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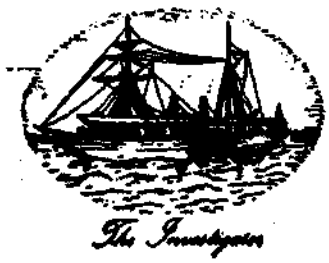

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OSTEOLOGY OF DOLPHINS *DELPHINUS DELPHIS TROPICALIS, STENELLA LONGIROSTRIS, TURSIOPS ADUNCUS* AND *SOUSA CHINENSIS* FROM SOUTH-WEST COAST OF INDIA

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ABSTRACT

Osteology of four dolphins *Delphinus delphis tropicalis* van Bree, *Stenella longirostris* Gray, *Tursiops aduncus* Ehrenberg and *Sousa chinensis* Osbeck are studied from the south-west coast of India. The measurements of the skulls are compared with the information available from other parts of the world.

INTRODUCTION

OUR information on the osteology of the dolphins occurring along Indian coast is far from satisfactory. Cuvier (1829) described the skull of *Delphinus dissunieri* Blanford from Malabar coast. The osteology of *Tursiops aduncus* Ehrenberg was recently studied by Ross (1977). There is no information on the skull of *Stenella longirostris* Gray and *Sousa chinensis* from India though their external morphology has been described (Blanford, 1891). In the present study, the osteology of these four species are described.

I am thankful to Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, Cochin for his encouragement and guidance throughout the study.

MATERIAL AND METHODS

The skulls were prepared by boiling the heads of dolphins caught in the gill net as by catch from the Calicut Coast. After removing the flesh, the skull was sun dried with sprinkling boric acid powder for about a week. The skull was then coated with french polish, adding a few grams of arsenic powder. The teeth were removed and treated with Hydrogen per oxide solution and fixed in the alveolus with eraldite gum. Measurements were taken after Perrin (1975)

OBSERVATION

Delphinus delphis tropicalis van Bree

Rostrum of the species is narrow and acute forming 66.2 to 70.0% of the condylobasal length. The number of teeth on the upper jaw ranged from 134 to 138. The rostral length Zygomatic width ratio varied from 2.1 to 2.2. The Zygomatic width measured 30.8 to 32.5% of the condylobasal length. The ventral surface of each maxilla on the palate is deeply grooved in the posterior two third of the rostrum. The vomer forms a ridge ventrally. The craniun is small (Fig. 1 a, b). The maximum width of premaxilla ranged from 13.6 to 13.7% of CBL (Table 1).

Stenella longirostris Gray

The rostrum of the species is not acute (Plate I A, B and Fig. 2 a, b) and measured

