

POPULATION STRUCTURE, ALLOMETRY AND GROWTH ESTIMATES IN *MERETRIX CASTA* (HANLEY, 1845) FROM THE SONMIANI BAY, BALOCHISTAN, PAKISTAN

Shahnaz Jahangir¹, Sher Khan Panhwar^{1*}, Nazia Qamar and Baradi Waryani²

¹Center of Excellence in Marine Biology, University of Karachi, Pakistan.

²Department of Freshwater Biology and Fisheries, University of Sindh, Jamshoro.

* Correspondence should be addressed to Dr. Sher Khan Panhwar, CEMB, University of Karachi
Tel: +92 21 9926 1551, Email: sk.panhwar@uok.edu.pk

ABSTRACT

The study was conducted to evaluate the population structure, morphometric relationships and growth in a commercial important bivalve species, *Meretrix casta*, collected from May 2010 to April 2011, from the intertidal region of the Sonmiani Bay, Balochistan, Pakistan. Some 445 males and 451 females of *Meretrix casta* measuring 10-77 and 14-77mm and weighing 0.2-72.5 g and 0.7-96 g respectively were studied. The overall sex ratio was slightly in favour of females (50.33) and 49.67 were males $\chi^2 = 1.151$. Allometric variations in various parameters were calculated with empirical equation $W = aL^b$ after transferring on logarithms. The relationship between length versus meat of the shell was stronger interpreted from $R^2 = 0.776$ and weak relationship in wet tissue weight and shell height $R^2 = 0.054$ was estimated. The growth was estimated with the von Bertalanffy growth model estimate $L_\infty = 72.45\text{mm}$, growth coefficient $K = 0.960 \text{ year}^{-1}$, score 0.408.

Key words: *Meretrix casta*, allometry, growth, Sonmiani Bay, Balochistan.

INTRODUCTION

The genus *Meretrix* of the Family Veneroidae is widely distributed throughout the world and many species of this family including *Meretrix meretrix*, *M. casta*, *M. planisulcata*, and *M. lyrata* have gained handsome economic value (Yoosukh and Matsukuma, 2001). In the tropical waters of southwest and southeast coast of India such as *Marcia opima*, *M. meretrix*, *M. casta* and *Gafrarium tumidum*, are commercially exploited and utilized as food (Suja and Mutiah, 2007). Among shellfish resource the clams are considered more important than the oysters, these are regularly fished from the creeks, estuaries and backwaters of India as their meat is used as food and their shells are utilized in making lime (Boominathan, *et al.*, 2008). However, Rai (1932) reported genus *Meretrix* and regarded *M. casta* as one of the most exported food items on the Chennai coast, India. Moreover, extensive studies have been carried out on *M. casta* including the rate of filtration (Durve, 1963), reproductive biology and fishery (Durve, 1964, 1970; Sreenivasan, 1983; Thangavelu and Sanjeevraj, 1985; Narasimham *et al.*, 1988) shell dimensional relationship and experimental transplantation (Durve and Bal, 1961) were studied. The allometric relationship and regression line was fitted in different bivalve species reported (Jayabal and Kalyani, 1989; Durve and Raja, 1965).

In Pakistan various species of the bivalve are reported, *Marcia cor*, *Tivela pondorosa*, *Meretrix tumida*, *M. meretrix*, *M. casta*, *M. casta* var. *ovum*, *Linconca picta*, *Circe scripta*, *Hemitapes pinguis*, *Phaphia malabarica*, *P. textile*, *Gafrarium divaricatum*, *Callist erycina* have been found in creeks, backwaters and lagoons which are of the commercial interest (Moazzam and Ahmed, 1994). Despite their economic importance and food value, the clams of Pakistan did not receive much attention. This study aimed to examine the allometric relationships and growth in *M. casta*, which is found on the coast of Balochistan, to provide an understanding of the population structure and growth of a potentially important clam species.

MATERIALS AND METHODS

Sampling: A total of 896 *M. casta* specimens sampled randomly at low tides from the intertidal area of the Sonmiani Bay Baluchistan during May 2010 to April 2011 (Fig. 1).

Identification: The identification of *Meretrix casta* was done using conchological characters such as morphology of the shell, its color, luster and teeth (cardinal and lateral) following the identification method described by Yoosukh

and Matsukuma (2001). The sexes were assessed by the coloration of each gonad. The female gonads color was baby pink to yellowish whereas male gonads observed white to milky whitish in colour.

Measurements: Each specimen was measured to its length, height and thickness to the nearest millimeter (0.01 mm) with the help of vernier caliper. The length of shell was taken from the outer edge of the hinge to the outermost growth margin, whereas, height was measured from the umbo to the outer growth margin at a point where it was oriented perpendicularly to the middle radial rib. The width of the shell was measured at the thickest point (at the maximum distance along the short axis of the valves), weight was taken in grams (0.1) using an electronic balance.

