# OBSERVATIONS ON THE BIOLOGY OF CUTTLEFISH *SEPIELLA INERMIS* AT MANDAPAM

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**ABSTRACT**

*Sepiella inermis* was found to grow to a size of 50 mm at the end of first year and 80 mm of mantle length at the end of second year. The size at first sexual maturity is 50 mm for males and 31 mm for females. Prawns were the main item of food of the species.

## INTRODUCTION

The cuttlefish, *Sepiella inermis* (Ferussac and d'Orbigny) is one of the species of cephalopods common in trawl catches in Mandapam area. Stray catches are noticed in shoreseines also. *S. inermis* has a wide distribution and has been recorded from Red Sea, South Arabia, east and west coasts of India, Andaman Islands, Ceylon, Burma, Malaysia, Indonesia and Vietnam (Ferussac and d'Orbigny 1835-1848, Rochebrune 1884, Adam 1939, Satyamurthi 1956, Adam and Rees 1966, Silas 1968). Oommen (1977) has studied the food, feeding and fishery of the species based on his collections from the west coast of India. As the biology of the species from the east coast has not been studied in detail, it has been investigated and the results are presented in this paper.

## DESCRIPTION OF THE SPECIES

*Sepiella inermis* is a small-sized cuttlefish with narrow fins. The mantle has a pore at the posterior extremity and the cuttle bone is without a spine. Shell is moderately small and rather narrowly ovate in outline. The horny margin forms a characteristic thin, broad plate behind the calcareous portion and is highly glossy. The dorsal surface is finely granular and bears two shallow longitudinal grooves which gradually diverge from the posterior to the anterior extremity, and enclose between them a slight broadly rounded elevation. Shell is chalky white, but the horny margin is pale brown and polished.

The eyes are of moderate size. The mantle is conico-cylindrical and its anterodorsal margin extends forwards over the nuchal region to blunt point. The third and fourth pairs of arms are predominantly keeled. In males the fourth arm of the left side is hectocotylised and the basal portion of the arm does not

have suckers. The total number of suckers on this arm is less (18-39) compared to the number (37-82) of suckers on the other arms. Tentacles are elongate and rounded bearing medium-sized tentacular clubs. Funnel is well developed. The jaws are horny and have well developed cutting edges. The dorsal surface is grey brown or purple depending on the chromatophores present. There is a series of white spots on the dorsolateral surface of the mantle. The ventral surface is pale grey or pale brown.

## Material and Methods

Random samples from January 1973 to May 1974 were collected from trawl catches from depths of 9 to 14 metres off Mandapam and Rameswaram. The size, length of mid-dorsal mantle and weight of the cuttlefish was noted. The length-weight relationship was determined for males and females using the formula,

$$W = a L^n$$

where, W = weight, L = length and a and n are constants.

The value of the constants was determined by the least square method after converting the length and weight data to logarithms. Age and growth were determined by length-frequency analysis and probability plot method (Cassie 1954).

Maturity stages were denoted as immature, maturing, mature, spent and recovering. In immature females the ovary appears as a thin white patch in the coelomic space in the posterior part of the mantle cavity beneath the dorsal mantle wall. Eggs can be distinguished only by microscopic examination. In maturing females the ovary is bigger in size, the eggs with accumulating yolk are small and are visible to naked eye. Mature ovaries prior to spawning have eggs fully grown. Ripe eggs are translucent with reticulate surface. The mature ovary is compact, occupying a large space in the posterior part of the mantle cavity. The nidamental glands are full and glossy white and the accessory nidamental glands orange red. Spent females have only a few number of eggs and the mantle becomes flaccid; nidamental glands become thinner and less glossy. Accessory nidamental glands turn pink. Spent females weigh considerably less than the gravid one of corresponding length. Recovering ovary contains developing eggs in addition to a few residual eggs.

