



## Morphometric characteristics of spinner dolphin, *Stenella longirostris* (Gray, 1828) from Bay of Bengal

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### Abstract

Morphometric characteristics of the spinner dolphin *Stenella longirostris* were analysed based on samples (n=16) collected from two centres along the east coast of India (Bay of Bengal). The total length of the samples ranged from 84 to 170 cm. Of the 11 characteristics related to the anterior part of the body, the ratio of 10 characteristics to the total length is higher for calf male than that of adult male. There are also a few conspicuous differences between adult male and female. The Bay of Bengal form appears to differ from the other forms of world oceans, confirming that the morphometric characteristics of the spinner dolphin vary greatly geographically.

**Keywords:** *Stenella longirostris*, spinner dolphin, sexual dimorphism, phenotype, Bay of Bengal

### Introduction

The spinner dolphin *Stenella longirostris* is globally distributed and found in all the tropical, subtropical and oceanic temperate waters (Perrin and Gilpatrick, 1994). Among the cetaceans that inhabit the Indian seas, the spinner dolphin is the most abundant and widely distributed species (Afsal *et al.*, 2008). Studies on the morphological characteristics of dolphins provide valuable information to determine sexual dimorphism, differential growth pattern and to distinguish the subspecies (Perrin *et al.*, 1979). Data on the morphometric characteristics of spinner dolphin in the Indian seas are limited to a few reports from stranded or washed-ashore animals (Lal Mohan, 1985; Rajaguru and Natarajan, 1985; Kumaran, 1989; Sathya and Chandrasekar, 1997). In the present study, the morphometric data on the spinner dolphin incidentally caught in fishing gear and landed at Chennai and Kakinada (Bay of Bengal; east coast of India) are presented.

### Material and Methods

**Sample collection:** A total of 16 specimens of the spinner dolphin *Stenella longirostris* incidentally

caught in fishing gear and landed at Chennai (13° 05' N lat., 79° 46' E long.) and Kakinada (16° 51' N lat., 80° 10' E long.) during September-October 2004 were analysed (Table 1). The distance between the two landing centres is about 400 km. All the specimens were in fresh condition.

**Morphometric measurements:** A set of 20 length and two girth measurements were made from each specimen following Perrin (1975). Measuring total length along the body gives erroneous reading due to irregular shape of the body. Hence, the total body length measurement was taken in a straight line parallel to axis from the tip of the upper jaw to the centre of the notch between the tail flukes using a flexible measuring tape. For measuring total length, two sticks one in upper jaw and another in fluke notch between flukes were placed perpendicularly and the length was taken by measuring the distance between the sticks without any slackening. Thus, the measurement of total length was parallel to the body axis whereas all the others were point-to-point measurements. Though it is possible to arrive at parallel to axis of all morphometric characteristics from point-to-point measurements by making use of good photographs, we have not attempted this, as

photographs were not taken under standard conditions.

Coefficient of Variation (CV= standard deviation / mean x 100) was calculated for each character to find out variation among the individuals.

## Results

The total length of males ranged between 84 and 170 cm and that of females from 86 to 168 cm (Table 1). The CV of each morphometric character was very high and ranged from 14.6 (centre of eye to centre of blowhole) to 34.0% (fluke span) among the 16 individuals (Table 2). *S. longirostris* is known to mature at total length of 162.5 cm (male) and 160 cm (female) (Perrin and Reilly, 1984). Considering this, the data collected were segregated into calf male, adult male and adult female. There were only two female calves in the sample. The CV for segregated data was considerably low, and ranged from 2.0 to 14.3% for calf male, 1.7 to 8.8% for adult male and 2.0 to 16.0% for adult female. This indicates differential growth pattern of the calf and adult, and the male and female.

