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THE BIOLOGY OF THE SPINELESS CUTTLEFISH *Sepiella inermis* d'Orbigny IN THE NORTH COASTAL WATER OF JAVA

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ABSTRACT

A study was carried out to investigate the length-weight relationship, reproductive aspect, growth, and the relationship between beaks and body size of the spineless cuttlefish, Sepiella inermis d'Orbigny in the northcoastal water of Java. The length-weight relationship varies in relation to sexes; the slopes (b) are 2.147 for male and 2.436 for female, implying that the female attains a larger size at the same length. The fecundity of the species ranges from 145 to 225 eggs (taken by means of direct egg counting from individuals having mantle length of 73 - 92 mm). The length at first maturity was estimated to be smaller in the male (73.24 mm) than in the female (91.63 mm). A growth model of the species is derived, based upon the data of cuttlebone striations and mantle length. The life span of the species is estimated to be around 1 year, with a maximum mantle length of about 140 mm. The species grows rapidly, with curvature parameter of 2.413 yr^{-1}*, and a hypothetical age* t_0 *of -0.01 yr. Lower hood length of the beaks show a strong, positive linear and and exponential relationships respectively with mantle length and total body weight. Their potential use for biomass estimation, and for tropho-dynamic studies in the coastal waters are indicated.*

Key words: cuttlebone, tentacular clubs, lower beaks, hood length

I. INTRODUCTION

Indonesia has diverse cephalopod resources distributed within its 6.2 million km^2 territorial seas and exclusive economic zones. However, until recently appropriate information of the diversity of these resources is lacking. Inadequate taxonomic skill often causes unnecessary landings classification, for example all cephalopods having internal calcareous shell are referred to as *Sepia*. In fact the family Sepiidae comprises other genera, such as *Sepiella*.

Roper *et al* (1984) indicated that the distribution of the Spineless Cuttlefish, *Sepiella inermis,* covers most of the Indo-Pacific region. However, it is suggested that its presence in Indonesian islands need to be confirmed. From the survey carried out from 1990-1993 by the author, it is reasonably clear that among the genus *Sepiella*, the most common species found in Western Indonesian Seas is *Sepiella inermis*. There is no special local name given to this species in the Indonesian islands; in Java all Sepiids are usually called 'sotong'. Several names are used for the species in some countries, however, like: Sepia inerme (French and Spanish), and Spineless cuttlefish (English). A number of synonyms are available in the literature i.e.: *Sepia (Sepiella) microcheirus* (Gray), *Sepia affinis* (Eydoux & Souleyet) and *Sepiella maindroni* (Rocherbrune) (Roper *et al*, 1984; Voss, 1963).

There is an extremely limited information available on the biology of *Sepiella inermis* Silas (1983) published in a review of India's cephalopod resources, part of which concerns with the spawning occurrence of the species. There is virtually no published study of the biology of the species in Indonesian region; such information is a primary requirement for their rational management and conservation.

II. METHODOLOGY

Fresh specimens of *Sepiella inermis* are collected by 'cantrang' net, and are examined in this study. About 14 specimens are also preserved in 4% formalin for reference collection and further laboratory observation.

Observations are carried out for the fresh specimens concerning their: dorsal mantle length (L, cm), total body weight (W, g), sex (male=1, female=2, unidentified=3), gonadal maturation (scale of 1-4), lower beak and cuttlebone characteristics and measurement.

Length-weight relationships are derived after plotting the weight (W) data against length (DML). The relationship usually follows the equations:

$$W = a \cdot DML^{b}$$

where a and b are regression constants (Beverton and Holt, 1993; Pauly, 1984; Ricker, 1975; Sparre *et al*, 1989) .

Using a four-stages gonadal maturation index, proportions (%) of each stage in the samples could be represented. By following through these figures within the successive times (weeks, months), the sequence of maturation and gonadal development during that period can then be traced. These proportions can also be used for estimating the size-at-first-maturity (Lm), following the procedures of Spearman-Karber (Sparre *et al*, 1989).

