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Note

Biometric relationships of *Mactra violacea* (Gmelin) from Kerala, south-west coast of India

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ABSTRACT

The length-weight (L-W) and other biometric relationships of the surf clam *Mactra violacea*, collected from the north coast of Kerala are presented in this study. In *M. violacea*, the L-W relationship between males and females was not found to be significantly different and therefore a combined equation was derived. The growth in length is accompanied by weight increase (isometric growth, b = 1). However, in all other biometric relationships such as length-width (L - B), length-height (L - H), total weight-meat weight (TW - MW), total weight-shell weight (TW - SW), and shell weight–meat weight (SW - MW)), allometric growth was observed. In the case of L - B, L - H and TW - MW, a positive biometric relationship exists (b > 1) while in TW - SW and SW - MW, a negative biometric relationship (b< 1) was observed.

Length–weight and other biometric relationships are important to the understanding of various aspects of a species *viz*., growth, ecology and physiology. These also allow life history and morphological comparisons between species or between populations of a species from different habitats/regions (Gaspar *et al*., 2001). Length weight relationships are also useful in estimations of weight from length, conversions of growth-in-length to growth-in-weight for predictions of weight at particular age and further use in stock assessment models (Anderson and Gutreuter, 1993; Pauly, 1993).

The surf clam *Mactra violacea* (commonly known as violet trough shell), is distributed all along the sandy beaches of North Kerala. It occurs in the surf zone, up to 75-100 m depth. It is a large clam (up to 80 mm) with high meat content and nutritive value. The length-weight and other biometric relationship of the surf clam collected from the sandy beach along Thalassery in Kannur district are presented in this paper.

In the present study, a total of 231 specimens of the surf clam *M. violacea* were collected by diving and picking, from the surf zone along Thalassery Beach (11° 75' N, 75° 49' E), off Kannur district, Kerala during 2005. The total length was measured using digital vernier calipers to the nearest 0.1 mm along the antero-posterior axis and width along dorso-ventral axis. The maximum distance between the valves when they are closed was considered as height. The total weight, wet meat weight and shell weight were recorded to the nearest 0.1 g.

The monthly means of each of the biological parameter (total length, total width, thickness, total weight, meat weight, shell weight) were analyzed and presented as mean ± SD. The length-weight (L - W) relationship was determined by the expression $W = a L^b$. The estimation of the morphometric relationships between these variables was made by adjustment of a linear function to the data (Ricker, 1973): Log Y = Log a + b Log X, where Y = width (B), Weight (W) or height (H); X = length (L); a = intercept (initial growth coefficient; b = slope (relative growth rate of variables). The parameters, *a* and *b* of the morphometric relationships were estimated by linear regression analysis (least squares method) and the association degree between variables was calculated by the determination coefficient (r^2). The 95% confidence limits of b and the significance level of r^2 were also estimated. The biometric relationships between total Length-width (L - B), total length-height (thickness) (L - H), total weight–meat weight (TW - MW), total weight-shell weight (TW - SW) and shell weight-meat weight (SW - MW) were also determined using MS Excel routines.

A *t*-test (H_0, b = 3) was performed with a confidence level of ±95% to confirm if the values of b obtained by linear regression were significantly different from the isometric value, expressed by the following equation $t_s = (b - 3) / S_b$, where t_s = *t* -test value, b = slope, S_b = standard error of the slope (b). Subsequently, comparison between the obtained value of *t* - test and the tabled critical value of *t* - test, allowed the determination of the statistical

significance of the b values and their inclusion in the isometric ranges (b =1) or biometric ranges (negative allometry; b<1 or positive allometry; b>1).

The results obtained for the length-weight and biometric relationships along with some sample descriptive statistics are given in Table 1. In *M. violacea*, the growth in length is accompanied by weight increase (isometric growth, b =1). The L - W relationship between males and females was not found to be significantly different and therefore a combined equation was derived. However, in all other biometric relationships such as L - B, L - H, TW - MW, TW - SW and SW - MW, biometric growth was observed. In the case of L - B, L - H and TW - MW, a positive biometric relationship existed (b > 1), while in TW - SW and SW - MW, a negative biometric relationship (b< 1) was observed.

The L - W relationship on *M. violacea* exhibited a typical isomeric pattern. The L - B, L - H and TW - MW relationships were positively allometric. This means that increase in width is superior to increase in length and the increase in meat weight is superior to increase in total weight. However, the TW - SW and SW - MW relationships were negatively biometric. This indicates that increase in shell weight is superior to increase in total weight and increase in total weight is superior to meat weight (Gaspar *et al.*, 2001). This interesting phenomenon has been reported for other clams (Thayer, 1975; Gaspar *et al.*, 2001) and may be explained by the fact that the substrate (sandy or sandy–mud beaches) is not a limiting factor (Thayer, 1975; Gaspar *et al.*, 2001). The positive allometries may also reflect the non-burrowing strategies or even the burrowing difficulties associated with their globous shape (Gaspar *et al.*, 2001). Bivalve shells, during ontogeny tend to become higher and thicker (Thayer, 1975; Eagar, 1978; Hinch and Bailey, 1988, Gaspar *et al.*, 2001).