Table 1. Samples of *Stenella longirostris* collected at Chennai and Kakinada during September-October 2004

Sex	Location		Total length (cm)
	Chennai	Kakinada	
Male	9	1	84-170
Female	4	2	86-168
Total	13	3	84-170

To confirm this, the ratio of each morphometric character to the total length was estimated. The analysis indicates the following trends in the male: (i) of the 11 characteristics related to the anterior part of the body (character 2 to 12), the ratio of 10 characteristics to the total length was higher for calf male than that of adult male (Table 2). This shows that the growth of the anterior portion slows as the animal grows. It also suggests that the head of calf is relatively larger than that of adult male as observed in *Stenella attenuata* by Sanvicenta-Anorve *et al.* (2004). (ii) The flipper (C17 and 18) growth also slows with the growth of the male. (iii) However, the height of dorsal fin (C20) and fluke span (C21) increases.

The conspicuous differences between adult male and female are as follows: (i) the posterior portion (C12 and 13) is lengthier in the female and facilitates enough space for accommodating the growing calf in the uterus. (ii) However, the girth (C15 and 16) of the female, especially at anus, is shorter than the male. (iii) The dorsal fin height (C20) and fluke span (C21) are shorter in female.

## Discussion

In the present study, the morphometric characteristics of the spinner dolphin have been analysed for only a few animals, but the samples were represented by individuals with a wide range of body length (84 cm to 170 cm). The study shows that the dorsal fin and fluke span grow rapidly with ontogeny. Perrin (1975) too reported that the ratio of the anterior portion of the body in the total length of the spinner dolphin is linear until the total length reaches approximately 150 cm, after which it increases much less rapidly and varies markedly. The pattern of change in the proportional dimension of the appendages of the adult is however, quite different from that of the young ones. The rate of increase of height of dorsal fin and fluke span relative to the total length accelerates with ontogeny, as reported by Perrin (1975), which indicates improvement in the swimming efficiency of the adult.

The morphometric characteristics of spinner dolphin vary greatly geographically. Based on morphological characteristics, three sub species of spinner dolphin, *viz.*, *S. longirostris centroamericana*, *S. l. orientalis*, *S. l. longirostris* and *S. l. roseiventris* are reported to occur in the world oceans (Perrin, 1990; Perrin *et al.*, 1999). Morphological features of these sub species found in different geographical regions have been described by Schnell *et al.* (1982) and Van Waerebeek *et al.* (1999). Rice (1998) has opined that the spinner dolphin occurring in the Indian seas is *S. longirostris longirostris* (Gray's spinner dolphin). Recent genetic investigation (Jayasankar *et al.*, 2008) on similar individuals used for the present study has suggested that spinner dolphin from the Indian sea as *Stenella longirostris* but did not recognize sub species.

Table 2. Morphometric measurements of calf male (n = 4), adult male (n= 6), adult female (n= 4) and calf female (n=2) of *Stenella longirostris* landed at Chennai and Kakinada; CV= Co-efficient of variation from the mean