Observations for lower beak characters follow the standard preparation of the procedure described in Clarke (1986). Measurement is made in particular for lower hood length (LHL in mm), which is defined as the distance between the tip of the rostrum to the posterior margin of the hood. Plots of LHL against dorsal mantle length and against total body weight are examined to identify the resulted relationships.

Observations of cuttlebone is focussed at the number of striations or cuttlebone bands, and is carried out primarily to relate those numbers to animal's size, so that their growth may be estimated using standard procedure described in Pauly (1984) and Sparre *et al* (1989).

III. RESULTS AND DISCUSSION

3.1. Biometry

Figure 1 shows the typical feature of *Sepiella inermis* specimen collected during the study. The body is broadly oval in shape with short, stout arms. The internal shell is straight and chalky, and there is no spine at the posterior end of the cuttlebone. A large ventral pore is present at the junction between fins. The tentacular club (Figure 1.a.) carries 16 to 24 equal-sized, minute suckers in transverse rows. The protective membranes at the base of the tentacular clubs are narrow, extending proximally onto the stalk of the tentacles as low ridges. The female may attain a larger size than the male. The mature males display 5-7 reddish-white, oval patches along the fin bases.

The relationships between dorsal mantle length (mm) and total body weight (g), are derived for the male as shown in Figure 2:

Male: $\ln W = -5.207 + 2.147 \ln DML$

$(r = 0.95)$

$(P < 0.05;\ n = 65)$. The relationship significantly differs from that of the female of the same species, which the following relationship hold (Figure 2):

Female: $\ln W = -5.278 + 2.436 \ln DML$

$(r = 0.95)$

$(P < 0.05;\ n = 55)$. This implies that the female attains a larger size than the male at the same length, as a result the larger individuals found in the catches are generally females.

As most Sepiid beak, the lower beak of *Sepiella inermis* features an erroded portion of the jaw angle, so that the 'point' of that angle is generally unlikely to be identified. However, the hood portion of the lower beak is usually observable and therefore the lower hood length is used in the analysis. The relationship between dorsal mantle length (DML, mm) and lower hood length (LHL, mm) is presented in the following linear regression:

$$DML = 17.958\ LHL + 12.369$$

$(r = 0.89)$

$(P < 0.05;\ n = 31)$, whereas the relationship between total body weight (W, g) and lower hood length follows the exponential equation:

$$\ln W = -7.578 + 2.548 \ln LHL$$

$(r = 0.88)$

$(P < 0.05;\ n = 31)$ (Figure 3). The relationships may therefore be used to estimate the cuttlefish *(Sepiella inermis)* length and weight from lower hood size within the size range. In other word this result implies that conversion of beak size to body weight is possible for the species. Such a result is primarily important in the assessment of cuttlefish predation, as it allows for biomass estimation to be made, when cuttlefish remains or beaks removed from predators' stomachs are analysed. In addition it is significant in understanding the coastal biological processes, in particular the dynamics of predator-prey and trophic relationships involving coastal cephalopods.

3.2. Growth and Reproduction

A typical feature of the cuttlebone of *Sepiella inermis* is shown in Figure 1 (b - d). It is oval in shape ventrally (b) and dorsally; whereas the lateral aspect (d) displays a curved thickening toward ventral part, at about its anterior third of the cuttlebone.

The ventral part of the cuttlebone shows fine, clear concentric striations or bands. Ghofar (1989) investigated the status of the cuttlebone bands of 2 cuttlefish species in the Alas Strait, and has shown that the bands formation is likely to occur on a daily basis.

Laguna (1989) applied the asymptotic Von Bertalanffy growth model for *Octopus vulgaris* in Central Atlantic water. Araya and Ishii (1972) and Murata (1989) have shown the sigmoid growth pattern for *Todarodes pacificus* in Japanese water. Scattered plot of mantle length against age of *Sepiella inermis* in Southern Java Sea for the present study indicates an asymptotic pattern, as is presented in Figure 4. The growth parameters are derived as follows: asymptotic length L_∞ of 145.5 mm, curvature parameter K of 2.413 per year, and hypothetical age t_0 of -0.01 year. It is likely, as shown by the curve, that the life span of this species is more or less only one year, when the animal's length is about 140 mm.

