Short Communication

Length- weight relationship and morphometric study on the squid *Loligo duvauceli* (d'Orbigny)(Mollusca / Cephalopoda) off Mumbai (Bombay) waters, west coast of India

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The length- weight relationship and morphometric study on the squid, *Loligo duvauceli* (d'Orbigny) is reported from Mumbai waters. The regression coefficient between the sexes was found to be not significant at 1% level. The 'b' value differed from the ideal cube law of '3'as is with the case of length- weight relationship studied on this species elsewhere. The morphometric characters indicated high degree of correlation among the compared characters. The study substantiated further that the length-weight relationship of squids do not follow ideal cube law. The morphometric characters compared here would be very useful for comparison with the same species in other geographical locations.

The length- weight studies are made to determine mathematically the relationship between the two variables to enable to calculate the length if weight is known and *vice versa*, the relative condition factor and to calculate the weight asymptote (W∞) at length asymptote (L∞) for von Bertalanffy's equation. The identity of a fish stock can often be ascertained by morphometric and meristic studies[1]. Recent studies on several species have amply demonstrated that the range of variation in characters used in the identification is of considerable importance. A statistical analysis of morphometric characters gives a better idea of relationship within the species and also to compare with the same species in different geographical areas. The studies on this species have been carried out by Kuber[2] from Mumbai waters. As no work has been done on this species thereafter from Mumbai, the present investigation on the length- weight relationship and morphometry of the species, *Loligo duvauceli* was undertaken.

Samples of *Loligo duvauceli* were weekly collected from New Ferry Wharf and Versova landing centers of Greater Mumbai for the period of eight months (September 1999 to April 2000). A total of 245 specimens were measured for the length- weight and morphometric studies, which included 134 females and 111 males. The lengths of females ranged from 38-231 mm and weight 2.8-121.8 g. The males were recorded in the length range of 33- 274 mm and the weight ranged from 2.2 to 282.4 g. The length- weight relationship was calculated by the method of least square employing the equation of Le Cren[3] :

$$W = a . L^b$$

where, W = weight of fish, L = length of fish and 'a' & 'b' are exponents. The same in the logarithmic form can be written as,

$$\log W = \log a + b \log L$$

To test the significance of difference of regression coefficient between males and females, the data was subjected to analysis of covariance following Snedecor & Cochran[4]. For morphometric study the specimen were brought to the laboratory and measurements were recorded to the nearest of millimeters using a divider and measuring board as described by Lagler *et al.*[5] and Laevastu[6]. A total of 245 specimens were measured for the length- weight and morphometric studies. The relationship between various characters were worked out employing the formula of linear regression $y = a + b . x$ where, 'y' is the dependant variable, 'x' is the independent variable and 'a' and 'b' are constants.

The length- weight relationship obtained for female was $W = 0.001157 \, L^{2.2819}$ and that of males was $W = 0.001816 \, L^{2.1617}$.

In the logarithmic formula the same could be written as

$\log W = - 2.9360 + 2.2819 \log L$ …… for females
$(r^2 = 0.9724)$

log W = - 2.7408 + 2.1617 log L ……. for males

$$(r^2 = 0.9229)$$

The analysis of covariance indicates that the value of regression coefficient within and between the sexes to be not significant at 5% level (Table 1). So by pooling the data a common formula was obtained for males and females, which could be written as

W = 0.001658 L $^{2.1932}$　　　or

log W = - 2.7804 + 2.1932 log L　　　$(r^2 = 0.9479)$

The morphometric study in which 15 characters were compared against dorsal mantle length indicated high degree of correlation ranging from 0.8075 to 0.9657 (Table 2).

Many researchers have carried out studies on the length-weight relationship of this species. It has been observed that the growth of this species appears to be allometric i.e. significant departure from 'b' of 3. The 'b' value estimated by Silas et al.[7] from the Madras coast was found to be 2.3769 and 2.5201 for males and females respectively. Kuber[2] while working on this species from Mumbai coast found the exponent 'b' to be 2.0551 and 2.3197 for males and females respectively. Meiyappan & Srinath[8] calculated the length- weight relationship of this species from Cochin waters and found the 'b' value to be 2.4 for males and 2.29 for females. Similarly Mohamed & Rao[9] working on L. duvauceli from Mangalore coast estimated the 'b' value of 2.10526. Supongpan[10] working on this species from the Gulf of Thailand found the exponent to be 2.0 while Ratana- anan[11] working on the same species from the same

Table 1—Test of identicality of regression lines for *Loligo duvauceli*

Sex.	Sample no.	Corrected sums				
		$\sum X^2$	$\sum Y^2$	$\sum XY$	d.f	$\sum Y^2 - \frac{(\sum Y)^2}{\sum X^2}$
Male	111	284304.90	411477.03	317519.10	109	56833.44
Female	134	132305.29	164149.29	127227.07	132	41805.52
				Total	241	98638.97
Combined	245	3431462.42	589382.55	459055.35	243	100969.642
				Difference	2	2330.67

Source of variation	d.f.	s.s.	m.s.	f.	Remarks
Between sexes	2	2330.67	1165.335	2.8045	F value obtained is not significant at level
Within sexes	243	100969.64	415.512		

Table 2—Comparison between various morphometric characters

Measurement code	Number	Coefficient of correlation (r)	Intercept (a)	Slope (b)
DML vs. total length including tentacles	245	0.9516	54.8747	2.1944
DML vs. dorsal mantle breadth	245	0.9229	13.7363	0.2169
DML vs. mantle breadth including fins	245	0.9657	1.0312	0.5505
DML vs. girth	245	0.9164	39.8302	0.51
DML vs. distance of fins from mantle margin	245	0.9354	14.7518	0.3668
DML vs. fin length	245	0.8668	-9.4993	0.6111
DML vs. fin width	245	0.9568	-1.2530	0.2134
DML vs. head length	245	0.887	9.2695	0.1114
DML vs. head width	245	0.8559	9.5284	0.1055
DML vs. length of I arm	245	0.8821	0.3534	0.3535
DML vs. length of II arm	245	0.8807	6.1927	0.3766
DML vs. length of III arm	245	0.8790	11.6360	0.3950
DML vs. length of IV arm	245	0.8803	6.4852	0.3793
DML vs. tentacle length	245	0.8698	42.6997	1.1270
DML vs. eye diameter	245	0.8075	5.4486	0.0494

geographical area estimated the 'b' to be 1.773 for males and 2.043 for females.

Thus from the available literature it appears that the cephalopods in general and for *Loligo* in particular follows the allometric growth pattern. In the present investigation also a similar pattern was observed supporting the theory that the growth is allometric in cephalopods.

The coefficient of correlation of dorsal mantle length of this species against other morphometric characters compared was very good and ranged from 0.8075 to 0.9657. This was higher as compared to 0.60 to 0.96 obtained by Kuber[2].

After the investigation carried out by Kuber[2], no study was done on this species particularly from Mumbai waters. This study of 1999-2000 was compared with that of 1987 done by Kuber[2]. The morphometric characters would be helpful in comparing the same species in different locations.

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