MORPHOMETRIC RELATIONSHIPS OF SPINELESS CUTTLEFISH, *SEPIELLA INERMIS* (ORBIGNY, 1848) FROM MUMBAI WATERS

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ABSTRACT

The relationships of various morphometric characters with dorsal mantle length (DML) of *Sepiella inermis* from Mumbai waters was established. The coefficient of correlation (r^2) for various morphometric characters against dorsal mantle length ranged from 0.747 to 0.942 indicating high degree of relationship among the characters compared. The regression of characteristics obtained by least squares method for *S. inermis* indicates that the characters have positive allometric growth.

Key words: Morphometric relationships, Cuttlefish.

INTRODUCTION

Cephalopods are strictly marine organisms and are found in all of the world's oceans, particularly over regions of continental shelf. *Sepiella inermis* (Orbigny, 1848) is a demersal shallow-water species with a wide distribution along the Indo-pacific region. In Indian waters, it constitutes the fishery along the east and west coasts in shallow waters up to depths of about 40 m.

Studies of morphological variation among fish population continue to play an important role in stock delineation, despite the advent of many biochemical and molecular genetic techniques. In tropical waters, where the fish fauna is very rich and diverse, identification becomes more difficult as many similar species exist in the same locality with overlapping characters. Morphometric relationships, that are proportions of different body parts are more frequently used since they are easier to compute. Frequently different authors quote different size measurements because of which comparisons are extremely difficult. It is therefore imperative to have mathematical expressions, which define a particular relationship, so that measurements can be converted for better comparisons (Farmer, 1986).

Many times meristic differences between the stocks are very small and not apparent in individual specimens, but often only in an average of large number of specimens. Analysis of such data requires intricate statistical treatment, which is essential to pin point differences or resemblances of characters for the identification of a particular stock of a specific locality. The studies of morphometric and meristic characters of a fish gives substantial information with regard to exact identification key of the species and such data can be used to compare the same species of different geographical locations.

In cephalopods, these include relationships between various parameters such as dorsal mantle length, dorsal body breadth, total weight, meat weight etc. In case of cephalopods, length of the mantle from the anterior most point on the dorsal side to the posterior body tip is considered as the 'standard' and is termed as dorsal mantle length (DML). A lot of work has been carried out by different authors, on many species of cephalopods from Indian waters, mainly on the length-weight relationship, but there is not much work on other morphometric relationships on cephalopods and there seems to be no study on the biometrics and morphometric characters of *Sepiella inermis* from Indian waters.

MATERIAL AND METHODS

A statistical analysis of morphometric characteristics gives a better idea of relationship with in the species and also to compare with the same species in different geographical areas. It was noticed that the males and females of *S. inermis* differ in size. The females grow larger in size than males and because of this all dimensional relationships were calculated separately for the two sexes. When the sexes of smaller specimens could not be identified externally, the mantle was cut open mid-ventrally to determine the sex. Presence of small pear shaped nidamental glands was indicative of females.

During the period January 2001-December 2002, monthly samples of *S. inermis* were collected from the trawlers operated at New Ferry Wharf. The samples from a wide range of sizes were brought to the laboratory and were identified, sorted and sexed after which the length and weight of individuals were taken in fresh condition. The DML and other morphometric measurements were taken using a divider and measuring board to the nearest millimeter as described by CMFRI (1995). After taking lengths, the cuttlefishes were blotted dry and weighed on an electronic balance up to nearest milligram to record the body weight (BD WT). The meat weight (MT WT) was noted after removing the head, cuttlebone, skin and the entire viscera. Cuttlebone (shell) weight (SL WT) was recorded after removing it from the mantle cavity.

The data collected from January 2001 to December 2002 were pooled together and the different relationships were obtained through regression analysis by the method of 'least squares' based on individual measurements. Relationships between dorsal mantle length (DML)/ dorsal mantle breadth (DMB), dorsal mantle length (DML)/ head length (HL), dorsal mantle length (DML)/ head breadth (HB), dorsal mantle length (DML)/ fin length (FL), dorsal mantle length (DML)/ tentacle length (TL), dorsal mantle length (DML)/ arm lengths (AL I, AL II, AL III, AL IV) and Head length (HL)/ eye diameter (ED) were found to be linear. The DML was taken as the independent variable (X) and the other characteristics according to suitability as a dependent variable (Y) for fitting the regression. The analysis showed exponential relationship for dorsal mantle length (DML)/ meat weight (MT WT) and dorsal mantle length (DML)/ cuttlebone (shell) weight (SL WT). Therefore, logarithmic transformation was adopted. The expression used for calculation was:

$$\text{Log } W = \text{Log } a + b \text{ Log } L$$

Scattergram plots of each measurement were plotted against DML for comparing regression of morphometric measurements. Relationship among the various morphometric parameters was worked out using standard linear regression analysis technique. Method of Le Cren (1951)

was used for the analysis. The curvilinear relation was transformed into linear one by taking base ten logarithms. Intercept (a) and slope or regression coefficient (b) was calculated using the standard regression analysis.

The relative length of arms is expressed as 'arm formula' in order of decreasing length (Silas *et al.*, 1985). For better comparisons, arm lengths and tentacle lengths from the right side of the body were considered for measurements. It was attempted to derive at the arm ratio, which is species specific. The current investigations would help to differentiate the populations and racial differences of this species, if any.

