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Note

Biometric relationships of the black winged pearl oyster, *Pteria penguin* (Roding, 1798) from Andaman and Nicobar Islands

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ABSTRACT

The dimensional biometric relationships including that of length-weight was studied in the black winged oyster *Pteria penguin*, which is a candidate species for mariculture. During the life span of the winged oysters, growth in length and weight was initially 40-100 mm dorso-ventral measurement (DVM), positively allometric and subsequently became isometric (100-160 mm DVM) and finally reverted back to allometry (160-220 mm DVM). This is attributed to the increase in visceral mass of animals corresponding to gonadal maturation during the size range 100 - 160 mm DVM. In larger sized *P. penguin*, increase in shell length is more predominant as evidenced by large proportion of non-nacreous layer at the outer edge of the shell. There was no parallel increase in visceral mass resulting in allometry. All dimensional relationships were positive in relation to DVM; however the relationship between DVM and hinge length did not show significant R^2 values ($p>0.05$) in all the size groups. This was mainly because, the tips of the hinge and ear were found to be broken at both the ends. Therefore, notch length is proposed as a better predictor of DVM in large hinged pterid oysters. Unlike other pterid pearl oysters, the thickness - DVM ratio showed a decline with size, indicating that bead seeding programmes can be initiated at early stages.

Keywords: Andaman and Nicobar Islands, Biometry, Length-weight relationships, *Pteria penguin*

Pteria penguin (Roding, 1798) commonly known as the black-winged or the penguin wing oysters are found naturally on rocks and corals near channels and capes where the currents are strong. They attach to the sea bottom and to wharf pilings using tough byssus threads. These oysters form a major source for mabe pearl production and commonly display a silver color under the oyster muscle with a rich mauve, gold banding towards the black/brown outer-lip. They produce brilliant nacre with a rainbow-like spectrum of hues, and the mabe pearls produced from this nacre possess a uniquely penetrating brilliance, with hues ranging from light pink through deep rose-red to a "rainbow" pink or blue. This has earned them the title "mabe oysters".

In India, *P. penguin* is reported mainly in northern parts of the Andaman and Nicobar Islands, where it forms communal assemblages with other bivalves such as *Saccostrea cucullata*, *Crassostrea* spp. and *Pinctada margaritifera* (Alagarswami, 1983). More recently, simple techniques were developed to produce mabe pearls in *P. penguin* in the Andaman and Nicobar Islands and its potential for development as a mariculture activity was also indicated (Kripa *et al.,* 2008). In island nations like Tonga and Zanzibar, development programs using *P. penguin* especially for mabe pearl production are being promoted (Farell *et al*., 1997; Teitelbaum *et al*., 2008).

Since the mabe oysters form an important resource in the Andaman and Nicobar Islands and considering the potential for development of mabe pearl industry in these islands, it was planned to study the biometric relationships of these oysters. It is well known that temporal changes in bivalve body mass and shape are strongly correlated with variations in the environment and habitat. With age, the biometric relationships undergo change and this information is vital for the planning and execution of any aquaculture enterprise. Therefore, the main objective of the study was to understand the changes in length and weight of these oysters over time and the co-relationships between shell dimensions which will help to plan and improve the mabe pearl production in *P. penguin* of Andaman and Nicobar Islands.

A total of 155 numbers of mabe oysters (*P. penguin*), collected from the sub-tidal regions near Port Blair, Havelock and Neil Islands of the south Andaman and Nicobar Islands by skin diving, were used for the study. The oysters were removed from the place of attachment by severing the byssus threads using a long narrow chisel. These were transported to the laboratory at the Marine Hill in cool moist condition. The oysters were scrubbed to remove the fouling organisms and silt, washed thoroughly in seawater and measured. The linear measurements, such as dorso-ventral measurement (DVM) or shell height, hinge length (HL), notch length (NL), thickness (THK) in millimeters, as depicted in Fig. 1, were taken using digital vernier calipers (Mitutoyo™) to a precision of 0.01 mm. In most animals, the anterior and posterior ear tips were broken and therefore the HL was frequently an unreliable measure. Therefore, to get a measure of the breadth dimension, the distance between the umbo and middle of the notch was measured as the NL. Total weight (TWT) in grams (g) was taken using a digital balance. The oysters were grouped into three length classes with a class interval of 60 mm DVM *viz.,* 40-100 mm (small), 100-160 mm (medium), and 160-220 mm (large).