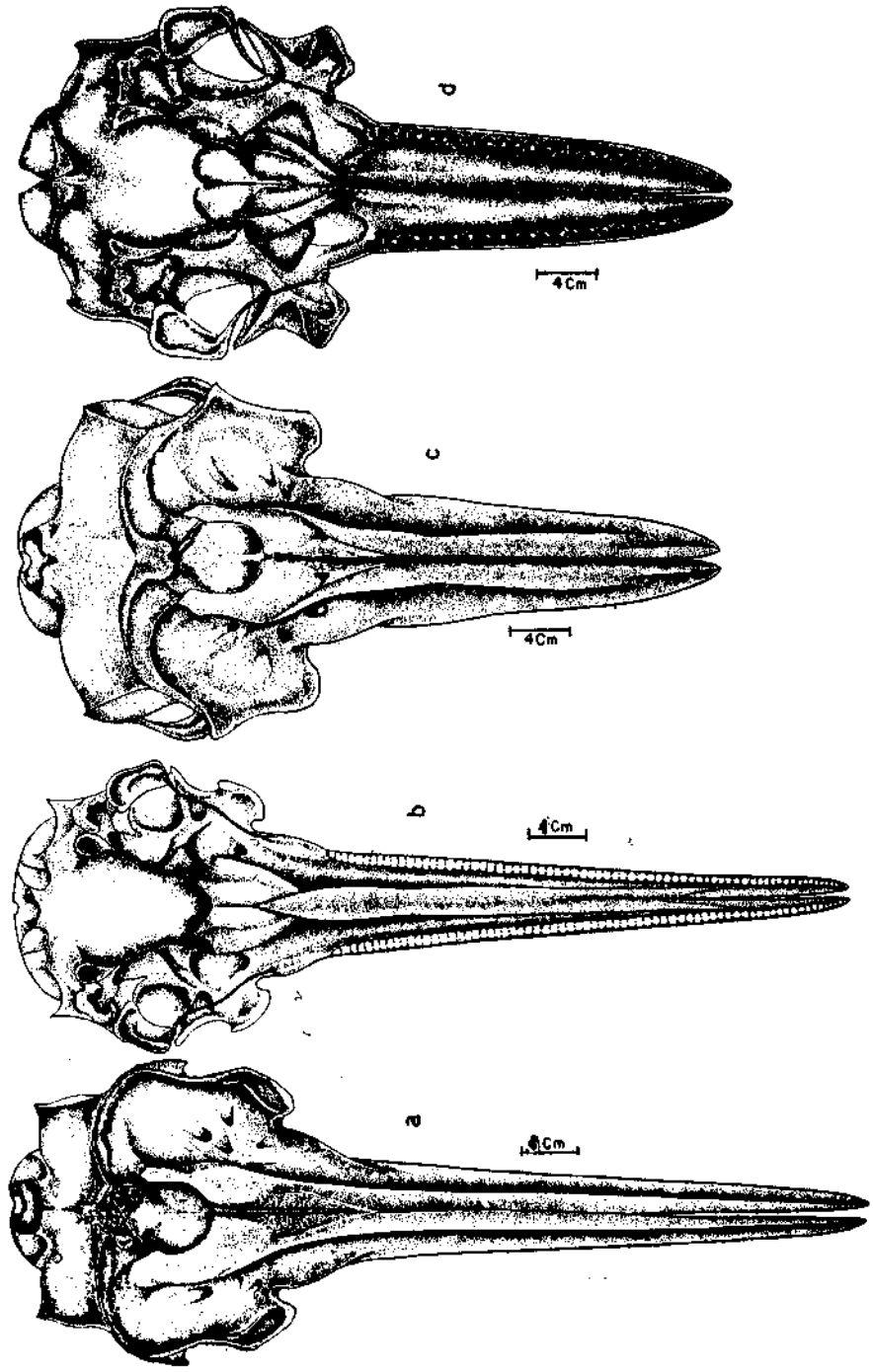

FIG. 1. Skulls of dolphins : a. Dorsal view of *Delphinus delphis tropicalis*, b. Ventral view of same, c. dorsal view of *Tursiops aduncus* and d. Ventral view of same.

