Length-weight relationship and growth of the speckled shrimp *Metapenaeus monoceros* (Fabricius) off Saurashtra

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Abstract

The length–weight relationship for male and female of the speckled shrimp *Metapenaeus monoceros* (Fabricius) collected at Veraval were $W = 0.009277\ L^{2.92}$ for male and female $W = 0.003570\ L^{3.29}$. The von Bertalanffy growth parameters were L_∞ 184 mm and 228mm and annual K 1.8 and 2.0 for males and females respectively. The fishery is constituted by the shrimps in the length range of 96 to 220 mm. Life span of the species is estimated as 2 to 3 years and the fishery is supported mainly by of zero year age group.

Keywords: LW relationship, growth, *Metapenaeus monoceros*

Introduction

Metapenaeus monoceros is an important component of the shrimp fishery along the coasts of India. In Gujarat this species, known as *kapsi*, supports a regular fishery and are usually exploited from a depth of 50 to 60 m. The size of this shrimps caught off Saurashtra coast ranged from 96 to 220 mm. Length weight relationship and growth of this species along southwest and southeast coast of India have been studied by various workers (George, 1959; Lalithadevi, 1987; Rao, 1988; Rao and Krishnamoorthi, 1990 and Nandakumar; 1997). There is no similar work on this species reported from northwest coast of India. Since the information on growth and length-weight relationship form the basis for estimations of mortality, recruitment and other parameters of populations, this study is expected to provide inputs for further studies on the species along the northwest coast of the country.

Materials and methods

Samples of *Metapenaeus monoceros* were collected twice a week from the trawl catches at Bhidiya and 'Old Light House' fish landing centres at Veraval during January 1996 to December 1999. For length-weight relationship the shrimps were washed thoroughly in seawater and excess water from the body was removed using a blotting paper. The total length, carapace length ($\pm$ 0.1cm) and total weight ($\pm$ 0.01g) were recorded for males and females separately. To minimize the deviation in values due to weight increase during maturation process of females, those with fully matured ovary were excluded

from the study (Ivanov and Krylov, 1980). The total length was measured from the tip of the rostrum to the tip of the telson, to the nearest millimeter, keeping the abdomen fully stretched.

The linear equation ($\log W = \log a + b \log L$) was fitted for males and females separately with the log transformed data. Regression analysis was performed to determine the constants a and b and relationship between length and weight. The correlation coefficient (r) was determined to know the strength and pattern of association between the two variables. Analysis of covariance (Snedecor and Cochran, 1967) was carried out to test the significance level in the relationship between the sexes at 1% level.

For growth studies, length frequency data (total length) were grouped into 5 mm class interval. Growth parameters of both sexes were determined separately and length at age of males and females were calculated using von Bertalanffy's growth formula. Monthly length frequency data were analysed using the Powel-Wetherall, ELEFAN I modules of FiSAT software (Gayanilo and Pauly, 1997) to get a preliminary estimate of L_∞ and K. These growth parameters were further refined and re-estimated using the data corrected for gear selection. Bhattacharya analysis was done for identification and linking of means belonging to the same cohorts. Using growth increments data resulting from the linking of means, growth parameters were estimated by Gulland and Holt plot also.

By using selected values for L_∞ and K, t_0 was calculated following Pauly's equation (1979) as $\log(-t_0)$ = $-0.392 - 0.275 \log(L_\infty) - 1.038 \, K$.

Results

Length-weight relationship: The regression equations for the length-weight relationship of males (n = 190) and females (n = 173) were calculated as:

Males : $W = 0.009277 \; L^{2.92}$

Females : $W = 0.003570 \; L^{3.29}$

where W is the total weight (g) and L is the total length (in cm).

The slope and elevation of regression lines between male and female derived through analysis of covariance indicated a significant variation in slope and elevation. The slope and elevation differed indicating a significant variation in the growth pattern between sexes (Table 1).

