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BIOLOGY OF THE SPINELESS CUTTLEFISH, *SEPIELLA INERMIS* (VAN HASSELT, 1835) LANDED ALONG VERAVAL COAST

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ABSTRACT : Sixteen morphometric and four meristic characters of *Sepiella inermis* of Veraval coast were studied and the relationships of morphometric characters with dorsal mantle length (DML) were established. Total 1900 samples were collected and analyzed. The characters compared showed a fair to high degree of correlation. The r value between DML and mantle breadth was 0.805 in male and 0.794 in female showing highest correlation. However the correlation coefficient for number of suckers of four arms against DML was poor in both male and female. The average slope (b) value was found to be 1.886 ± 0.1275. The average intercept (a) value was -3.973 ± 0.5284. The r value was 0.483 in male. In female the average slope (b) value was found to be 2.518 ± 0.1227. The average intercept (a) value was -6.634 ± 0.5124. The r value was 0.532. As per average slope (b) it can be concluded that there was allometric growth. There was differential reproductive growth in male and female. The gut content analysis revealed higher food availability in the month of December. Food and feeding analysis confirm the carnivorous feeding behavior of the species. Condition factor was found good in the month of February. There was a variation in condition factor by size (length) class. Relatively lower condition factors were recorded for smaller size of *Sepiella inermis* females and higher in medium size of males. Full gut content was observed in the month of May.

Key words : Gut analysis, length-weight relationship, reproductive biology, *Sepiella inermis,* condition factor, allometric.

INTRODUCTION

The spineless cuttlefish, *Sepiella inermis* constitutes 2-4% of the total cephalopod landings of India (CMFRI, 2006). *Sepiella inermis* is a demersal shallow water species with a widely distributed along the Indo-Pacific region (Roper *et al*, 1984). In Indian waters, it is widely distributed along both east and west coasts upto depths of about 100 m. Trawlers are the main gear used to capture *Sepiella inermis*. In Kerala and Tamil Nadu, they are also caught by shore seines and boat seines (Silas *et al*, 1982). Along the Mumbai coast, Studies on the biology of this species was carried out by Oommen (1977) from Cochin waters, Jothinayagam (1981) from Madras, Unnithan (1982) from Mandapam, Silas *et al* (1985b) from Kakinada, Madras, Proto Novo, Waltair and Cochin, Apparna Sastry (1989) from Kakinada, Talukdar *et al* (1995) from West Bengal, Sarvesan (1996) from Madras, Sivalingam (1999) and Neethiselvan *et al* (2002) from Tuticorin and Sujit S. and Mohammad Zafar (2011). Though, *Sepiella inermis* is an emerging species in the cuttlefish fishery from the shallow inshore waters, not much work has been carried out on this species from the Gujarat coast of India. Therefore, an attempt has been made to study the length-weight relationship, food and feeding and reproductive biology of *Sepiella inermis* from Veraval coast, north-west coast of India.

MATERIALS AND METHODS

During the period March 2015-February 2016, 1900 samples of *Sepiella inermis* were collected fortnightly from the trawlers operated at bhidia landing center, finger jetty and light house landing center of veraval. The Dorsal Mantle Length (DML) and Body Weight (TW) measurements were taken as described in CMFRI (1995). Samples could not be collected for the month of June and July as mechanised trawling was suspended from 10th June to 15th August, due to the restrictions imposed by the government of Gujarat during south-west monsoon season. The length-weight relationship (L-W) (length in mm and weight in g), food and feeding habits and reproductive biology of 786 males (21 - 69 mm, DML) and 1222 females were analysed. Studies on 100 specimens of indeterminants (5 - 10 mm, DML) were also carried out. The sex-ratio was determined for the period March 2015-February 2016, based on random selection of 1900 individuals (males: 678 and females: 1222). Length-Weight relationships were obtained with the regression equation W = a * Lb (Le Cren, 1951). To find out difference between L-W relationship of males

and females, regression coefficients were tested by 't' test described by Zar (1999). To test the equality of correlation coefficient 't' test was followed.

The stomach condition was divided into six stages such as 'full', '¾ full', '½ full', '¼ full', 'trace' and 'empty' as per Kore and Joshi (1975). The feeding intensity was calculated by the 'points' method (Hynes, 1950) and the index of preponderance was estimated as suggested by Natarajan and Jhingran (1961). Apart from these, monthly gastrosomatic index was also estimated. Reproductive studies were carried out according to Silas et al. (1985a). The animals were classified into four maturity stages, immature (stage I), maturing (stage II), mature (stage III) and gravid or ripe (stage IV). The size at first maturity was estimated by King's (1995) method. To estimate the fecundity, ovaries were removed from the fresh specimens and a few drops of formalin (4%) were added and teased to facilitate easy separation. Ovadiameter measurements were made according to Prabhu (1956). Apart from these parameters, sex ratio, maturity, spawning population, spawning season, spawning frequency, gonadosomatic index were estimated.

RESULTS

The regression coefficient values obtained for the length-weight relationship of males and females were significantly different. The 't' test indicated that the 'b' value significantly ($p<0.05$) departed from the isometric value for males, females and indeterminants. The average slope (b) value was found to be 1.886 ± 0.1275. The average intercept (a) value was -3.973 ± 0.5284. The r value was 0.483 in male. In female the average slope (b) value was found to be 2.518 ± 0.1227. The average intercept (a) value was -6.634 ± 0.5124. The r value was 0.532. As per average slope (b), it can be concluded that there was allometric growth.