Characteristics	Calf male		Adult male		Adult female		Calf female Mean (cm)	All samples	
	Mean (cm)	CV (%)	Mean (cm)	CV (%)	Mean (cm)	CV (%)		Mean (cm)	CV (%)
Length, total	88.4	5.9	161.7	3.8	162.8	3.7	90	132.8	27.3
Length, tip of the upper jaw to centre of eye	17.9	2.8	30.4	6.7	30.1	3.4	18.35	25.4	24.1
Length, tip of the upper jaw to apex of the melon (snout length)	7.4	5.9	15.4	5.8	15.7	3.8	7.35	12.3	33.1
Length of the gape (tip of the upper jaw to angle of the gape)	15.2	4.5	26.7	7.9	26.7	4.2	15.9	22.1	25.6
Length, tip of the external auditory meatus	20.3	3.8	33.4	5.6	34.6	3.2	21.35	28.6	23.3
Centre of the eye to external auditory meatus	2.6	11.4	4.5	7.7	4.9	16.0	2.85	3.9	27.8
Centre of eye to angle of gape	2.5	2.0	4.1	4.8	4.1	6.1	2.75	3.5	21.6
Centre of eye to centre of blowhole	8.9	9.5	11.9	3.9	11.3	8.4	8.75	10.6	14.6
Length, tip of upper jaw to blowhole along the mid line	18.0	2.3	31.1	5.8	31.2	3.5	17.9	26.4	26.0
Length, tip of upper jaw to anterior insertion of flipper	24.8	2.7	42.1	5.3	41.0	2.0	25.4	35.0	23.6
Length, tip of upper jaw to tip of dorsal fin	59.0	5.3	102.0	4.8	100.6	4.6	60.65	83.6	25.5
Length, tip of upper jaw to mid point of umbilicus	47.4	3.1	82.8	5.4	92.1	15.4	49.25	71.2	29.0
Length, tip of upper jaw to mid point of genital aperture	60.2	4.8	110.4	5.8	117.0	2.7	64.5	92.2	28.0
Length, tip of upper jaw to center of anus	66.4	4.7	123.2	5.6	120.8	2.4	69.25	99.9	27.2
Girth at axilla	46.3	6.9	75.6	4.0	74.8	3.7	47.65	63.8	22.3
Girth at anus	25.1	9.2	52.0	8.8	43.1	8.2	25	39.1	31.3
Length of flipper (anterior insertion of tip)	15.9	4.7	24.7	3.6	25.7	6.8	15.8	21.4	22.0
Length of flipper (axilla to tip)	12.1	14.3	18.8	1.7	18.9	4.5	11.5	15.9	22.5
Width, flipper (maximum)	5.5	7.6	9.1	5.2	8.7	3.7	5.7	7.6	22.5
Height of dorsal fin (fin tip to base)	8.6	12.0	16.7	8.4	14.6	13.5	8.15	12.7	30.7
Fluke span	17.4	6.0	38.1	5.9	34.2	8.6	16.75	28.6	34.0
Width of flukes	6.1	7.5	10.0	5.8	10.2	6.1	6.4	8.5	23.2

In earlier works by different researchers in India, there was no uniformity in measuring the animals. Hence, comparison of the present study with those of earlier studies was not attempted. A comparison

of the morphometric characteristics of the spinner dolphin of Bay of Bengal (present study) with those from other geographical areas reveals the following: (i) the total length of individuals in the present study

(84-170 cm) was smaller than those from the Costa Rican (181-216 cm), eastern Pacific (163-182 cm) and Hawaiian (179-185 cm) waters (Perrin, 1975). (ii) The ratio of most of the characteristics in the total length of both adult male and female in the Bay of Bengal is higher than that of the eastern Pacific

and Hawaiian forms as reported by Perrin (1975) (Table 3). However, a few measurements in particular, the ratio of flipper length and width are similar to those of the eastern forms. Similarly, the ratio of the Bay of Bengal form is higher than the white belly form (Perrin, 1975). A perusal of

Table 3. Comparison of ratio of morphometric characters with the total mean length of *S. longirostris* from the Bay of Bengal (BOB; present study) and eastern Pacific and Hawaii (EP&H; Perrin, 1975); mean total length is given in cm; all the other values are in percentage