In length-weight relationships, isometry has been reported for several bivalves. The parameter *b* for *M. violacea* was 2.90687. Similar *b* values have been recorded for *Donax cuniatus* (3.1079) (Talikhedkar and Nagabhushanam, 1976). The *b* value for *Mactra chinensis* was reported as 2.387 ± 0.18 (Park and Oh, 2002). For *Perna viridis*, the *b* value was 2.8616 (Narasimham, 1981); 2.6648 (Qasim *et al*., 1977) and 2.4175 (Rao *et al*., 1975). Isometric relationships have been reported for *Anomia ephippium, Lutraria angustior, Mactra corallina corallina, Modiolus adriaticus, Pandora albida, Pharus legumen, Ensis siliqua, Dosinia lupinus, Donax semistriatus, Venerupis rhomboides, Corbula gibba* and *Spisula subtruncata* (Gaspar *et al*., 2001; 2002). *Scapharca subcrenata, Mactra chinensis, Ruditapes philippinarum, Cyclina sinensis, Haliotis discus, Mya arenaria oonogal,*

Table1. Biometric relationships in *Mactra violacea*

Allometric relation	N	L mean ± SD L min - L max	Regression equation	Reg. Coeff. (r)	Relationship (*t* - test)
Length on total weight (L - TW)	F = 116	56.8 ± 9.1 38 - 79	Log Y = -3.57675 + 2.935083 Log X	0.953566	Isometric
	M = 84	57.4 ± 8.1 38.6 - 80	Log Y = -3.43771 + 2.856601 Log X	0.909189	Isometric
	Pooled = 200	57 ± 8.7 38 - 80	Log Y = -3.52724 + 2.906887 Log X	0.937366	Isometric
Length on width (L - B)	209	57.99 ± 8.1 38 - 80	Log Y = -0.24709 + 1.089967 Log X	0.769478**	+Allometric
Length on height (L - H)	257	57.15 ± 8.0 38 - 80	Log Y = -0.59022 + 1.193027Log X	0.93502**	+Allometric
Total weight on meat weight (TW - MW)	230	57.77 ± 7.59 38.6 - 80	Log Y = -0.56259 + 1.023962 Log X	0.796064**	+Allometric
Total weight on shell weight (TW - SW)	231	57.69 ± 7.66 38.6 - 80	Log Y = -0.29568+ 0.849933 Log X	0.736676**	-Allometric
Shell weight on meat weight (SW - MW)	230	57.77 ± 7.59 38.6 - 80	Log Y = 0.30672 + 0.713529 Log X	0.644847**	-Allometric

N - number; SD - Standard deviation; Length units (L mean, L minimum and L maximum) are given in mm; ** - Significant, ($p < 0.05$)

Mytilus edulis and *Batilus cornutus* (Park and Oh, 2002). Positive allometry has been observed in *Acanthocardia aculeate, A. paucicostata, A. tuberculata, Laevicardium crassum, Mactra coralline stultorum, M. glauca, Spisula solida, Dosinia exoleta* and *Venerupis rhomboides* (Gaspar *et al*., 2001; 2002); *Scapharca broughtonii* and *Fulvia mutica* (Park and Oh, 2002). Negative allometry has been reported in *Donax trunculatus, Chamelea gallina* and *Venus fasciata* (Gaspar *et al*., 2001); *Pandora albida* and *Pharus legumen* (Gaspar *et al*., 2002), *Tegillarca granosa* and *Solen strictus* (Park and Oh, 2002).

Biometric relationship has been observed for relationships involving heights and other linear measurements. Isometry occurs in *M. meretrix* (Narasimham *et al.*, 1988), *P. viridis* (Shafee, 1976), *Laevicardium crassum, Mactra corallina stultorum, M. corallina corallina, Dosinia exoleta* and *Venerupis rhomboides* (Gaspar *et al*., 2002). Positive allometry occurs in *P. viridis (*Narasimham, 1981); *A. aculeate, A. tuberculata, Corbula gibba, Donax semistriatus, Lutraria angustior, M. glauca, Spisula solida, S. subtruncata, Ensis siliqua, Callista chione* and *Chamelea gallina* (Gaspar *et al*., 2002). Negative allometry in H-L has been observed in *Anomia ephippium, Acanthocardia aculeate, D. trunculatus, Dosinia variegata, P. albida, P. legumen* and *V. fasciata* (Park and Oh, 2002). It was observed that clams <38 mm did not occur in the surf zone. It is possible that the smaller clams occur in deeper areas beyond the surf zone and then growth pattern could be different from those of the adults as has been reported in green mussel (Narasimham, 1981). Ontogenic changes in growth in bivalves to counter dislodgement by turbulence and currents have been noticed in several species (Talikhedkar and Nagabhushanam, 1976; Eagar, 1978; Hinch and Bailey, 1988).

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