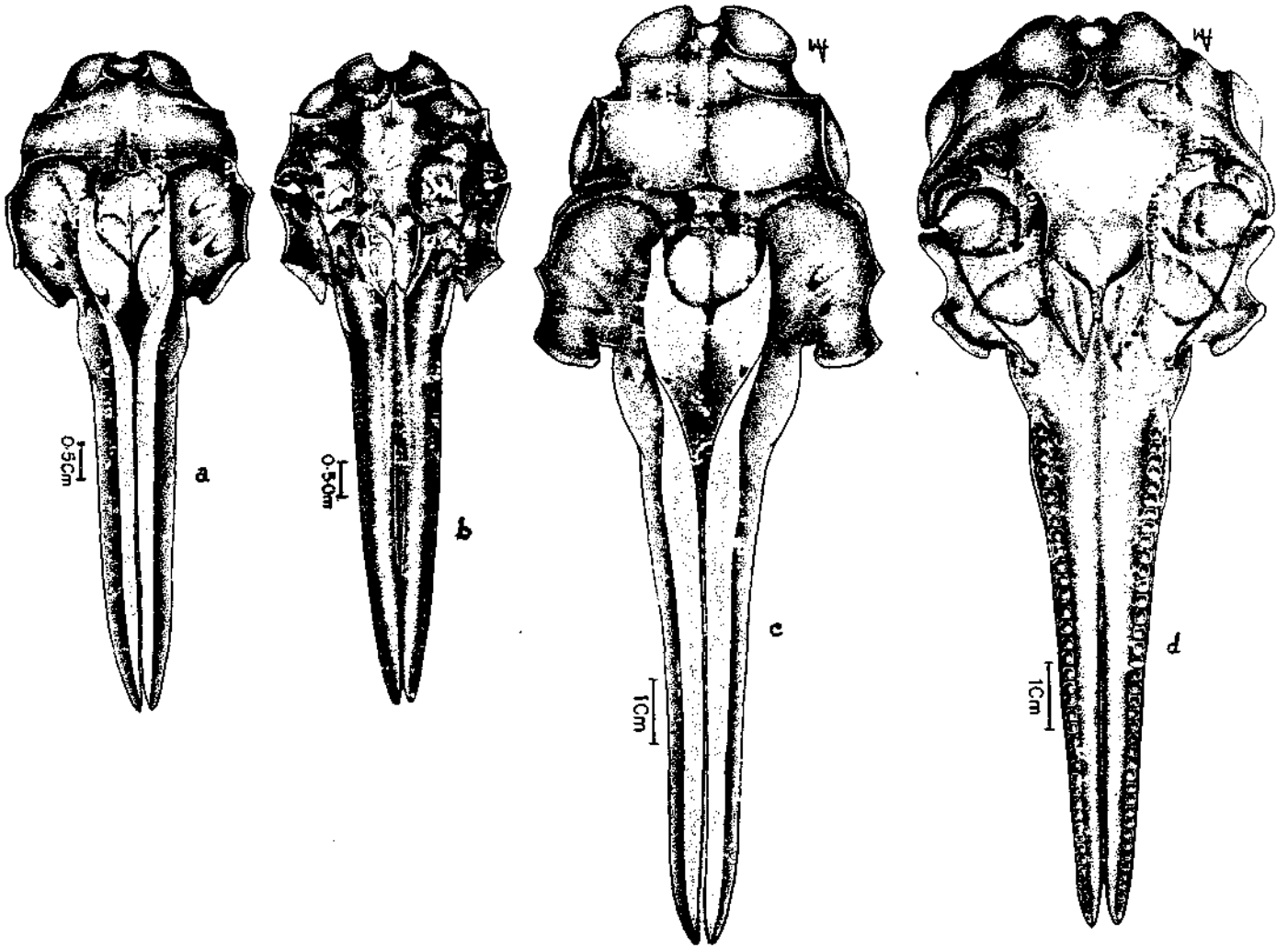

FIG. 2. Skulls of dolphins, a and b. Dorsal and Ventral views of the skull of *Stenella longirostris*; and c and d. Dorsal and ventral views of the skull of *Tursiops aduncus*.

64.5 to 67.5% of the condylobasal length. Number of teeth varied from 107 to 108 in upper jaw. The rostral-Zygomatic ratio was 1.7 to 1.8. The palate was not grooved ventrally. The greatest length of pterygiod measured from 12.9 to 14.2% of the condylobasal length. The length of tooth row was 55.2% to 59.7% of CBL. The length of mandibles ranged from 84.2% to 83.3% of CBL (Table 2).

Tursiops aduncus Ehrenberg

The rostral length was 60.6 to 62.5% of the CBL. The skull was also much heavier and the bones are solid and firm (Fig. 1 c, d). The number of alveolus on the upper jaw ranged between 27 to 28. The rostral-Zygomatic ratio was 1.3. The length of tooth row in the upper jaw was 1.2 to rostral length. Teeth strong measuring 26 mm (Table 3).

Sousa chinensis Osbeck

The rostrum is long measuring 63.3 to 64.1% of the condylobasal length. It is slender and laterally compressed; the premaxillae are arched dorsally along its length. The frontal bones are exposed near the vertex of the cranium between the posterior margin of the premaxillae and the transverse supraoccipital crest. The pterygiod hamuli are narrow (Plate I c, d and Fig. 2 c, d). The rostral-Zygomatic ratio is 1.6 to 1.7. The length of teeth row on upper jaw 55.1 to 56.0% of CBL. The number of alveolus on the upper and lower jaws range from 73-76 and 69-72 respectively. Teeth in the middle of the jaws measured 20 mm (Table 4).

Discussion

The need for more information on the osteology of the dolphins from the Indian coast has been expressed by many workers. (Banks and Brownell, 1969; Perrin, 1975 and Mitchell, 1975). This information is vital as the knowledge of the geographical variation is important in determining the species based on the collection from its whole range of distribution.