Table 1 shows the number of eggs, egg diameter and the nidamental gland length of the species, which all tends to increase with the increasing body size. However, the small number of samples of completely mature eggs (4 only) do not allow for further analysis. From the samples, the fecundity ranges from 145 to 225 eggs, each with diameter range of 1.5 - 3.7 mm.

The size at first maturity of the species was estimated using procedure of Spearman-Karber, as shown in Table 2. The values were estimated for male to be 73.24 mm (with 73.08 - 73.39 mm lower-upper limits), and about 91.63 mm for female (90.77 - 92.48 mm limits).

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Tabel 1. Fecundity, egg diameter and nidamental gland length of *Sepiella inermis* in the North Coastal water of Java.

DML mm	Number of eggs*	Egg diameter mm	Nidamental gland length, mm
73	145	1.5 - 3.5	23
75	160	1.5 - 3.5	26
88	210	1.6 - 3.7	30
92	225	1.7 - 3.7	31

* counted whole

Table 2. Estimation of length at first maturity of *Sepiella inermis* in the North Coastal water of Java.

Mid-length cm	log ML Xi	Ni	Nj	Pi Ni/Nj	Qi 1-Pi	d Xi+1 - Xi	Pi.Qi/ Ni-1
Female 5.8	0.7634	2	0	0	1	0.0219	0
6.1	0.7853	3	3	0	1	0.0208	0
6.4	0.8062	6	2	0	1	0.0263	0
6.8	0.8325	4	2	0	1	0.0187	0
7.1	0.8512	6	3	0	1	0.0238	0
7.5	0.8751	11	7	0.6364	0.3636	0.0226	0.0231
7.9	0.8976	11	7	0.6364	0.3636	0.0214	0.0231
8.3	0.9191	12	9	0.7500	0.2500	0.0254	0.0170
8.8	0.9445	3	1	0.3333	0.6667	0.0193	0.0111
9.2	0.9638	2	1	0.5000	0.5000	0	0.2500
Sum		60	35	2.8561		0.2003	0.4244
Mean						0.0200	
Lm =	**9.16**						
Lm range=	**9.07-9.25**						
Male 3.9	0.5911	1	0	0	1	0.0217	0
4.1	0.6127	0	0	0	1	0.0307	0
4.4	0.6434	0	0	0	1	0.0286	0
4.7	0.6721	0	0	0	1	0.0269	0
5.0	0.6989	0	0	0	1	0.0253	0
5.3	0.7243	6	2	0.3333	0.6667	0.0239	0.0444
5.6	0.7482	5	1	0.2000	0.8000	0.0299	0.0400
6.0	0.7781	17	5	0.2941	0.7059	0.0280	0.0129
6.4	0.8062	16	5	0.3125	0.6875	0.0263	0.0143
6.8	0.8325	11	3	0.2727	0.7273	0	0.0198
Sum		56	16	1.4126		0.2414	0.1316
Mean						0.0241	
Lm =	**7.32**						
Lm range=	**7.31-7.34**						