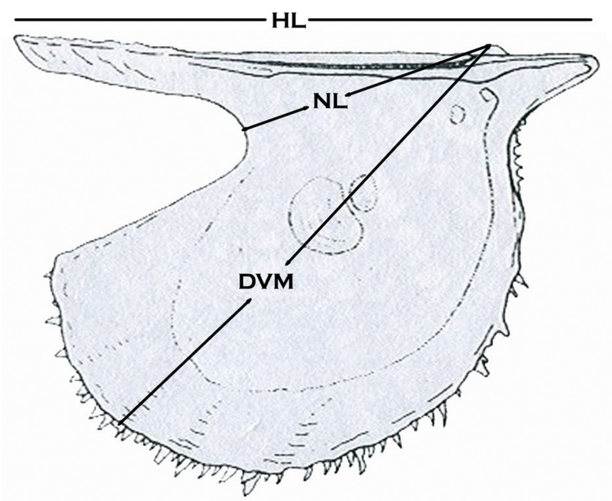

Fig. 1. Linear length measurement locations from *P. penguin* used in the study. DVM - dorso-ventral measurement; HL - hinge length; NL - notch length

The length-weight relationship (curvi-linear) was calculated using the ABee software (Pauly and Gayanilo, 1998) after converting the measurements to centimeter-gram units. For all other biometric relations such as DVM-HL, DVM-NL and DVM-THK millimeter was used as the unit and calculations were done by the least square method using the linear regression equation 'y = a + bx ', where, 'a' is the intercept and 'b' the slope. The level of significance of the regression coefficient (R^2) value was determined using a simple one-way ANOVA test.

The DVM and TWT of the oysters collected ranged from 40.65 to 215.00 mm and 7.8 to 450.0 g respectively. The relationship between length and weight of the various size groups are given in Fig. 2 and the corresponding values for intercept, slope and regression coefficients are presented in Table 1.

Table 1. Intercept (*a*), slope (*b*) parameters and regression coefficient (R^2) for the relationships between DVM and TWT in different size groups of *Pteria penguin*

Size group	N	'*a'* value	'*b'* value	R^2 value
40-100	65	0.3459	2.1817	0.5526
100-160	50	0.0316	3.1955	0.7450
160-220	30	0.9886	1.9520	0.6225

The length-weight relationships of the small and large oysters were positively allometric and in the case of medium sized oysters, it was isometric. The relationships had

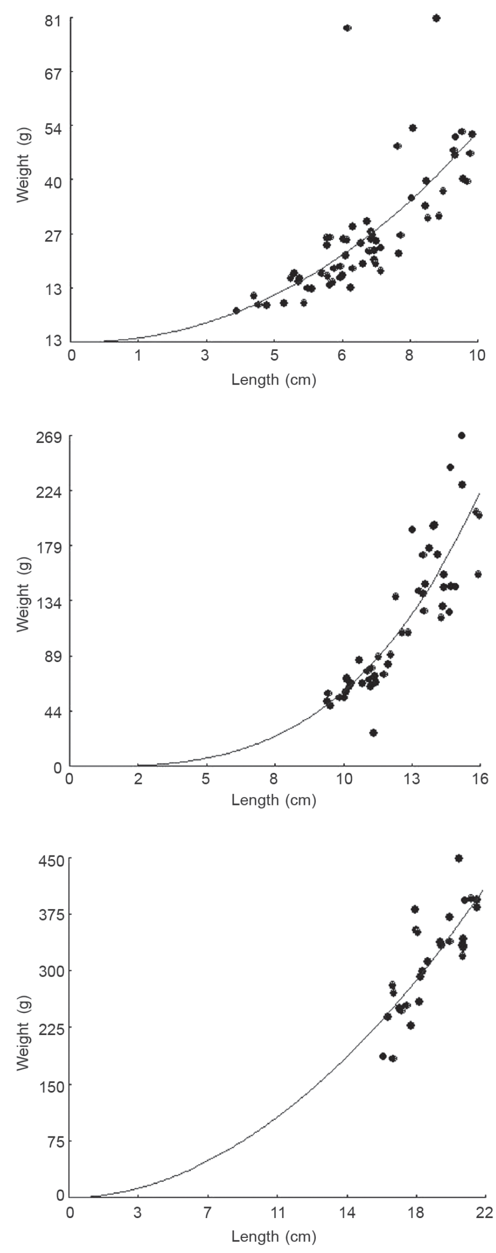

Fig. 2. Length-weight relationship for 40-100 mm, 100-160 mm and 160-220 mm DVM size groups in *P. penguin.*