Immature males can be identified only by microscopic examination of the testis which appears as a thin and pale white mass in the gonadial part of coelomic space, very close beneath the dorsal mantle wall in the distal part of the mantle cavity. Maturing males can be distinguished by thicker pale white testes which are bigger compared to the previous stage. Ripe testes are thick and turgid containing spermatozoa. The spermatophore sac is bulged with spermatophores. After spawning, the testis becomes flaccid and pale and the spermatophore sac shrunken with a few seprmatophores only.

The food and feeding habits of the cuttlefish of different sizes and in different maturity stages were studied by points method (Hynes 1950) through eye estimation. Based on the degree of distension of stomach the stomachs were classified as poor, ¼ full, ½ full, ¾ full, full and gorged. Stomachs of 273 specimens of *S. inermis* of both sexes were examined.

## Length-Weight Relationship

A total 134 specimens ranging from 24 mm to 84 mm in length were analysed for this purpose. Length and weight of individuals were taken in fresh condition. Logarithmic equation derived for males and females are given below.

Males : $\text{Log } W = -1.9601 + (1.9320 \text{ Log } L)$

$W = 0.01096\ L^{1.9320}$

Females: $\text{Log } W = 2.5493 + (2.3208 \text{ Log } L)$

$W = 0.002823\ L^{2.3208}$

The logarithmic values of observed lengths and corresponding weights were plotted (Fig. 1) and the regression line fitted to the data indicates a straight line relationship between the two variables.

In Table 1 the sum of squares and products of X and Y are given and in Table 2 the corrected sum of squares and products. Males and females were treated separately and when analysed by the analysis of covariance (Table 3) they differed significantly at 5% level.

## Age and Growth

From the analysis of the random samples obtained during a period of 17 months, from January 1973 to May 1974, the progression of modes was traced through successive months. The size of cuttlefish ranged between 21 mm and 112 mm. Individuals above 80 mm were not common.

One mode seen at 35 mm in May 1973 (Fig. 2) shifted to 45 mm in August, 1973 showing a growth rate of 3.3 mm per month. The mode further shifted to 55 mm by December 1973 showing a growth rate of 2.5 mm per month. The same mode progressed to 65 mm in May 1974, indicating a growth rate of 2 mm a month. By plotting the modal sizes and tracing the origin of the brood by extrapolation (Fig. 3) it was noticed that the brood was recruited in October, 1972. Thus the size of 65 mm seen in May 1974 is 19 months old. Up to the seventh month, i.e., May 1973, this brood showed a growth rate of 5 mm per month. Thereafter a gradual decline in the growth rate was evident as the cuttlefish advanced in age. At the end of first year, the cuttlefish reached 50 mm size. This agrees with the results obtained by the probability plot method (Fig. 4) i.e., a growth of 51 mm at the end of first year.

The modal size seen at 65 mm in May 1974 (Fig. 3) represents a brood 19 months old. Another mode found at 55 mm in February 1973 could be traced to 75 mm in October 1973 showing a growth rate of 2.5 mm per month. By extrapolation it was found that the brood was recruited in December 1971. So the brood has attained a length of 75 mm at the end of 22 months. The rate

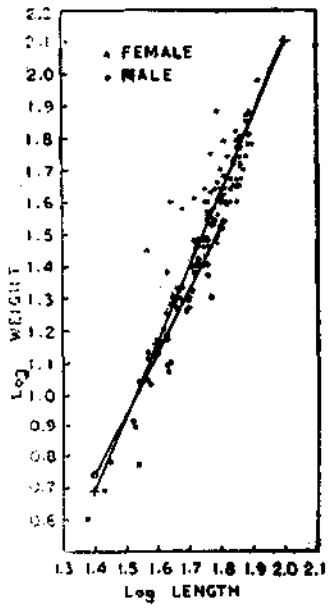


FIG. 1. Logarithmic relationship between length and weight of male and female of *sepiella inermis*.