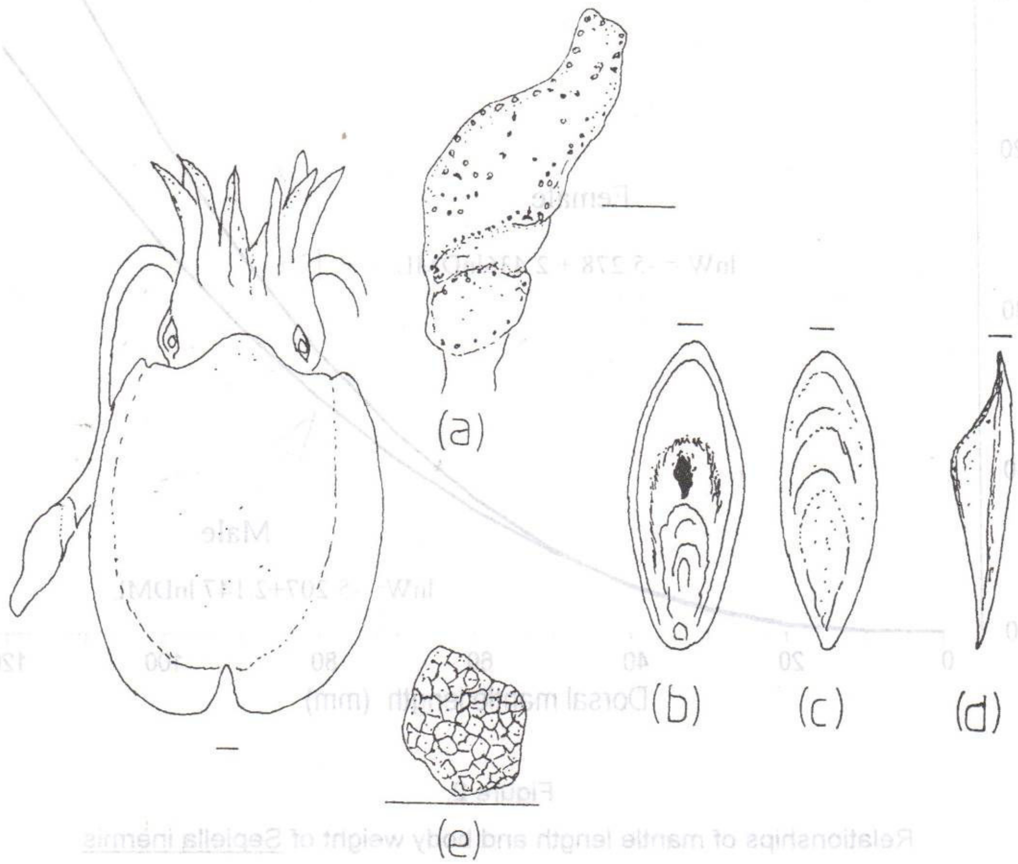

Figure 1.

Sepiella inermis d'Orbigny (dorsal view). (a) tentacular club showing minute suckers; cuttlebone: (b) ventral, (c) dorsal, (d) lateral; and (e) mature egg.
Bar = 5 mm