The osteology of the *Delphinus delphis tropicalis* has been recently studied by van Bree (1971) clearing some of the confusion that existed in the nomenclature of the species and relegating the species *Delphinus dussumieri* Blanford and *Delphinus longirostris* Cuvier as junior synonyms. The importance of the extreme acute nature of the rostrum and more number of teeth were considered to be of taxonomic significance. Banks and Brownell (1969) while studying the common dolphin of Eastern pacific suggested that the ratio of Zygomatic width to rostrum length was important enough to differentiate between *D. delphis* Linnaeus and *D. bairdii* Dall. However, this was refuted by van Bree and Purves (1972) who explained that dolphins with short rostrum were found in colder waters and that with longer rostrum in warmer waters. They attributed the elongation of the rostrum to lower surface to volume ratio. However, they conceed that it may be the beginning of speciation. If the attenuation of the rostrum is temperature related, it should be seen in other species of dolphins also. Perrin (1975) while examining the spotted and spinner dolphins in the eastern tropical Pacific found that coastal population was with longer rostrum and the off-shore population with short rostrum. The degree of attenuation in relation to the skull is important. Considering this aspect, the *Delphinus* species occurring along the south-west coast of India with long attenuated rostrum, more number of teeth and higher rostral-Zygomatic ratio was given subspecific status (Mohan, 1983). The rostral-Zygomatic width ratio in *D. tropicalis* of south Africa was 1.8-2.03 (Ross, in press) whereas in the dolphins off Calicut coast it ranged from 2.14 to 2.15.

The ratio of condylobasal length to rostrum of *Stenella longirostris* of Calicut coast ranged

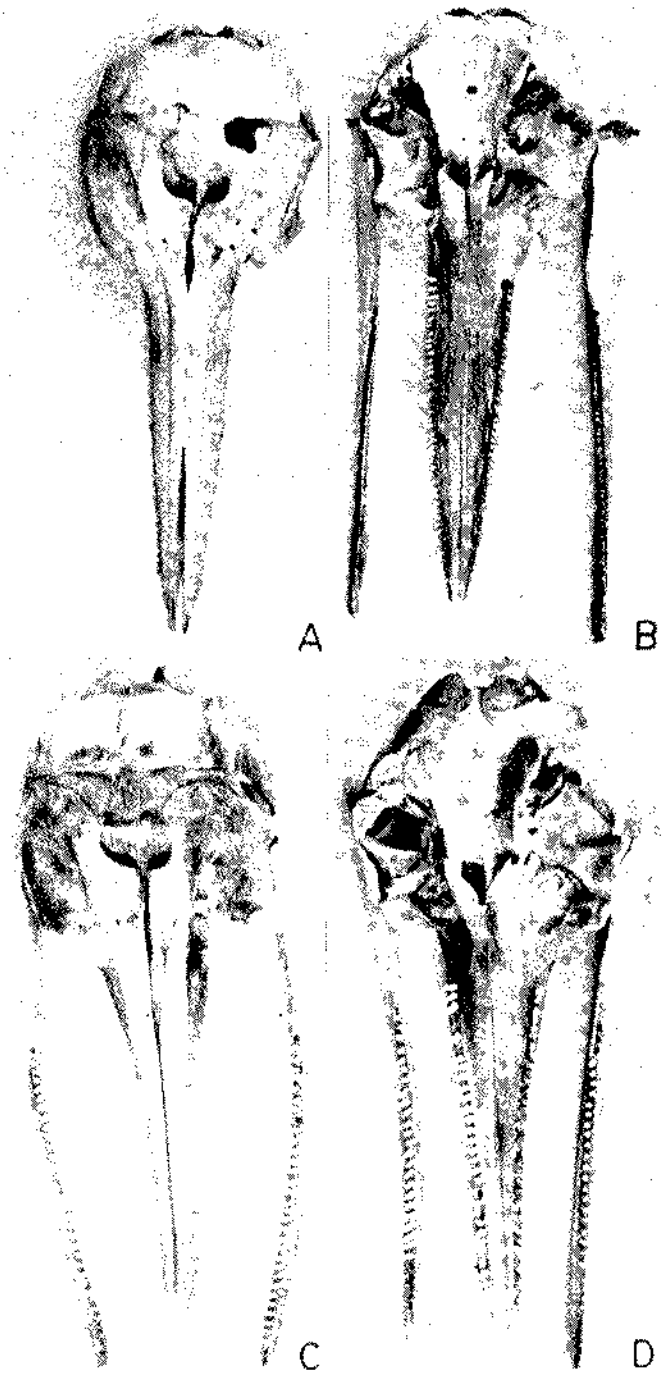

PLATE I. Skulls of dolphins. A, B. Dorsal view of *Stenella longirostris*. B. Ventral view of rostrum. C. dorsal view of *Steno bredanensis* and D. Ventral view of same.