Sex pooled length-weight relationship is a basic requirement for the biomass and other stock parameter estimation with the help of length frequency data. Keeping this requirement in view the sex pooled data (n = 363) were also subjected to regression analysis and the length-weight equation was derived as

$$W = 0.006188 \; L^{3.09}$$

Estimation of growth parameters: The fishery of the species was supported by individuals in the length range of 96 to 220 mm and males ranging from 125 to 150 mm and females from 145 to 180 mm dominated the catch. Preliminary estimation of L_∞ was made using the Powell-Wetherall plot. L_∞ obtained by Powell-Wetherall method was used for ELEFAN I routines. In males the values calculated for L_∞ and K were 184.0 mm and $K = 1.8$ yr^{-1} (Fig. 1) and in females, the values were 228.0 mm and 2.0 yr^{-1} respectively (Fig. 2). The L_∞ and K values estimated using the Gulland and Holt plot for males were
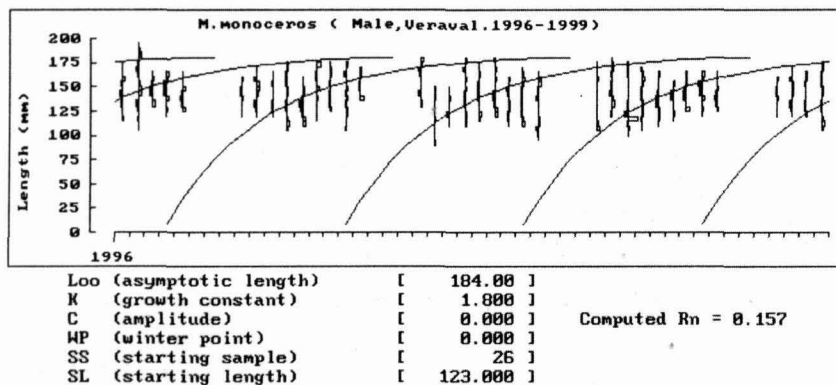

Fig. 1. Estimation of $L\infty$ and K of *M. monoceros* (males) using ELEFAN I method.

Table 1. *Results of the length–weight analyses of males and females of* M. monoceros *and their pooled value.* *(Transformation applied:* $\log(Y) = a + b * \log(X)$)

SOURCE	DF	SS-X	SP	SS-Y	b	DF	SS	MS	F
Male	189	1.1766	3.4400	12.2258	2.924	188	2.168	0.01153	
Female	172	3.4380	11.3180	39.4565	3.292	171	2.198	0.01285	
Total						359	4.366	0.01216	
Pooled	361	4.6146	14.7580	51.6823	3.198	360	4.485	0.01246	
Difference between slops						1	0.119	0.11892	9.78
Between1	2.5164	7.2422	20.8432						
W + B	362	7.1310	22.0002	72.5254	3.085	361	4.652	0.01289	
Difference between corrected means						1	0.167	0.16681	13.39

SOURCE	MEAN-X	MEAN-Y	a	b	r
Male	2.405	2.352	-4.68026	2.92368	0.906998
Female	2.572	2.832	-5.63520	3.29199	0.971751
Pooled	2.485	2.581	-5.08509	3.08514	0.967399

184.2 mm and 1.8 yr⁻¹ (Fig. 3) and that of females were 228.4 mm and $K = 2.0$ yr⁻¹ (Fig. 4). It is found that ELEFAN I and modal progression routines are giving similar values for growth parameters L_∞. and K. From these results, L_∞ of 184 mm and 228 mm and K (yr⁻¹) of 1.8 and 2.0 for males and females respectively were selected as growth parameters of the species. By using these values L_∞ and K as inputs, t_0 was calculated for males and females by Pauly's (1979) equation. The calculated t_0 values for males and females were -0.015 and -0.011 respectively.

By following von Bertalanffy growth curves derived from the selected growth parameters (Fig.5), age of the

largest male (180 mm) and female (220 mm) caught is found to be more than two years and it can be assumed that the species is having a life span of 2 to 3 years. The fishery during the period of observation was dominated by age groups less than one year.