Characteristics	Calf male (BOB)	Calf female (BOB)	Adult male		Adult female	
			BOB	EP & H	BOB	EP & H
Length, total (cm)	88.4	90	161.7	171.7	162.8	168.3
Length, tip of the upper jaw to centre of eye	20.2	20.4	18.8	17.8	18.5	18.3
Length, tip of the upper jaw to apex of the melon (snout length)	8.4	8.2	9.5	7.9	9.6	8.4
Length of the gape (tip of the upper jaw to angle of the gape)	17.2	17.7	16.5	15.4	16.1	15.9
Length, tip of the external auditory meatus	23.0	23.7	20.7		21.3	
Centre of the eye to external auditory meatus	2.9	3.2	2.8		3.0	
Centre of eye to angle of gape	2.8	3.1	2.5		2.5	
Centre of eye to center of blowhole	10.1	9.7	7.4	6.8	6.9	6.9
Length, tip of upper jaw to blowhole along the mid line	20.4	19.9	19.2	17.8	19.2	18.4
Length, tip of upper jaw to anterior insertion of flipper	28.1	28.2	26.0	25.1	25.2	25.5
Length, tip of upper jaw to tip of dorsal fin	66.7	67.4	63.1	55.2	61.8	57.8
Length, tip of upper jaw to mid point of umbilicus	53.6	54.7	51.2	49.4	56.7	49.7
Length, tip of upper jaw to mid point of genital aperture	68.1	71.7	68.3		71.9	
Length, tip of upper jaw to center of anus	75.1	76.9	76.2		74.2	
Girth at axilla	52.4	52.9	46.8	44.5	45.9	43.8
Girth at anus	28.4	27.8	32.2		26.5	
Length of flipper (anterior insertion of tip)	18.0	17.6	15.3		15.8	
Length of flipper (axilla to tip)	13.7	12.8	11.6	11.4	11.6	11.5
Width, flipper (maximum)	6.2	6.3	5.6	5.5	5.3	5.3
Height of dorsal fin (fin tip to base)	9.7	9.1	10.3		9.0	
Fluke span	19.7	18.6	23.6	22.8	21.0	21.7
Width of flukes	6.9	7.1	6.2		6.3	

literature shows wide variations among the morphometrics of the spinner dolphin from different geographical locations. Perrin *et al.* (1985) reported that the coastal forms are larger than offshore forms of *Stenella* sp. with regard to all measurements. These differences are related to the feeding habits of the coastal animals (Douglas *et al.*, 1984). Schnell *et al.* (1982) also reported that the coastal *Stenella longirostris* are larger than the offshore forms and have robust feeding apparatus to feed on larger and harder prey. In the present study, the animals were caught incidentally by gillnet within 20 nm from the shore where the depth ranges between 20 and 70 m and hence, it can be considered that all the samples may be coastal. In the absence of oceanic samples, it is not possible to determine differences between coastal and offshore forms in the Bay of Bengal.

This study emphasizes the need for further research on small cetaceans in the Indian seas on the following lines: (i) more samples need to be analysed for arriving at conclusions on differential growth pattern and sexual dimorphism. (ii) For assigning endangered status of a species, it is important that data sets generated from the Indian seas are compared with the large data sets available from different oceans. (iii) To achieve this and to make inferences, similar data on other small cetaceans in the Indian seas need to be collected by following standard and uniform methods of data collection.

### Acknowledgements

We are thankful to the Director, CMFRI, Cochin for encouragement and facilities. We are thankful to Ms. Jansi Rani for assisting in data collection. It is a pleasure to express our gratitude to the fishermen who provided carcasses of dolphin. This study was a part of the project funded by the Centre of Marine Living Resources & Ecology, Ministry of Earth Sciences, Government of India, which is greatly acknowledged.

### References

Afsal, V. V., K. S. S. M. Yousuf, B. Anoop, A. K. Anoop, P. Kannan, M. Rajagopalan and E. Vivekanandan. 2008. A note on cetacean distribution in the Indian EEZ and contiguous seas during 2003-07. *J. Cetacean. Res. Manage.*, 10(3): 209 - 215.

Douglas, M. E., G. D. Schnell and D. J. Hough. 1984. Differentiation between inshore and offshore of spotted dolphin in the eastern Pacific. *J. Mammal.*, 65: 375 - 387.

Jayasankar, P., B. Anoop, E. Vivekanandan, M. Rajgopalan, K. M. M. Yousuf, P. Reynold, P. K. Krishnakumar, P. L. Kumaran, V. V. Afsal and A. K. Anoop. 2008. Molecular Identification of Delphinids and Finless Porpoise (Cetacea) from the Arabian Sea and Bay of Bengal. *Zootaxa.*, 1853: 57 - 67.

Kumaran, P. L. 1989. Systematics and organ weights of dolphins and a whale collected at Porto Novo, 11° 29' N, 79° 46' E, southeast coast of India. *M.Sc. Dissertation*, Annamalai University, Parangipettai, India, 52 pp.