TABLE 1. *Measurements of the skull of* Delphinus delphis tropicalis *Mohan from Off Calicut coast*

		(mm)		(%)	(%)
		1	2	range	$\bar{x}$
Condylobasal length	..	438	585		
Rostrum	..	290	410	66.2-70.1	68.1
Rostrum basal width	..	75	100	17.1	17.1
Breadth across Pre-orbital	..	128	178	29.2-30.0	29.6
Zygomatic width	..	135	190	30.8-32.5	31.6
Width of Brain case (across parietals)	..	130	153	26.1-29.6	27.8
Greatest length of Pterygoid	..	62	80	14.1-13.6	13.8
Greatest postorbital width	..	136	182	31.0-31.1	31.0
Maximum width of pre-maxilla	..	60	80	13.6-13.7	13.6
Length of post-temporal fossa	..	57	82	13.0-14.0	13.5
Length of tooth row (right)	..	230	365	52.5-62.4	57.4
Number of alveolus (upper jaw)	..	68-67	69+69	68-69/67-69	68.5/68.0
Length of mandible	..	375	512	85.6-87.5	86.5
Length of lower tooth row	..	235	340	53.6-58.1	55.8
Number of alveolus (lower jaw)	..	65+65	64+64	64-65/64-65	64.5/64.5
Teeth length	..	12	14	12-14	2.5

TABLE 2. *Measurements of the skull of* Stenella longirostris *Gray from Off Calicut coast*

		(mm)			(%)	(%)
		1	2	3	range	$\bar{x}$
Condylobasal length	..	385	351	380		
Rostrum length	..	260	230	245	64.5-67.5	66.7
Rostrum basal width	..	70	65	68	17.9-18.5	18.2
Breadth across Pre-orbital	..	127	120	127	33.0-34.2	33.4
Zygomatic width	..	138	132	135	35.5-35.8	36.3
Width of Brain case (across parietals)	..	132	120	130	34.1-34.2	34.1
Greatest length of Pterygoid	..	50	50	54	12.9-14.2	13.8
Greatest post-orbital width	..	139	135	138	31.0-38.5	34.6
Maximum width of pre-maxilla	..	55	52	55	14.3-14.8	14.5
Length of post-temporal fossa	..	47	58	46	12.1-16.5	13.6
Length of tooth row (right)	..	230	200	210	55.2-59.7	57.3
Number of alveolus (upper jaw)	..	56+54	53+54	49+49	49-56/49-54	52.6-52.3
Length of mandible	..	340	300	320	88.3-84.2	86.0
Length of lower tooth row	..	227	190	210	54.1-59.0	56.1
Number of alveolus (lower jaw)	..	50+51	50+50	49+49	49-50/49-51	49.6-50.0
Teeth length (30th)	..	11	11	11	2.3-2.7	2.7
			30th			
Sex	..	M	M	F		

TABLE 3. *Measurements of the skull of the dolphin* Tursiops aduncus *Ehrenberg off Calicut coast*

	(mm)			(%)	(%)
	1	2	3	range	$\bar{x}$
Condylobasal length ..	432	435	495		
Rostrum length ..	270	265	300	60.6-62.5	61.3
Rostrum basal width ..	95	95	105	21.2-22.0	21.6
Breedth across Pre-orbital ..	185	175	190	38.4-42.8	40.4
Zygomatic width ..	205	200	230	45.9-47.4	46.5
Width of Brain case (across parietals) ..	165	165	185	37.4-38.2	37.8
Greatest length of Pterygoid ..	58	50	66	11.5-13.3	12.6
Greatest post-orbital width ..	185	—	—	—	42.8
Maximum width of pre-maxilla ..	77	74	83	16.7-17.8	17.1
Length of post-temporal fossa ..	91	87	95	19.1-20.1	20.0
Length of tooth row (right) ..	223	220	250	50.5-51.6	50.8
Number of alveolus (upper jaw) ..	28+28	27+27	27+27	27-28	27.3
Length of mandible ..	385	370	410	82.8-89.1	85.6
Length of lower tooth row ..	222	220	255	50.4-51.5	51.1
Number of alveolus (lower jaw) ..	28, 26	26, 26	28, 28	26-28	27.3
Teeth length (14th) ..	26	26	26	26	26
		14th			
Sex ..	F	F	M		