reasonably good fit in medium sized oysters (R^2 = 0.75), while it was moderate in small (R^2 = 0.55) and large sized (R^2 = 0.62) oysters. In the Gulf of California, Mexico, Hernandez-Olalde (2007) reported that in *P. sterna,* the reproductive activity starts from 77 mm DVM and the size at first maturity is attained at 117 mm. The reproductive dynamics of *P. penguin* from the Andaman and Nicobar Islands has not been studied. However, it is presumed that as in *Pteria sterna*, reproductive effort by the animal is maximal during 100 to 160 mm DVM and this is the reason for the increased visceral mass which is reflected in the isometric growth pattern in this size group. In larger sized *P. penguin*, increase in shell length is more predominant as evidenced by large proportion of non-nacreous layer at the outer edge of the shell. There is no parallel increase in visceral mass resulting in allometry. Thus, during the life span of the wing oysters, growth in length and weight is initially allometric and then it becomes isometric and finally reverts back to allometry.

The dimensional relationships between DVM and HL, NL and THK are shown in Fig. 3. The regression coefficient, intercept and slope of these relationships for various size groups are given in Table 2. All relationships were positive with respect to DVM; however the relationship between

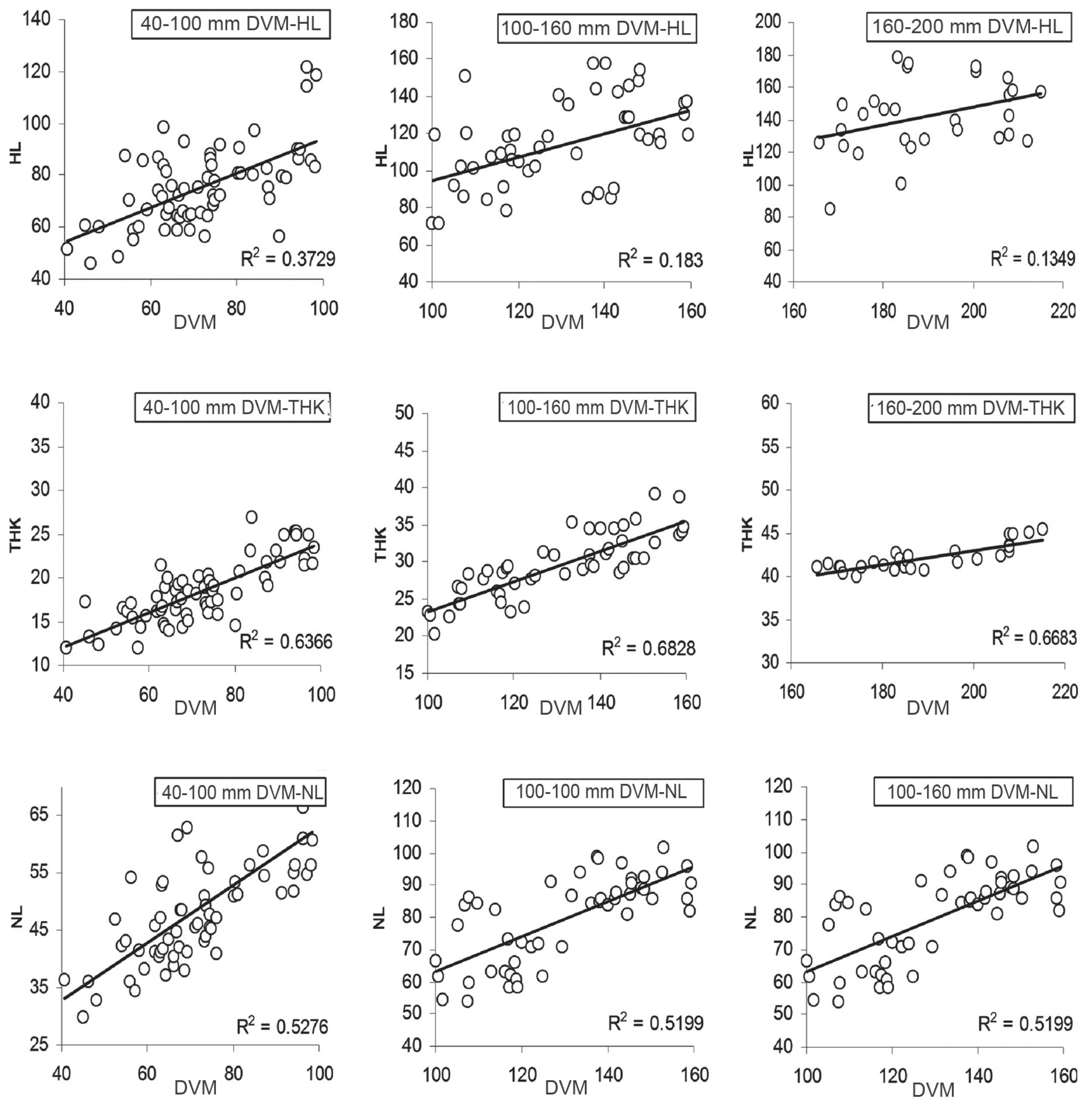

Fig. 3. Biometric relationships between DVM and HL (first row); DVM and THK (middle row) and DVM and NL (last row) in *P. penguin.*

Table 2. Intercept (*a*), slope (*b*) parameters and regression coefficient (R^2) for the linear relationships in different size groups of *P. penguin*.