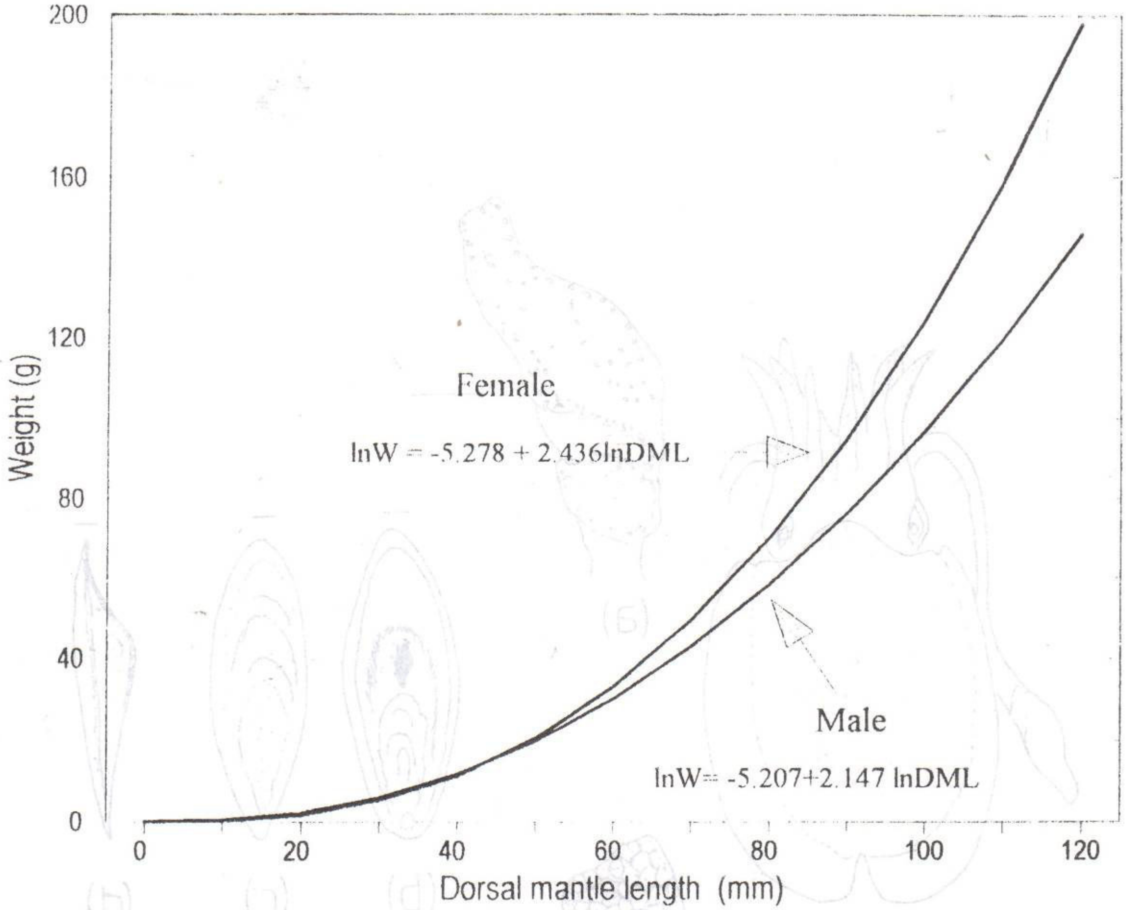

Figure 2.

