habitat do exist for select time periods. Because *Kogia sima* and *Kogia breviceps* are difficult to differentiate at sea, the reported abundance estimates are for both species of *Kogia*.

An abundance of 115 (CV=0.61) for *Kogia* sp. was estimated from a line-transect survey conducted from July 6 to September 6, 1998, by a ship and plane that surveyed 15,900 km of track line in waters north of Maryland (38° N) (Fig. 1; Palka *et al.,* Unpubl. Ms.). Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and *g(0)*, the probability of detecting a group on the track line. Aerial data were not corrected for *g(0)*.

An abundance of 580 (CV=0.57) for *Kogia* sp. was estimated from a shipboard line-transect sighting survey conducted between 8 July and 17 August 1998 that surveyed ,4,163 km of track line in waters south of Maryland (38°N) (Fig. 1; Mullin and Fulling 2003). Abundance estimates were made using the program DISTANCE (Buckland *et al.* 2001; Thomas *et al.* 1998).

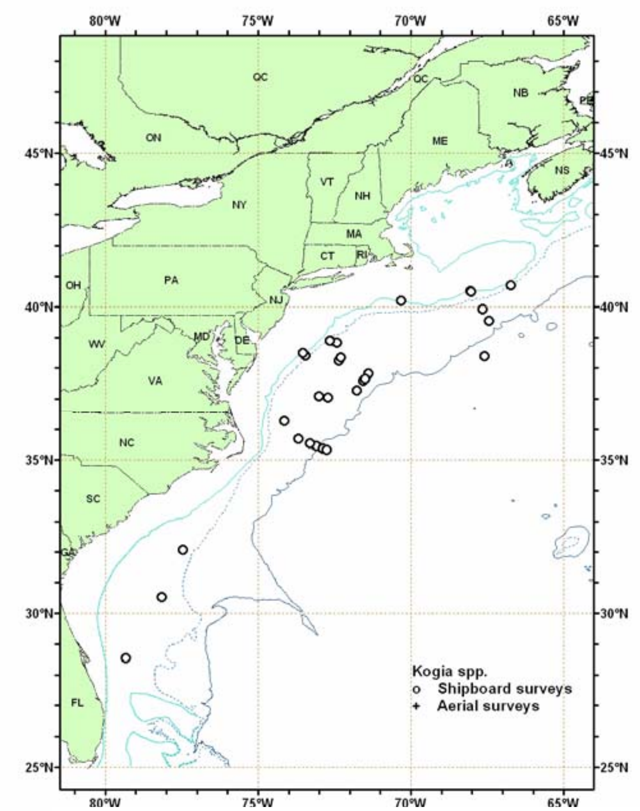

Figure 1. *Distribution of Kogia sp. sightings from NEFSC and SEFSC shipboard and aerial surveys during the summer in 1998 and 2004. Isobaths are at 100 m, 1,000 m and 4,000 m.*

An abundance of 358 (CV= 0.44) for *Kogia* sp.was estimated from a line transect sighting survey conducted during June 12 to August 4, 2004 by a ship and plane that surveyed 10,761 km of track line in waters north of Maryland (about 38° N) to the Bay of Fundy (about 45° N) (Figure 1; Palka unpublished). Shipboard data were collected using the two independent team line transect method and analyzed using the modified direct duplicate method (Palka 1995) accounting for biases due to school size and other potential covariates, reactive movements (Palka and Hammond 2001), and *g(0)*, the probability of detecting a group on the track line. Aerial data were collected using the Hiby circle-back line transect method (Hiby 1999) and analyzed accounting for *g(0)* and biases due to school size and other potential covariates (Figure 1; Palka unpublished).

A survey of the U.S. Atlantic outer continental shelf and continental slope (water depths ≥ 50m) between 27.5 – 38 ºN latitude was conducted during June-August, 2004. The survey employed two independent visual teams searching with 50x bigeye binoculars. Survey effort was stratified to include increased effort along the continental shelf break and Gulf Stream front in the Mid-Atlantic. The survey included 5,659 km of trackline, and there were a total of 473 cetacean sightings. Sightings were most frequent in waters North of Cape Hatteras, North Carolina along the shelf break. Data were analyzed to correct for visibility bias (*g(0)*) and group-size bias employing line transect distance analysis and the direct duplicate estimator (Palka 1995; Buckland *et al.*, 2001). The resulting abundance estimate for *Kogia* sp. between Florida and Maryland was 37 (CV=0.75).

The best 2004 abundance estimate for *Kogia* sp. is the sum of the estimates from the two 2004 U.S. Atlantic surveys, 395 (CV=0.40), where the estimate from the northern U.S. Atlantic is 358 (CV=0.44), and from the southern U.S. Atlantic is 37 (CV=0.75). This joint estimate is considered the best because together these two surveys have the most complete coverage of the species' habitat. A separate estimate of dwarf sperm whale abundance cannot be provided due to the uncertainty of species identification at sea.