Size group	N	Variables	*'a'* value	*'b'* value	R^2 value	Significance at 5%
40-100	65	DVM vs HL	27.855	0.663	0.3729	NS
		DVM vs THK	4.237	0.197	0.6366	Si
		DVM vs NL	12.649	0.5031	0.5276	Si
100-160	50	DVM vs HL	32.564	0.6232	0.183	NS
		DVM vs THK	2.8931	0.2038	0.6828	Si
		DVM vs NL	8.1733	0.5475	0.5199	Si
160-220	30	DVM vs HL	39.167	0.5429	0.1349	NS
		DVM vs THK	27.215	0.0786	0.6683	Si
		DVM vs NL	3.350	0.5619	0.6398	Si

NS – not significant; Si - Significant

DVM and HL did not show significant R^2 values ($p>0.05$; 0.37, 0.18, 0.13) in all the size groups. This was mainly because smaller oysters also had larger hinge lengths and hence in the relationship plots there was wide scatter. In the Andaman and Nicobar Islands, *P. penguin* is usually found attached to hard substrata wedged between rocks and dead corals. Almost always, the tips of the hinge and ear were found to be broken at both ends. This could be the reason why the DVM-HL did not show any siginificant relationship. Guenther and De Nys (2006) reported that the hinge is the most fouled part of the shell in *P. penguin* found in the South China Sea. Since the chances of breakage of hinge on detaching the oyster from the substratum are high, the hinge length cannot be used as a good predictor of DVM.

The DVM-THK relationship was positive and had significant regression coefficients ($p<0.05$; >0.6) in all size groups. The slope was more positive in small and medium size groups than in the large size group. In the larger size group, the slope was barely positive (Fig. 3) indicating that with increasing DVM there was little concomitant increase in THK. In most pterid oysters belonging to the genus *Pinctada*, there is an increase in this THK-DVM ratio with age (Hynd, 1955). In contrast, in *P. penguin*, there is lowering of the ratio with age (Fig. 4). This indicates that pearl seeding programmes can be initiated early in these oysters and on the other hand, mabe seeding which needs more nacreous area in the shell, can be started later. Such observations were also made by Ruiz-Rubio *et al*. (2006) in their study on influence of culture method and culture period on quality of half-pearls from the winged pearl oyster, *P. sterna*.

The DVM-NL relationship was strongly positive with significant correlation coefficients in all size groups (Table 2). Considering that hinge length was not a good predictor of DVM, the notch length was measured and related to DVM. Though it is positive in *P. penguin*,the use of this measure in other pterids with elongated hinge needs to be explored.

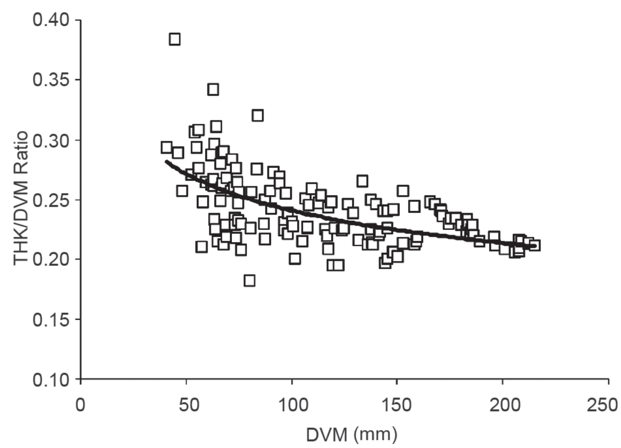

Fig. 4. Variation in THK/DVM ratio with increasing DVM. Trend line shows declining trend with size.

Andaman and Nicobar Islands are bestowed with highly skillful shell craftsmen with ability to do value addition in every piece of shell collected. Kripa *et al*. (2008) noticed the potential and introduced the mabe pearl technology as an additional source of livelihood for Tsunami affected villagers in the islands. The present findings on the biometric relationships of winged oysters collected from natural beds will be helpful for them to choose the right sized animals for implantation of round nucleus and mabe base images for cultured pearl production.

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