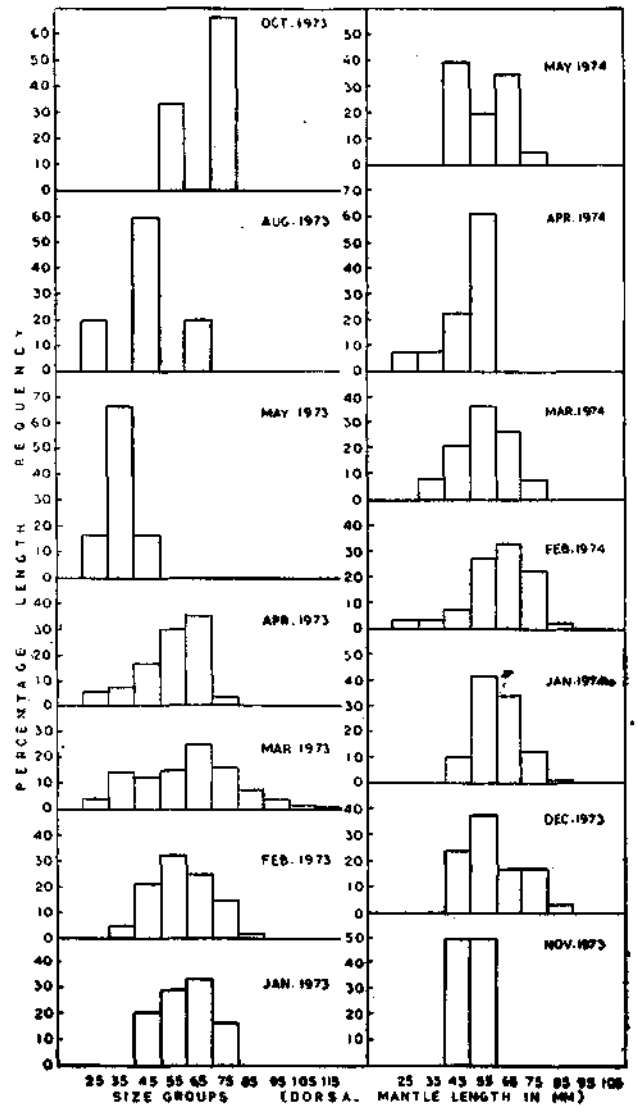


FIG. 2. Hisogram giving the percentage length-frequency distribution of *Sepiella inermis* in different months.

TABLE 1. *Sum of squares and products of length-weight data of males and females of* Sepiella inermis.

| Source | No. of specimens | SX | SY | $SX^2$ | $SY^2$ | SXY |
|---|---|---|---|---|---|---|
| Male | 42 | 70.0899 | 53.0249 | 117.3690 | 68.7247 | 89.3076 |
| Female | 92 | 163.4588 | 144.8134 | 291.2636 | 232.9195 | 259.2543 |

SX, SY = sum of X and Y; SX2, SY, SXY = sum of squares and products.

TABLE 2. *Corrected sum of squares and products of length-weight data regression coefficient and deviation from regressions.*

| | | Sum of squares and products | | | B | errors of estimate | |
|---|---|---|---|---|---|---|---|
| Source | D.F. | $X^2$ | $Y^2$ | XY | | D.F. | SS |
| Male | 41 | 0.4380 | 1.7861 | 0.8462 | 1.9320 | 40 | 0.1513 |
| Female | 91 | 0.8464 | 4.9362 | 1.9644 | 2.3208 | 90 | 0.3770 |

D.F. = degree of freedom; $X^2$, $Y^2$ XY = corrected sum of products and squares; B = regression coefficient; SS = sum of squares

TABLE 3. *Analysis of covariance of length-weight data.*

| Source of variations | Degree of freedom | sum of squares | Mean square | observed F | 5% F |
|---|---|---|---|---|---|
| Deviation from individual regression within sexes | 130 | 0.5283 | 0.0041 | 10.666* | 3.84 |
| Difference between regression | 1 | 0.0437 | 0.0437 | | |
| Diviation from average regression | 131 | 0.5720 | | | |

* Significant at 5% level.

of growth is comparable with that observed for the earlier brood. At the end of the second year the brood would attain a size of 80 mm which compares favourably with the values of 84 mm derived from probability plot method (Fig. 4).