The food items were in well crushed and macerated condition, therefore they were categorised into groups, such as 'crustacean', 'fishes', 'cephalopods' and 'digested matter'. Month-wise analysis of stomach contents of *Sepiella inermis* revealed that 'crustacean ' formed the major constituent in all the months with dominance in December. The monthly percentage occurrence of 'fish' exhibited considerable variation. The maximum amount of 'crustacean' was observed in December and very high feeding intensity was also observed during this month. The dominance of 'crustacean' was reduced during May and September. 'Fish' was the dominant group in September which was very less in January. In May, they consumed 'crustacean remains' and 'fish' in equal quantities. 'Cephalopod' parts were observed in small quantities in January, March and April, hence cannibalism appears to be occasional. In indeterminants (5-19 mm), 'digested matter' found which was not categorized. There is no definite trend in feeding intensity of *Sepiella inermis* and there are wide fluctuations in the percentage occurrence of degree of fullness of stomach in different length groups. The gastrosomatic index showed five peaks; February (7.15%), May (14.5%), September (12.80%) and October (12.20%)December (10.15%).

Sex ratio Below 29 mm, all the males and females were in stage I while beyond 70 mm they were in stage IV. The smallest mature male and female were recorded at 30 mm and 32 mm, respectively. The maturity curve showed that 50% of the males matured at 45.00 mm and females matured at 52.00 mm. Males of length range 45-69 mm and females of length range 55-79 mm form the spawning population caught intrawlers from Mumbai waters. The matured animals occurred throughout the year.A primary peak of mature females was observed in five months indicating that species has five spawning seasons in a year.

DISCUSSION

The 'r^2' values of the length-weight relationship of *Sepiella inermis* are highly correlated to each other and the 'b' values were also high. It can be inferred that this species follows allometric growth. Females tend to gain moreweight, which is in agreement with that observed by Unnithan(1982), Appanna Sastry (1989) and Sarvesan (1996). Jothinayagam (1981), Unnithan (1982), Silas *et al* (1985b) and Talukdar *et al* (1995) have recorded 'crustaceans' asthe common food item and 'fishes' next in abundance,which is in accordance with the this findings. The present investigation revealed occasional cannibalism, which was also observed by Silas *et al* (1982). The monthwise feeding intensity shows that they are 'very active' just before the spawning seasons and during spawning they seem to feedvery less which is evident by the GSI values. It was observed that females were dominant throughout the year. The sexes were significantly different ($p< 0.05$) throughout the year. The number of 'empty' stomachs observed during January-February, April-May, August and October-November.Between the two sexes, females showed more 'active feeding' than males and this may be because the reproductive output of females is far higher and theirmetabolic requirements may be greater than that of males. According to Sarvesan (1996), active feeding was recordedin size group 80-84 mm. A similar observation was made in the present study with active feeding intensity in larger length group of 70-84 mm (spent), which may be to recoup the energy spent

during spawning. In indeterminants, 50% of the stomachs were found to be 'empty' and this can be attributed to them having high basic metabolic rate, which seems to enable them to grow fast. The sex ratio of *Sepiella inermis* showed dominance of females throughout theyear which is also in agreement with Jothinayagam (1981), Unnithan (1982), Silas *et al* (1985), Sarvesan (1996) and Neethiselvan *et al* (2002). The variation in the sex ratiomay be due to movement of the females to inshore waters for spawning. Immature and mature individuals were observed throughout the year, which was also observed by Jothinayagam (1981), Unnithan (1982), Sarvesan (1996) and Talukdar *et al* (1995). According to Neethiselvan *et al* (2002), the representation of wider length range with mature stages rules out the possibility of semelparity in this species. The size at first maturity in the present study was estimated at 48.06 mm for males and 55.04 mm for females, but according to Unnithan (1982), Sarvesan (1996) and Neethiselvan *et al* (2002), the values are 51 mm, 47 mm and 45 mm for males and 31 mm, 58 mm and 45 mm for females, respectively.

According to the observations made by Unnithan (1992), Silas *et al* (1985b), Talukdar *et al* (1995) and Neethiselvan *et al* (2002), occurrence of mature and immature stages throughout the year indicate prolonged nature of breeding habits. Sarvesan (1996) from Madras waters observed the dominance of males over females instage II and III, with equilibrium at stage III that indicating that the sexes probably congregate together for courtship and spawning activities. From the present study, it may also be inferred that this species exhibits prolonged breeding with five spawning seasons. According to Unnithan (1982), Sarvesan (1996) and Neethiselvan *et al* (2002) the fecundity of *Sepiella inermis* varied between 470-850, 380-590 and 437-684 ova respectively and in the present study, the fecundity ranged from 216 to354 ova, which was less than those observed from other areas. This could be probably because *Sepiella inermis* from veraval coast grow comparatively smaller in size and attain maturity faster because of intense fishing pressure. Sarvesan (1996) and Neethiselvan *et al* (2002) commented that fecundity increased in direct proportion to the total length, which was also observed in the present study, It was often observed that sometimes females with smaller size and weight produced more number of eggs than those with larger size and weight. This may be attributed to the fact that *Sepiella inermis* shed eggs in batches (Sivalingam, 1999) and therefore there is poor relation between total weight and fecundity. Based on the observations made on this species from veraval coast, it can be inferred that the species have five spawning seasons, which is well supported by the values of GSI. High values of GSI indicate full development of gonads and low values indicate spawning activity. Based on GSI values, it seems that spawning was active almost throughout the year. Thus from the ongoing discussion, it is inferred that *Sepiella inermis* from Veraval coast shows allometric growth, feedingmainly on 'crustacean' followed by 'fish'. Basedon the observations made by the maturity studies, conditionfactor and GSI it can be inferred that *Sepiella inermis* has five spawning seasons *viz*., February, May, September, October and December.

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