Statistical analysis: Allometric variations in different parameters were estimated with the empirical equation: $W = aL^b$ where W = weight, L = length, a & b = constant and slope, b , i.e. is a power function of length, respectively. Logarithmic transformations were used so that the exponential relationship can be expressed by a linear equation and logarithmically can be written as $\text{Log } W = \text{Log } a + b \text{ Log } L$.

Estimation of chi square test: Chi square test was calculated to test the ratio of males and females in the population estimated with: $\chi^2 = \sum_{j=1} \frac{(A_{ij} - E_{ij})^2}{E_{ij}}$ (Plackett, 1983), where (A) stands for observed and (E) for expected frequency.

Estimation of growth: The growth coefficient (K) was estimated with the von Bertalanffy (1938) growth model: $L_t = L_\infty (1 - e^{-K(t-t_0)})$.

The parameter L is the length, K is the growth rate, L_∞ is asymptotic length at which growth is zero and t_0 is the time or initial size of the animal at age zero.

RESULTS

In present study some 445 males and 451 females of *Meretrix casta* were collected measuring 10-77 and 14-77mm and weighing 0.2-72.5 g and 0.7-96g, respectively. These were collected at low tides from the intertidal region of the Sonmiani Bay Balochistan (Fig. 1). The overall sex ratio was slightly in favour of females (50.33) and 49.67 were males $\chi^2 = 1.151$ $P=0.283$. The growth in *M. casta* exhibited differential rates between sexes throughout the year, males and females have at least two cohorts in most months of the year (Fig. 2). Month wise male and female proportion and chi square value in the population of *M. casta* was estimated and presented in Table 1, which shows that number of male were dominant in the month of the February and lower number were recorded in June 2010. The highest number 89% of females were registered in December and lowest 11% in September 2010. The Regression equations for estimates morph metric measurement (a) intercept, (b) slope and (R^2) coefficient of determination are presented in Table 2. Estimation of five parameters was done for comparison between length and width, length and height, length and total weight (Meat shell), Width and height, wet tissue weight and shell weight.

The relationship between various body parts and weight were calculated and are presented in the (Table 2 & 3). The relationships in various morphometric measurements were estimated and are presented in (Table 2). The von Bertalanffy growth model was applied to length frequency data of *M. casta* $L_\infty = 72.45\text{mm}$ and $K = 0.9/\text{year}^{-1}$ whereas score 0.408 was estimated.

The number of individual in size class ranges between (41-50) mm was found to be higher in both sexes which were 56 in male and 69 in female and lowest individual recorded was in size class 21-30mm, where no female was recorded to this range and only one male was found (Table 3). Sex ratio in favours of male were recorded in large size class interval ranges (71-80) mm by observing high value of chi square distribution $\chi^2 = 3.6$. and closest to 0 $\chi^2 = 0.125$ shows that equal number of male and female were belongs to size class of (31-40mm).

DISCUSSION

This study was aimed to estimate population parameters, length-weight and growth of bivalve, *Meretrix casta* one of the commercial important species available in Pakistan. Generally in shells study value of slope ($b=1$) indicates that the organism grows symmetrically or isometrically and values below or above 1 indicate allometric growth whereas growth is positively allometric when b values >1 and <1 is negatively allometric. In this study estimated slope for shell weight and length and other parameters is <1 which indicate negative allometric

relationship between parameters. Gracia, *et al.* (1998) stated that interpretation of slope and intercept is often not obvious with exception when growth is isometric intercept could be interpreted as condition factor and when growth is allometric the role of intercept as the condition factor is not clear. The present consequence is in conformity with the result in clam, *M. casta* (Mohan *et al.*, 1986) calculated the correlation coefficient ranging from $R = 0.8$ to 0.9 . In this study correlation coefficient R ranges from 0.230 to 0.880 . The Correlation was moderately significant in case of length and height relationship but marginally significant wet tissue weight and shell weight relationship. In the large size class of (71-80mm) males were dominating the population. In the size class (31-40mm) the male and female population size was equal.

Table 1. Monthly sex ratios and chi square value in the population of *M. casta* collected from the Sonmiani Bay.

Month	Male	Female	Proportion of males	χ^2
May 2010	38	37	0.51	0.01
June	7	12	0.37	1.32
July	44	39	0.53	0.30
August	50	13	0.79	21.73
September	28	9	0.89	9.76
October	37	39	0.49	0.05
November	65	38	0.66	7.08
December	47	82	0.36	9.50
Jan 2011	40	48	0.45	0.73
February	48	61	0.44	1.55
March	32	33	0.49	0.02
April	19	30	0.39	2.47
Total	455	441	6.37	54.51

($P < 0.05$)

Table 2. Regression equations for estimated morphometric measurements (a) intercept, Slope (b) and coefficient of determination (R^2), estimated parameters are based on the logarithmically transferred data.