## REPRODUCTION

Table 4 shows that females are proportionately more than males during all the months in 1973 except in November when the two sexes are in equal proportion. In January 1974 males formed 51.5% while females formed 48.4%. Between February and May 1974 females were dominant.

Majority of the males and females belonging to the 21-30 mm and 31-40 mm sizes groups were immature (Table 5). All the males of the 21-30 mm group were sexually immature. But some females of the same size group were sexually mature. The size group 41-50 showed higher percentage of ripe males

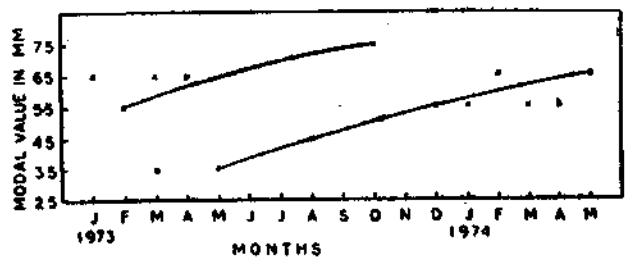


FIG. 3. Modal distribution of *Sepiella inermis* from January 1973 to May 1974 showing the progression of modes.

and females. In the size group 51-60 mm more than 50% of the males and females showed sexual ripeness. The size at first sexual maturity is 51 mm for males and 31 mm for females, as more than 50% of the individuals in these sizes have been found to be sexually mature.

The percentage of ripe males and females increased gradually from the group 51-60 mm. All the males in the size range 71-80 mm were ripe while 99.9% of the females of the same group were sexually mature. Those in the 81-90 mm size were all ripe.

The occurrence of cuttlefish in different maturity stages is given in Table 6. Immature and mature males and females were found during January-April 1973 and again in November-December 1973. The same condition was recorded in the period January-May of 1974 also. Spent condition was noticed in February and March 1973 and in January 1974. The occurrence of mature stages

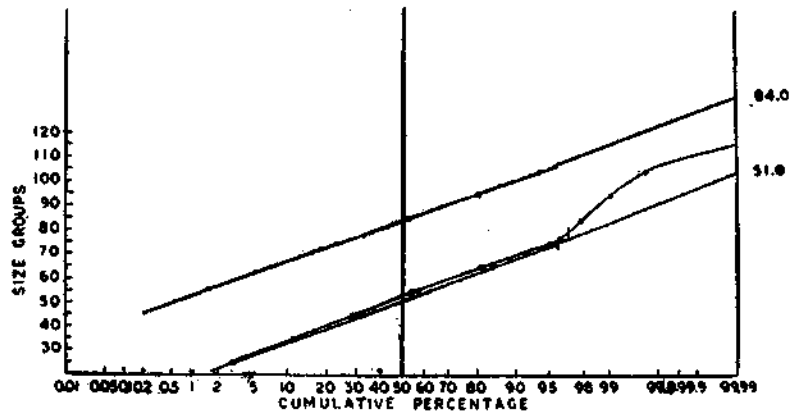


FIG. 4. Age determination of *Sepiella inermis* by probability plot method.

TABLE 4. *Sex-ratio of* S. inermis *in percentages*

| Months | Male % | Female % |
|---|---|---|
| January, 1973 | 22.5 | 77.5 |
| February | 39.6 | 60.4 |
| March | 40.0 | 60.0 |
| April | 27.5 | 72.4 |
| May | 33.3 | 66.6 |
| October | — | 100.0 |
| November | 50.0 | 50.0 |
| December | 37.0 | 62.9 |
| January 1974 | 51.5 | 48.4 |
| February | 48.6 | 51.3 |
| March | 31.8 | 68.1 |
| April | — | 100.0 |
| May | 15.0 | 85.0 |

TABLE 5. *Percentage of immature and mature stages of* Sepiella inermis *in different size groups.*

| Size groups | MALES | | FEMALES | |
|---|---|---|---|---|
| | Immature % | Mature % | Immature % | Mature % |
| 21-30 | 100.0 | — | 100.0 | — |
| 31-40 | 92.4 | 7.6 | 50.0 | 50.0 |
| 41-50 | 85.0 | 15.0 | 84.7 | 15.3 |
| 51-60 | 49.1 | 50.9 | 44.7 | 55.3 |
| 61-70 | 55.5 | 44.4 | 18.9 | 81.1 |
| 71-80 | — | 100.0 | 9.1 | 90.9 |
| 81-90 | — | — | — | 100.0 |

throughout the period of observations suggests prolonged breeding. However, only one brood originating in December 1971 and another originating in October 1972 were traced in the two years in commercial catches.