TABLE 4. *Measurements of the skull of the hump back dolphin* Sousa chinensis *Osbeck from off Calicut*

	(mm)		(%)	(%)
	1	2	range	$\bar{x}$
Condylobasal length ..	557	575		
Rostrum ..	357	364	63.3-64.1	63.7
Rostrum basal width ..	108	115	19.4-20.0	19.7
Breadth across Pre-orbital ..	192	195	33.9	33.9
Zygomatic width ..	210	220	37.7-38.2	37.9
Width of Brain case (across parietals) ..	185	180	31.3-38.2	32.2
Greatest length of pterygoid ..	74	70	12.1-13.2	12.6
Greatest post-orbital width ..	195	195	33.9-35.0	34.4
Maximum width of pre-maxilla ..	80	84	14.3-14.6	14.4
Length of post-temporal fossa ..	110	110	14.7-15.3	15.5
Length of teeth row (upper right) ..	312	317	55.1-56.0	55.5
Number of alveolus (upper jaw) ..	38, 38	36, 37	36-38/37-38	37.0/37.5
Length of mandible ..	465	481	83.6-88.5	83.5
Length of lower teeth row ..	295	312	52.9-53.9	53.4
Number of alveolus (lower jaw) ..	34+35	36+36	34-36/35-36	35.0/35.5
Teeth length ..	20	20	3.3-3.6	3.4
		16th		

between 1.48 to 1.55 and it is more or less same in the species from Costa Rica, Eastern Pacific and Hawaii with values 1.53 to 1.57 (Perrin, 1975). Similarly the rostrum-Zygomatic ratio was also found to vary between 1.74 to 1.88 in the specimen from Calicut whereas the values ranged from 1.67 to 1.84 in the samples from Costa Rica, Eastern Pacific and Hawaiian waters. However, lower values were obtained in the Calicut specimens for the width of brain case (across parietal) to condylobasal length. In the Calicut samples it ranged between 2.91 to 2.92 whereas it was observed to vary between 3.0 to 3.3 in the Costa Rican, Eastern Pacific and Hawaiian samples. The number of teeth in the Indian form ranged between 98 to 110 in upper jaw, whereas, in the Costa Rican waters it was found to vary between 101 to 117 showing a high degree of closeness. (Perrin, 1975).

In the *Tursiops aduncus* occurring in India, the CBL rostrum ratio was 1.5 whereas in the South African bottle-nose dolphins the value was found to be 1.7 (Ross, 1977). The width of the brain case-CBL ratio was for 2.9 *T. aduncus* from the Indian Sea and 2.7 for the South African waters, showing a great degree of closeness. The same trend is reflected in the dentition as well. The Indian specimens have 54-56 teeth in upper jaw and 52-56 teeth in lower jaw, while the South African specimens have 48-53 teeth in the upper jaw and 46-56 in the lower jaw.

The ratio of condylobasal length to rostrum of *S. chinensis* was found to be 1.56 to 1.57 in the Indian form whereas the above ratio in the South African hump-backs varied between 1.56 to 1.63. The number of teeth in the dolphin from both places also did not show much variation. The Calicut hump-back dolphin has 76 or 77 teeth in upper jaw and 69 to 72 in lower jaw, whereas in South African dolphins the teeth ranged from 67 to 82 in the upper jaw and 62 to 76 in the lower jaw.

Though many species of the genus *Sousa* were described based mainly on the colour variation, a closer examination of their osteology may show that *S. plumbea* Cuvier, *S. lentiginosa* Gray, and *S. borneensis* Lydekker and *S. teuszi* Kukanthal are conspecific.

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