Relationships of mantle length and body weight of Sepiella inermis

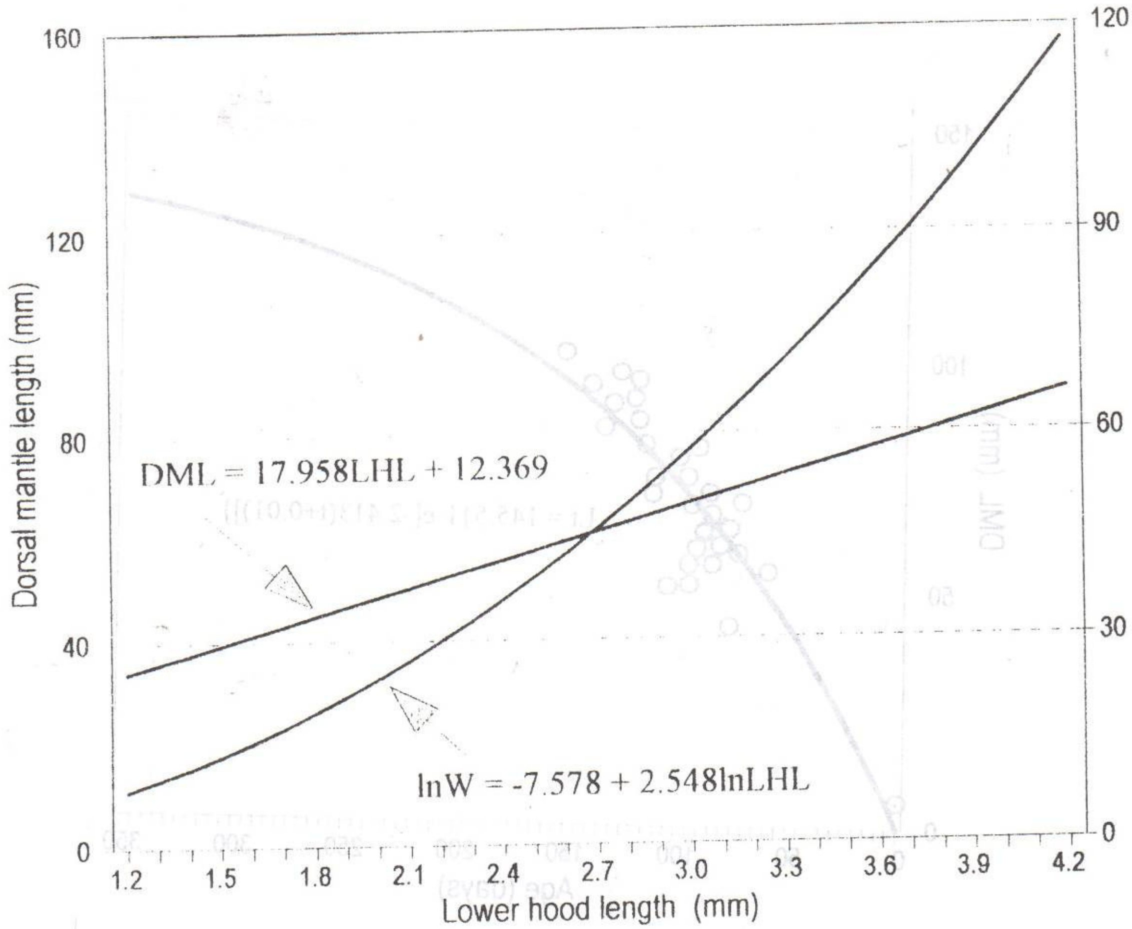

Figure 3.

Relationships of lower hood, mantle lengths and body weight of Sepiella inermis
See text for detail

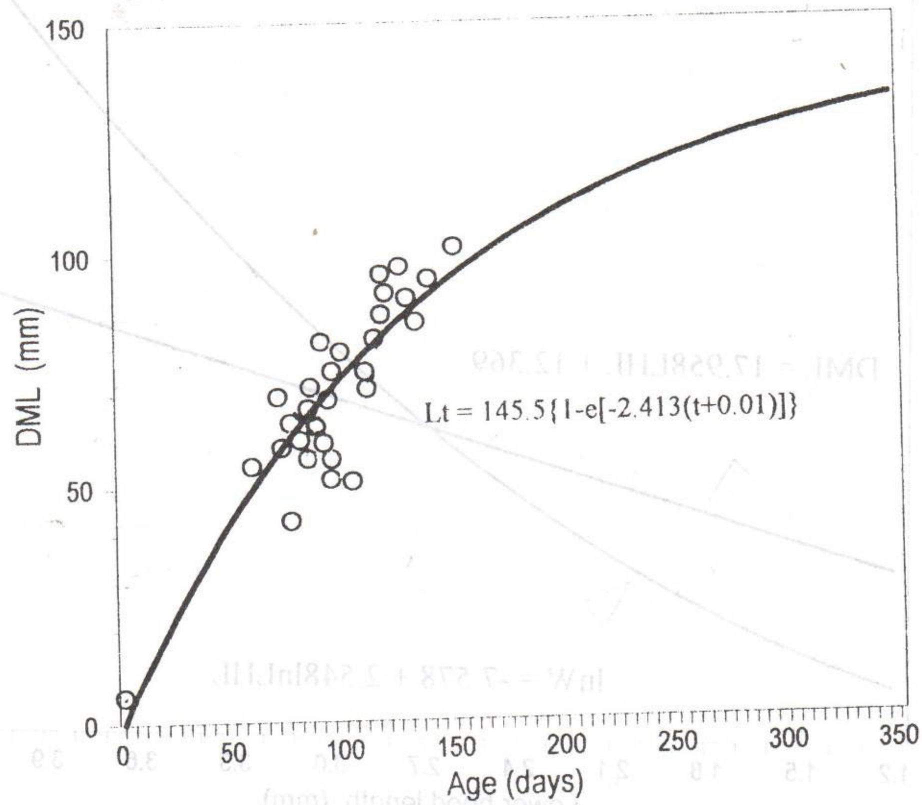

Figure 4.

Growth curve of *Sepiella inermis* d'Orbigny in the North Coastal water of Java. Open circles represent data points.