Equation for (pooled data) (N=894)	(a)	(b)	R^2	R	P value
Length (X) and width (Y)	0.721	0.435	0.492	0.701	<0.001
Length (X) and Height (Y)	0.591	0.572	0.776	0.881	<0.001
				0.756	<0.001
Length (X) and Total weight (Meat shell) (Y)	-0.259	0.862	0.572	0.736	<0.001
Width (X) Height (Y)	0.86	0.452	0.542	0.756	<0.001
Length (X) and total weight (Meat + shell) (Y)	-0.259	0.862	0.572		
Wet tissue weight (X) on shell on weight (Y)	1.084	0.067	0.0533	0.230	< 0.05

Generally the growth of an individual depends upon its activities and utilization of energy for reproduction (Quinn and Deriso, 1999). The growth in *M. casta* exhibited differential rates between sexes throughout the year, males and females have at least two cohorts in most months of the year. The estimate of von Bertalanffy growth model was much higher that indicates good growth in *M. casta*. Because of scarcity of literature on growth of *M. casta* from different parts of its distribution we could not compare its growth.

Table 3. Chi-square distribution in various size classes in the population of *M. casta*.*($P = <0.05$).

Size-class (N=896)	(mm)	♂	♀	Proportion of males	χ^2
21-30		11	16	0.41	0.153
31-40		67	49	0.58	0.035
41-50		141	168	0.46	0.013
51-60		127	107	0.54	0.017
61-70		88	89	0.50	0.023
71-80		11	22	0.33	0.135
Total		445	451	2.81	0.376*

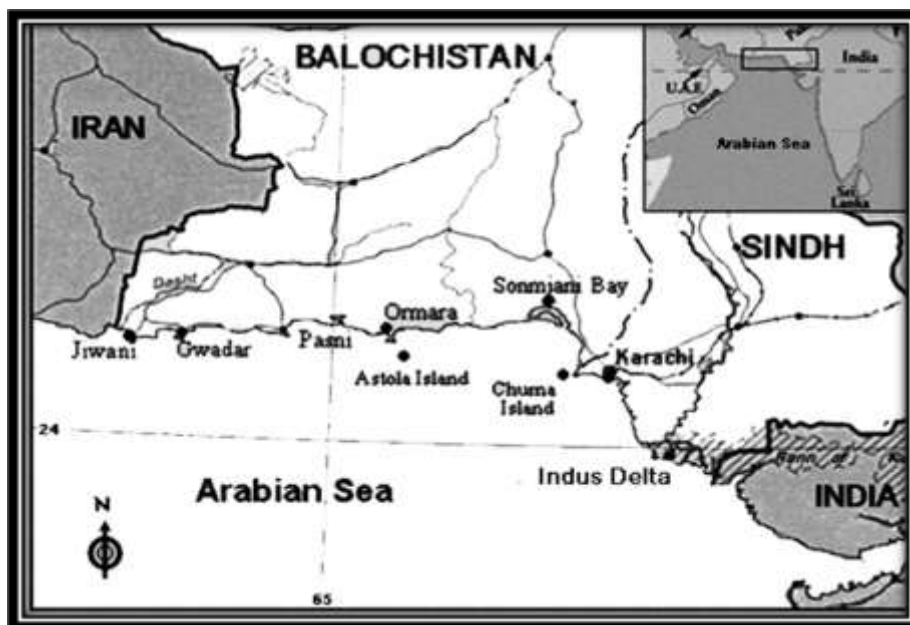
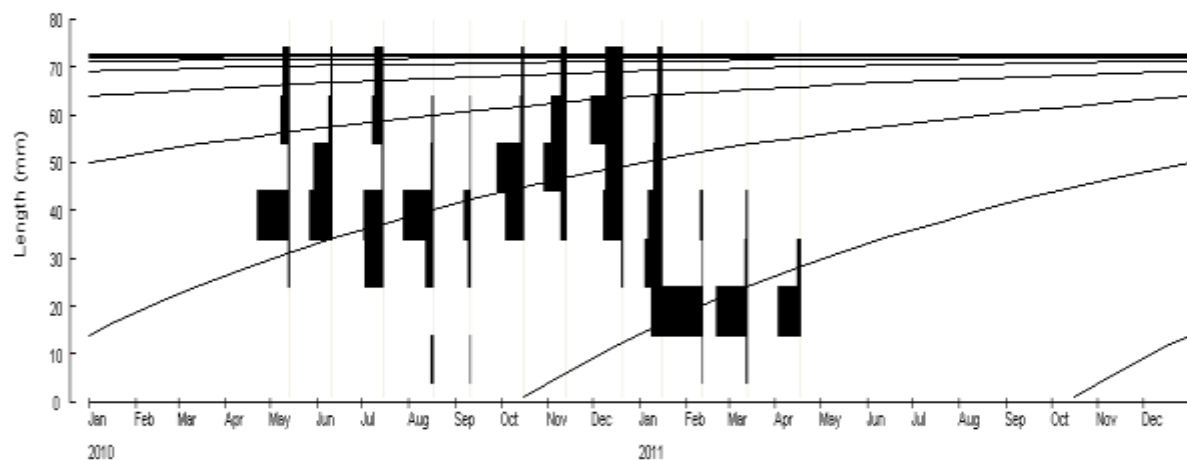


Fig. 1. Map showing sampling site Sonmiani, Balochistan in the present.

