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Note

Length-weight, width-weight and height-weight relationships of cultured freshwater pearl mussel *Lamellidens marginalis* (Lamarck, 1819)

SWETA PRADHAN[1], SHAILESH SAURABH[1], NANDINI PADHI[2], TARKESHWAR KUMAR[3], RAJESH KUMAR[1], U. L. MOHANTY[1] AND J. K. SUNDARAY[1]

[1]*ICAR-Central Institute of Freshwater Aquaculture, Kausalyaganga, Bhubaneswar - 751 002, Odisha, India*
[2]*College of Fisheries, Rangailunda, Berhampur - 760 007, Odisha, India*
[3]*ICAR Research Complex for Eastern Region, Patna - 800 014, Bihar, India*
e-mail: ssaurabh02@rediffmail.com

ABSTRACT

Lamellidens marginalis (Lamarck, 1819) is one of the important candidate species for freshwater pearl production in India. In the present study, the length-weight, width-weight and height-weight relationships of *L. marginalis* maintained in the farm were examined from January 2015 to September 2016. Monthly sampling was carried out and a total of 1015 specimens were analysed for the study. The length-weight, width-weight and height-weight relationships derived were $W = 0.0003L^{2.712}$, $W = 0.0018L^{2.708}$ and $W = 0.0.0293L^{2.210}$ and the value of r^2 was estimated as 0.776, 0.619 and 0.597 respectively. The values of b indicated the relative growth in body weight and superior physiological condition of the mussel. The length-weight, width-weight and height-weight relationships were found to be positive allometric and better correlation was observed in length-weight and width-weight relationships.

Keywords: Height, *Lamellidens marginalis,* Length, Pearl mussel, Weight

The freshwater pearl mussel *Lamellidens marginalis* (Lamarck, 1819) is a unique resource in Indian sub-continent not only for its pearl producing capabilities, but also for its multifaceted uses as human food, feed for lower animals, use of its shell for pharmaceutical, cosmetic, decorative purposes and in the lime industry (Saurabh *et al*., 2014; 2016). The study on growth and establishing biometric relationships are essential for generating vital information for conservation, utilising its pearl production capabilities and in understanding the impact of climate changes and pollution. Moreover, the abundance of bivalve populations are good indicators of localised condition of water quality. In one study Kumar *et al*. (2017) reported that freshwater mussels could be best utilised as bioindicators of pollution in aquatic environment. Further, indigenous mussel species are additionally challenged as results of overexploitation for pearl production and food value (Dey *et al*., 2016). With this backdrop, the present study attempted to derive length-weight, width-weight and height-weight relationships in cultured freshwater mussel *L. marginalis*, to aid in future conservation and management programmes.

L. marginalis maintained in the farm of ICAR-Central Institute of Freshwater Aquaculture (ICAR-CIFA), Kausalyaganga, Bhubaneswar, Odisha, India (20º 11′ 06″- 20º 11′ 45″N; 85º 50′52″- 85º 51′35″E) were used for the study. Monthly sampling was carried out from January 2015 to September 2016. The mussel specimens were collected by hand picking from the earthen ponds and transported to the laboratory alive, in polythene bags. The total length, TL (maximum distance between anterior and posterior ends of the shell), total width, TW (maximum transverse distance, perpendicular to the length and height matrices), total height, TH (maximum distance between umbo and the ventral margin of the shell perpendicular to the shell length) and body weight of randomly selected specimens were measured to the nearest 0.1 mm using Vernier calipers and the body weight using digital balance with 0.01g accuracy, respectively.

The length-weight, width-weight and height-weight relationships were established using linear regression analysis (least squares method). Parameters of the length-weight, width-weight and height-weight relationship were estimated using the equation proposed by Le Cren (1951):

$$W=aL^b$$

After logarithmic transformation of length-weight data, this equation may be expressed as:

$$\text{Log}W = \log a + b \log L$$

where, "W" is the weight of the mussel in grams, "L" is the total length of mussel in mm, "a" is the intercept of the regression curve (coefficient related to body form) and "b" is the regression coefficient (exponent indicating isometric

growth; Froese, 2006). The degree of assoiation between variables was calculated by the coefficient of determination (r^2). To test the "b" value against the isometric value of b = 3 (negative allometry b<3 or positive allometry b>3), Student's t-test (H_0: b = 3) was employed to predict any significant deviation (Snedecor and Cochran, 1967). The t-statistic was calculated as:

$$t = (b-3)/S_b$$

where, S_b (Standard error of b) = $\sqrt{}$ (1/(n−2)) × [(Sy/Sx)^2 − b^2]; Sx and Sy are the standard deviations of x and y, respectively. The t-value was compared with t-table value of t-test which allowed the determination of statistical significance of b value. All statistical analyses were done with SPSS statistics 24.0, SAS 9.2 and Microsoft Office Excel.