The spent females weigh much less than the mature ones and the mantle is comparatively thinner. The gland of oviduct and nidamental glands are small and flabby. Spent males have flabby bodies and testes and spermatophoric sacs are small. Similar observations have been made by Fields (1950) in *Loligo opalescens* and by Rao (1954) in *Sepioteuthis arctipinnis*.

TABLE 6. *Percentages of maturity stages of* Sepiella inermis *in successive months*

| Months | Immature | | Maturing | | Mature | | Spent | | recovering | | Indeterminate |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female | |
| Jan 1973 | 88.8 | 15.6 | — | 3.1 | 11.1 | 81.2 | — | — | — | — | 17.1 |
| Feb | 21.1 | 27.6 | 21.1 | — | 42.1 | 55.2 | 15.8 | 17.2 | — | — | 6.4 |
| Mar | 50.0 | 6.7 | 10.0 | — | 30.0 | 86.7 | 10.0 | 6.7 | — | — | 20.0 |
| Apr | 50.0 | 19.0 | 25.0 | — | 25.0 | 80.9 | — | — | — | — | — |
| May | — | — | — | — | 100.0 | 100.0 | — | — | — | — | 66.7 |
| Oct | — | — | — | 100.0 | — | 100.0 | — | — | — | — | — |
| Nov | — | — | 100.0 | — | — | 100.0 | — | — | — | — | — |
| Dec | 10.0 | 41.2 | 30.0 | 23.0 | 60.0 | 29.4 | — | — | — | 5.9 | — |
| Jan 1974 | 2.9 | 6.3 | 61.8 | 18.8 | 35.3 | 65.6 | — | 3.1 | — | 6.3 | — |
| Feb | 44.4 | 5.3 | 27.8 | 21.1 | 27.8 | 63.2 | — | — | — | 10.5 | — |
| Mar | 71.4 | 20.0 | 14.3 | 6.7 | 14.3 | 73.3 | — | — | — | — | — |
| Apr | — | 37.5 | — | 25.0 | — | 37.5 | — | — | — | — | 12.5 |
| May | 66.7 | 29.4 | — | 11.8 | 33.3 | 52.9 | — | 5.9 | — | — | — |

The total number of eggs found in the mature ovaries of individuals of *S. inermis,* 69 mm to 71 mm in mantle length (weighing 35.4 g to 59.3 g respectively) varied between 470 and 850 (Table 7). In sexually ripe ovaries both ripe and immature eggs were present, the former forming 37.5% to 62.6%. The diameter of immature eggs ranged from 0.67 mm to 2.24 mm and that of ripe eggs from 2.56 mm to 3.84 mm.

## FOOD AND FEEDING HABITS

A good percentage of cuttlefish, 50.00-76.4% of males and 23.5-31.2% of females, showed empty stomachs. Gorged stomachs were noticed only in females. Feeding intensity was generally poor in the two sexes, as in 5.8 to 25%

TABLE 7. *Fecundity of* Sepiella inermis

| Serial No. | Length (mm) | Weight (g) | Ripe eggs | | Immature eggs | | Total number of eggs |
|---|---|---|---|---|---|---|---|
| | | | No. | % | No. | % | |
| 1. | 59.0 | 35.7 | 232 | 39.4 | 238 | 50.6 | 470 |
| 2. | 60.0 | 37.7 | 280 | 46.6 | 321 | 53.4 | 601 |
| 3. | 66.0 | 59.3 | 532 | 62.6 | 318 | 37.4 | 850 |
| 4. | 69.0 | 35.9 | 293 | 47.4 | 325 | 52.6 | 618 |
| 5. | 71.0 | 55.1 | 297 | 37.5 | 495 | 62.5 | 792 |

of males and females only the stomachs were ¼ full or full (Table 8). The intensity of feeding was highest in the period January to April, whereas the observations made from the west coast of India by Oommen (1977) has shown that the species exhibits active feeding during the months of April and May. Compared to males, feeding was generally better in females.