Table 1. Summary of abundance estimates for the western North Atlantic *Kogia* sp. 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
Jul-Sep 1998	Maryland to Gulf of St. Lawrence	115	0.61
Jul-Aug 1998	Florida to Maryland	580	0.57
Jul-Sep 1998	Florida to Gulf of St. Lawrence (COMBINED)	695	0.49
Jun-Aug 2004	Maryland to Bay of Fundy	358	0.44
Jun-Aug 2004	Florida to Maryland	37	0.75
Jun-Aug 2004	Bay of Fundy to Florida (COMBINED)	395	0.40

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* sp. is 395 (CV=0.40). The minimum population estimate for *Kogia* sp. is 285.

Current Population Trend

The available information is insufficient to evaluate trends in population size for this species in the western North Atlantic.

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 (Wade and Angliss 1997). The minimum population size is 285. 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 the western North Atlantic *Kogia* sp. is 2.

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

Detailed fishery information is reported in Appendix III. There has been no logbook report of fishery- related serious injury recorded off the east coast of Florida in the pelagic longline fishery in 2000 (Table 2) (Yeung 2001; Garrison 2003;

Garrison and Richards, 2004). Total annual estimated average fishery-related mortality and serious injury to this stock during 1999-2003 was zero for dwarf sperm whales, as there were no reports of mortality or serious injury to dwarf sperm whales (Yeung 2001; Garrison 2003; Garrison and Richards 2004).

Earlier Interactions

No dwarf sperm whale mortalities were observed in 1977-1991 foreign fishing activities. Bycatch has been observed by NMFS Sea Samplers in the pelagic drift gillnet fishery, but no mortalities or serious injuries have been documented in other fisheries.

There was one report of mortality or serious injury to a dwarf sperm whale attributable to the pelagic drift gillnet fishery. Estimated annual fishery-related mortality and serious injury (CV in parentheses) was 0 dwarf sperm whales from 1991-1994, 1.0 in 1995 (CV=0), and 0 from 1996-2003.

Other Mortality

From 1999-2003, 37 dwarf sperm whales were reported stranded between North Carolina and Puerto Rico (Table 2). No dwarf sperm whales were reported to stranded in Nova Scotia from 1990-2004 (T. Wimmer, Nova Scotia Marine Animal Response Society, pers. comm.). The total includes 8 animals stranded in North Carolina and 1 in Georgia in 1999; 4 animals stranded in North Carolina, 1 in South Carolina, and 4 in Florida in 2000; 1 animal stranded in North Carolina, 1 in South Carolina, and 2 in Florida in 2001; 3 animals stranded in Florida and 2 in Puerto Rico in 2002; and 4 animals stranded in North Carolina, 2 in South Carolina, 2 in Georgia, and 2 in Florida in 2003. In addition to the above strandings of *Kogia sima,* there were 8 strandings reported as *Kogia* sp. as follows: 1 *Kogia* sp. stranded in Georgia in 2000, 1 stranded in North Carolina and 2 in Florida in 2002, and 1 stranded in Georgia and 3 in Florida in 2003.

Table 2. Dwarf sperm whale (*Kogia sima*) strandings along the Atlantic coast, 1999-2003

STATE	1999	2000	2001	2002	2003	TOTALS
North Carolina	8	4	1[a]	0[a]	4	17
South Carolina	0	1	1	0	2	4
Georgia	1	0[a]	0	0[a]	2[a]	3
Florida	0	4	2	3[b]	2[c]	11
Puerto Rico	0	0	0	2	0	2
TOTALS	9	9	4	5	10	37

[a]1 additional *Kogia* sp. stranded
[b]2 additional *Kogia* sp. stranded
[c]3 additional *Kogia* sp. stranded

There were no documented strandings of dwarf sperm whales along the U.S. Atlantic coast during 1999- 2003 which were classified as likely caused by fishery interactions.

Historical stranding records (1883-1988) of dwarf 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 17% of all *Kogia* strandings in this area. During the period 1990-October 1998, 3 dwarf sperm whale strandings occurred in the northeastern U.S. (Maryland, Massachusetts, and Rhode Island), whereas 43 strandings were documented along the U.S. Atlantic coast between North Carolina and the Florida Keys in the same period. A pair of latex examination gloves was retrieved from the stomach of a dwarf sperm whale stranded in Miami in 1987 (Barros *et al.* 1990). In the period 1987-1994, 1 animal had possible propeller cuts on or near the flukes.

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.

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

The status of the dwarf sperm whale relative to OSP in the western U.S. Atlantic EEZ is unknown. This species is not listed as endangered or threatened under the Endangered Species Act. There is insufficient information with which to assess population trends. Total fishery-related mortality and serious injury for this stock is less than 10% of the calculated PBR and therefore, can be considered to be insignificant and approaching zero mortality and serious injury rate. This is not a strategic stock.

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