Lal Mohan, R. S. 1985. Osteology of dolphins, *Delphinus delphis tropicalis*, *Stenella longirostris*, *Tursiops aduncus* and *Sousa chinensis* from south-west coast of India. *Proc. Symp. on Endangered Marine Animals and Marine Parks*, 1, p. 93 - 99.

Perrin, W. F. 1975. Variation of spotted and spinner porpoise (genus *Stenella*) in the eastern Pacific and Hawaii. *Bull. Scripps. Inst. Oceanogr.*, University of California press, 21: 1 - 206.

Perrin, W. F. 1990. Subspecies of *Stenella longirostris* (Mammalia: Cetacea: Delphinidae). *Proc. Biol. Soc. Washington*, 103(2): p. 453 - 463.

Perrin, W. F. and S. B. Reilly. 1984. Reproductive parameters of dolphins and small whales of the family Delphinidae. *Rep. Int. Whal. Commn.*, Special Issue, 6: 97 - 134.

Perrin, W. F. and J. W. Gilpatrick. 1994. Spinner dolphin - *Stenella longirostris* (Gray, 1828). In: S. H. Ridgway and S. R. Harrison (Eds.) *Handbook of Marine Mammals Vol. 5: The First Book of Dolphins*. Academic Press, London, p. 99 - 128.

Perrin, W. F., P. A. Sloan, and J. R. Henderson. 1979. Taxonomic status of the southwestern stocks of spinner dolphin *Stenella longirostris* and spotted dolphin *S. attenuata*. *Rep. Int. Whal. Commn.*, 29: 175 - 184.

Perrin, W. F., M. L. L. Dolar and D. Robineau. 1999. Spinner dolphins *Stenella longirostris* of the western Pacific and southeast Asia: pelagic and shallow water forms. *Mar. Mammal Sci.*, 15(4): 1029-1053.

Perrin, W. F., M. D. Scott, G. J. Walker and V. L. Cass. 1985. Review of geographical stocks of tropical dolphins (*Stenella* spp. and *Delphinus delphis*) in the eastern tropical Pacific. *NOAA Tech. Memo. Rep. NMFS-SWRF*, 737. 1-14.

Rajaguru, A. and R. Natarajan. 1985. Systematics and organ weights of two dolphins, *Stenella longirostris* (Gray, 1828) and *Tursiops truncatus* (Montagu, 1821) of Porto Novo, Southeast coast of India. *Proceedings of the Symposium of Endangered Marine Animals and Parks*, 1: p.72 - 77.

Rice, D. W. 1998. Marine mammals of the world: Systematics and distribution. In: D. Wartzok and K. S. Lawrence. (Eds.), *Society for Marine Mammalogy*, USA, Special Publication No 4, 1-231.

- Sanvincente-Anorve, L., J. L. Lopez-Sanchez, A. Aguayo-Lobo and L. Medrano-Gonzalez. 2004. Morphometry and sexual dimorphism of the coastal spotted dolphin, *Stenella attenuata graffmani*, from Bahia de Banderas, Mexico. *Acta Zoologica*, 85: 223 - 232.
- Sathya R. S. and S. Chandrasekar. 1997. On the landing of spinner dolphin *Stenella longirostris* at Lawson's Bay, Visakhapatnam. *Mar. Fish. Infor. Ser T & E Ser.*, 127: 18.
- Schnell, G. D., M. E. Douglas and D. J. Hough. 1982. Geographical variation in morphology of spotted and spinner dolphins (*Stenella attenuata* and *S. longirostris*) from the eastern tropical Pacific. *NOAA Tech. Rep. NMFS-SWFC* 15C, 213 pp.
- Van Waerebeek, K., M. Gallagher, R. Baldwin and V. Papastavrou and S. M. Al Lawati. 1999. Morphology and distribution of the spinner dolphin, *Stenella longirostris*, rough-toothed dolphin, *Steno bredanensis* and melon-headed whale, *Peponocephala electra*, from waters off the Sultanate of Oman. *J. Cetacean. Res. Manage.*, 1(2): 167 - 177.

Received : 13.11.09  
Accepted : 05.03.10