Fig. 2. Monthly shell length-frequency distribution with growth curves estimated for males and females of *M. casta* in present study.

REFERENCES

- Boominathan, M., Subash Chanden, M. D., and Ramchandra, T. V. (2008). Economic valuation of bivalves in the Aghanashini Estuary, West Coast, Xahalaka. ENVIS Technical Repodi 3, pp.33.
- Changes and spawning in the clam *Meretrix Casta* (Chemnitz).from the Marine fish farm. J. Mar. Biol. Assoc. India, 6: 241-248.
- Durue, V. S. and S.K.D. Raja. (1965). A study on dimensional clam *Meretrix Casta* (Chemnitz). Collected from two localities. J.Mar. Biol. Assoc. Indian, 7: 6979.
- Durve, V. S. (1963). A study on the rate of filtration of clam *Meretrix Casta* (Chemnitz) J. Mar. biol. Assoc. Indian, 5: 221-231.
- Durve, V. S. (1970). On the growth of the clam *Meretrix Casta* (Chemnitz).from
- Durve, V. S. and D. V. Bal. (1961). Studies on chemical composition of the oysters, *Crassostrea.graphoides* (Schlolheim). *J. Zool. Soc. India*, 13:7577.
- Gracia C.B., J. O. Duarte., N. Sandoval., D. von Schiller., G. Melo., and P. Navajas. 1998. Length-weight relationship of demersal fishes from the Gulf of Salamanca, Colombia. *Nega, ICLARM Q.*, 21(3):30-32
- Jayabal, R. and M. Kalyani. (1989a). Reproductive cycle of some bivalves from velar Estuary. East coast of India. J Mar. Sci 15:59-60
- Moazzam, M., and J. Ahmed. (1994). Prospect of development of mollscan Fisheries in Pakistan. In: Majid, A., Khan, M. Y., Moazzam, M., Ahmed, J. (eds.): Proc. Nat. Sem. Fish. Pol. Plann. Marine Fish. Dept, Govt. Pakistan, pp.41-76.
- Mohan, M. V., R. Damodaran, and K.Y. M. Salih. (1986). Allometric relationships in the clam, *Donax incarnates* Gmelin. *Oceanography* 19(1): 57-60.
- Narasimham, K. A., P. Muthiah., C.P. Gopinalhan., and A. D. Gandhi. (1988). Larval rearing spat production of the great clam *Meritrix Meritrix* (Linnaeus) Indian J. Fish., 35: 107'112.
- Plackett, R. L. (1983). Karl Pearson and the Chi-Squared Test, *International Statistical Review / Revue Internationale de Statistique*, 51(1): 59-72
- Quinn II T. J, and R.B. Deriso. (1999). Quantitative Fish Dynamics, Biological Resource Management Series, Oxford University Press, New York, U.S.A. 542 pp.
- Rai, H. S. (1932). The shell Fishries of the Bombay Presidency J Bombay Nat. Hist. Soc., 32: 826-847.
- Sreenivasan, P. V. (1983). Distribution of *Meretrix Casta* (Chemnitz) in Vellar Estuary.Proc. Symp. Coast Aqua. Mar. Biot. Assoc. India, 2: 56.1-563.
- Suja, N. and P. Muthiah. (2007). The reproductive biology of the baby clam *Marcia Opima* From two geographically separated areas of India. Tuticorin Research Centre of Central Marine Fishries India. Aquaculture, pp 11.
- Thangavelu, R. and P. J. Sanjeevarj. (1985). Fisheries and biology of of *Meretrix Casta* (Chemnitz) in the Pulicat Lake. J. Mar Biol. Assoc. India, 27: 75-83.
- the marine fish farm J. Mar. biol. Assoc. Indian, 12: 125-135.
- von Bertalanffy L. (1938). A quantitative theory of organic growth (Inquiries on growth laws, II). *Hum. Biol.*, 10: 181-213.
- Yoosukh, W. and A. Matslkuma. (2001). Taxonomic study on *Meretrix* (Mollusks: Bivalvia) from Thailand. Phuket Mar. Biol. Cent Spe. Publ. 2: 451-460.