RESULTS

In males, there are a series of white spots or ornamental ocelli along the dorso-lateral surface of the body and the entire strip of the fins. It is interesting to note that males do not have these spots when they are young up to the size of about 20 mm. These spots develop as the animal grows and it becomes prominent and larger in size with age. Females do not have these spots but start to develop them as they mature. They develop tiny spots from the size 35 mm onwards. Though these spots are prominent, they are smaller in size compared to males of the corresponding size. Because of this anomaly there is every chance of sexual misidentification for this species.

A total of 88 male specimens ranging from 18 to 68 mm in DML with the body weight ranging from 1.164 to 45.363 gms and 88 female specimens ranging from 25 to 82 mm in DML with the body weight ranging from 3.858 to 87.857 gms were analysed for various morphometric relationships. The results of analysis of data on various body proportions against DML are given in Table 1.

It is seen that the correlation coefficient (r^2) of various morphometric characteristics (other than arm lengths) as a function of length varied from 0.6463 (eye diameter) to 0.9263 (fin length) for males and it varied from 0.3719 (eye diameter) to 0.9421 (fin length) for females. The values indicated that the compared characteristics were related to each other. Most of the characters correlated, exhibited linear growth. The 'b' values for MT WT and SL WT indicated that they grew in exponential fashion hence they were converted in to Log to get a linear relationship. The meat and shell grew in weight exponentially as the animal grew. The 'r^2' value varied from 0.9223 in the case of shell weight to 0.9356 in case of meat weight for males and it varied from 0.9397 in the case of shell weight to 0.9457 in case of meat weight for females. On an average the arm ratio of *S. inermis* is found to follow the ratio 4:3:2:1 for both males and females. When the animals were young, it was observed that the arms seemed to be more or less equal in length and the same was the case in large sized animals also.

DISCUSSION

The regression coefficient (b) value or slope for fins was high with 0.9250 and 0.9542 respectively for males and females, which indicates that the fins grew along with the mantle length. Low 'b' values were observed in HL (0.3812 for males and 0.3342 for females), HB and ED, which indicated very slow growth rate, from which it can be inferred that as the animal grew the head did not grow proportionately. Thus compared to older animals the younger animals head looked slightly wider and bigger. The tentacles grew extremely fast (b = 2.7605 for males and b = 2.7615 for females) in both the sexes compared to other body parts, indicated higher growth rate for tentacles. The high

Table 1: Regression values for various morphometric characteristics of *Sepiella inermis* from Mumbai waters

Measurement code	Coefficient of correlation (r^2)		Intercept (a)		Slope (b)	
	Male	Female	Male	Female	Male	Female
DML / DMB	0.8885	0.9099	1.8122	1.8974	0.7359	0.7399
DML / HL	0.7899	0.8406	1.6025	2.7945	0.3812	0.3342
DML / HB	0.7478	0.8805	3.6205	4.3753	0.4337	0.4092
DML / FL	0.9263	0.9421	-1.7119	-3.3467	0.925	0.9542
DML / TL	0.7848	0.8567	8.9443	5.8393	2.7605	2.7615
DML / AL (I)	0.5280	0.6238	3.4904	5.1124	0.4017	0.2937
DML / AL (II)	0.5077	0.5458	5.3924	9.0615	0.4136	0.2686
DML / AL (III)	0.5126	0.4384	6.3351	12.0913	0.4568	0.2597
DML / AL (IV)	0.4744	0.3913	9.6033	14.8141	0.4653	0.2843
HL / ED	0.6463	0.3719	2.3755	4.766	0.2193	0.1153
DML / MT WT	0.9356	0.9457	-3.7471	-3.6187	2.7573	2.6778
DML / SL WT	0.9223	0.9397	3.9177	4.0633	2.3536	2.4494

values may be because in cephalopods, the tentacles are the main organs for predation. The 'b' values for the arms were very less ranging between 0.2597 (A III, female) to 0.4653 (A IV, male), indicating a slow growth of arms. The 'r^2' values were also very low and this could be attributed to the constant wear and tear the arms have to incur throughout their lifetime for various activities. It's a known fact that cephalopods regenerate their arms and tentacles, which has been reported by many authors worldwide. Nair and Rao (1985) has given an account of this phenomenon in the cuttlefish, *Sepia pharonis* and in the squid *Loligo duvauceli* from Indian waters.

The regression of characteristics obtained by 'least squares method' for *S. inermis* indicates that the characters have positive allometric growth. The growth in body proportion is much faster than head length and eye diameter indicating growth of head is slowed down as the animal grows in length. In the present study the coefficient of correlation (r^2) for various morphometric characters against dorsal mantle length ranged from 0.74 to 0.94 (excluding arm lengths and eye diameter) indicating high degree of relationship among the characters compared. The high values of correlation coefficient obtained for various

morphometric characters also indicate high degree of interdependence of these compared characters. It is evident from the results that the compared characters were correlated to each other, which indicated that the species continue to retain its specific body shape throughout its life except for a shorter head. From the eye diameter studies as a function of length, it can be inferred that the eye diameter of males ($r^2 = 0.6463$) are larger than females ($r^2 = 0.3719$).

Thus from the present studies it appears that *S. inermis* follows allometric growth pattern like all other cephalopods. Such allometric growth has also been reported for other cuttlefishes from Mumbai waters like *Sepia aculeata* (Menon, 1988 and Nalwa, 2005). From the foregoing discussion it is safe to assume that the population of *S. inermis* in Mumbai waters is homogenous and belong to the same stock.

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