As the stomach contents consisted mostly of digested matter and skeletal remains like bones and fins in the case of fish and exoskeleton in the case of crustaceans the identification of individual food items up to generic level was found to be difficult. Stomach contents included prawns, fishes, stomatopods, crabs and other crustaceans (Table 9). Of these Prawns constituted the common food item. Fishes were next in importance and included *Leiognathus* spp., *Upeneus* spp., and *Apogon* sp., Stomatopods and crabs were present in a few stomachs only. Study of frequency of preference of various food items in relation to the size of the cuttlefish showed gradual increase in the preference for prawns from the size group 31-40 mm. It reached the maximum in the size

TABLE 8. *Degree of fullness of stomach of* S. inermis *in relation to its maturity stages.* (M: male, F: female)

| Stages of maturity | Degree of fullness (in percentage) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Emtpy | | Poor | | ¼ Full | | ½ Full | | Full | | Gorged | |
| | M | F | M | F | M | F | M | F | M | F | M | F |
| Immature | 76.4 | 31.3 | 8.8 | 21.9 | — | 18.8 | 5.9 | 12.5 | 8.8 | 12.5 | — | 3.1 |
| Maturing | 66.7 | 23.5 | 19.4 | 52.9 | 5.6 | 5.9 | — | 5.9 | 8.3 | — | — | 11.8 |
| Mature | 51.6 | 23.1 | 22.6 | 24.8 | 9.7 | 15.4 | 9.7 | 14.5 | 6.5 | 11.9 | — | 10.2 |
| Spent | 50.0 | 25.0 | 25.0 | 25.0 | — | 25.0 | 25.0 | 12.5 | — | — | — | 12.5 |
| Recovering | — | — | — | — | — | 50.0 | — | 25.0 | — | — | — | 25.0 |

TABLE 9. *Frequency of various food items in stomachs of* S. inermis *in relation to its size.*

| Size group | Prawns % | Crabs % | Stomatopods % | Other crustaceans % | Fishes % |
|---|---|---|---|---|---|
| 31-40 | 22.2 | — | — | 11.1 | 7.4 |
| 41-50 | 32.2 | — | — | 15.2 | 5.0 |
| 51-60 | 26.2 | 2.9 | 1.9 | 10.6 | 12.6 |
| 61-70 | 41.2 | 1.0 | 1.0 | 11.2 | 25.0 |
| 71-80 | 48.8 | — | 2.3 | 9.3 | 18.6 |
| 81-90 | 50.0 | — | — | — | 50.0 |

group 61-70 mm. Fish occurred in 5.0-7.4% of cuttle-fish examined in the size range of 51-90 mm. Other crustaceans in a digested condition constituted 9.3-15.2% in different size groups. Crabs and stomatopods were evident in the stomach contents from 51 mm onwards.

## Remarks

*Sepiella inermis* occurring in trawling grounds off Palk Bay and Gulf of Mannar attains a size of 50 mm at the end of second year. Usually females of *S. inermis* are proportionately more than males in trawl catches. Sarvesan (1974) has stated that the size range of *S. inermis* in commercial landings at Madras is 40-55 mm. Since individuals above 80 mm are rarely caught at Mandapam it appears safe to conclude that the fishery is supported by 0- and one-year classes only. Breeding season appears to be prolonged. Prawns seem to be the favourite food item of *S. inermis*, as it is common in the stomach contents. Oommen (1977) has observed that the food of the species collected from the west coast constituted mainly of fishes. *S. inermis* is carnivorous like *Sepia* spp., which has been stated by Tompsett (1939) to feed mainly on crabs, small whiting, shrimps and prawns.

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