The range of water quality parameters recorded in the culture ponds in the farm were: dissolved oxygen - 5.6 to 6.5 mg l^{-1}; pH - 7.5 to 7.6; nitrite-N - 0.020 to 0.030 mg l^{-1}; ammonia-N - 0.05 to 0.08 mg l^{-1} and temperature - 27 to 29 °C

The number of samples measured, range of length, width, height and weight as well as length-weight, width-weight and height-weight relationship parameters for the species are given in Table 1. Length-weight, width-weight and height-weight relationships were significant with coefficients of determination (r^2) greater than 0.7, 0.6 and 0.5, suggesting that the application of the length-weight, width-weight and height-weight relationships between the shell length, shell width, shell height and total body weight is the most suitable for cultured *L. marginalis*. Estimated growth coefficients (b) for length-weight, width-weight and height-weight relationship of *L. marginalis* were 2.712, 2.708 and 2.21, respectively. Student's t-test was performed to test whether the length-weight relationship follows the isometric pattern. The value of 't' was found to be significant (p>001) indicating positive allometric growth.

The maximum total length and weight reported for *L. marginalis* (103.4 mm and 86 g) in the present study constitutes a new record, where the previous highest values of total length and weight reported were 73 mm and 36.35 g (Suryawanshi and Kulkarni, 2014). The b values reported for *L. marginalis* for length-weight relationship were 2.608 from Nanded region of Maharashtra (Suryawanshi and Kulkarni, 2014), which appeared to be somewhat lower than the present estimates of 2.712. The b value of width-weight and height-weight relationships of *L. marginalis* estimated in the present study were 2.708 and 2.210 respectively, whereas Kovitvadhi *et al.* (2009) estimated the b value of width-weight and height-weight relationships of *Hyriopsis* (*Limnoscapha*) *myersiana* as 2.649 and 2.785 respectively, which is somewhat higher than the value recorded in the present study. Normally the regression coefficient value (b) equal to 3 for length-weight relationship indicates that the species grows symmetrically or isometrically (provided its specific gravity remains constant). In isometric relationships, shape does not change as size increases. Values other than three indicate allometric growth. Variation in the relative growth (b) of the species reported from different places suggests regional difference in length-weight relationship of the species (Tarkeshwar Kumar *et al*., 2012). Therefore, the variations observed in the length-weight, width-weight and height-weight relationship of *L. marginalis* at different places may be attributed to geographical and ecological differences which lead to difference in soil and water quality parameters and food availability which are directly responsible for growth of the animals. To conclude, the study could provide valuable information for better understanding of mussel research and management, which may further help to conserve the precious stock of pearl mussels.

Table 1. Length-weight, width-weight and height-weight relationships in freshwater pearl mussel *L. marginalis*

Allometric relation	Number (N)	TL range (mm)	Weight range (g)	Regression parameters						Student's t-test (b)		
				a	95% CL of a	b	95% CL of b	SE (b)	r^2	t-stat (b)	p-value	t-calculated
Length-weight (L- Wt)	1015	62.45-103.4	19-86	0.0003	(-3.712)-(-3.370)	2.712	2.622-2.802	0.046	0.776	59.136	0**	3.147
Width-weight (W-Wt)		21.48-36.09		0.0293	(-1.692)-(-1.374)	2.210	2.098-2.323	0.057	0.597	38.684	1.071E201**	9.377
Height-weight (H-Wt)		32.42-53.73		0.0018	(-2.958)-(-2.537)	2.708	2.577-2.839	0.067	0.619	40.541	3.149E214**	2.826

N: sample size; a and b: parameters of length weight relationship; CL: confidence limits; SE (b)" standard error of slope b; r^2 : coefficient of determination; t stat (b): t-statistic of b; F-stat (b): F-statistic of b; p-value: probability level, **p<0.001

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