Discussion

The morphometric relationship of *M. monoceros* from east coast of India has been reported by Rao (1988) and he has stressed the need for deriving separate relationship for both sexes. The present study showed that the variation of slopes and elevations of regression values of length-weight relationship significantly varies, thus neces-
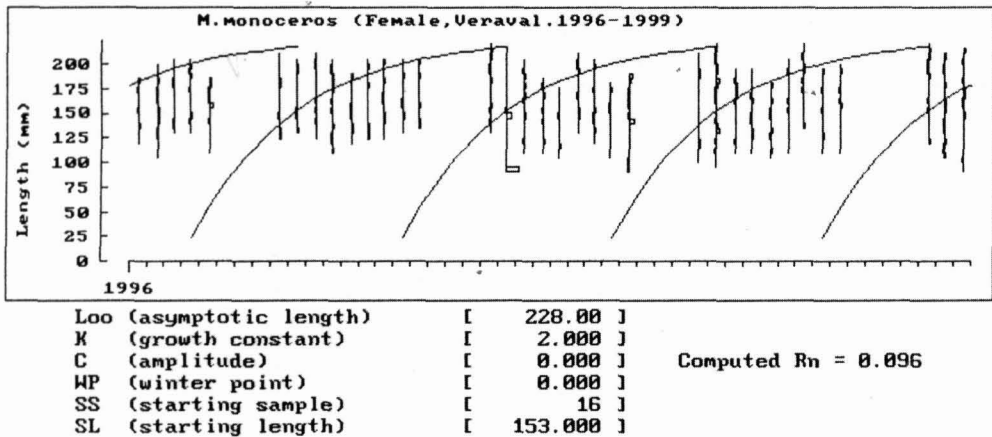

Fig. 2. Estimation of L_∞ and K of *M. monoceros* (females) using ELEFAN I method.
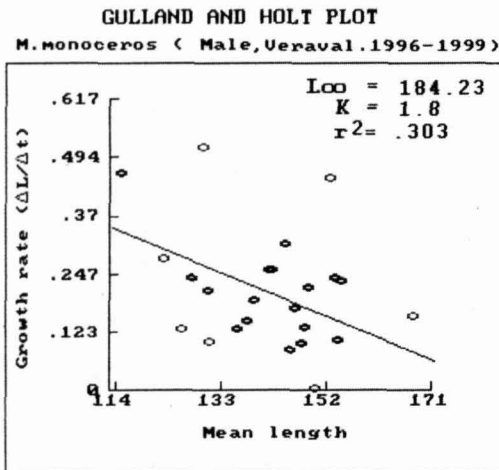

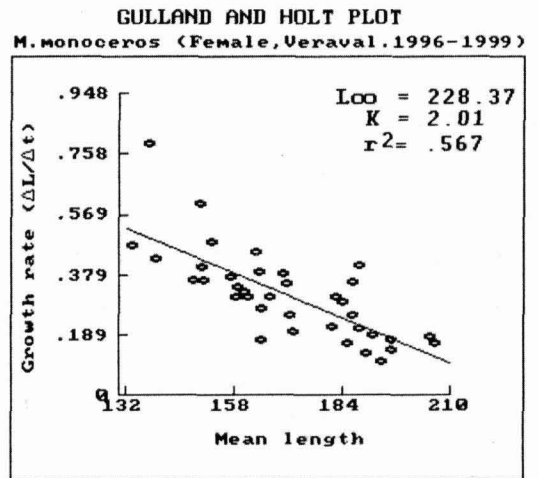Fig. 3. Estimation of growth parameters using Gulland and Holt plot for *M. monoceros* (males)

Fig. 4. Estimation of growth parameters using Gulland and Holt plot for *M. monoceros* (females)
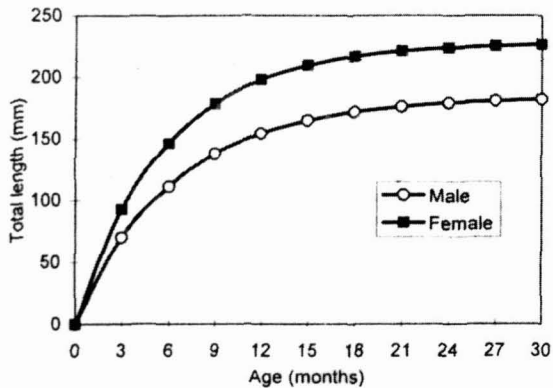
Fig. 5. Von Bertalanffy's growth curve for males and females of *M. monoceros*

sitating separate equations for males and females. In the present study b value obtained for females (3.29) was higher than those for males (2.92) which agreed with the findings of Nandakumar and Srinath (1999) where the values respectively were 2.90 and 3.13. Lalithadevi (1987) found that b value for males is higher than those of females in this species.

There were wide variations in the findings of growth and life span of the penaeid shrimps by different workers and these anomalies were attributed to pooling of the sex wise data instead of an independent analysis of males and females (Rao and Krishnamoorthy, 1990). When the pooled data are used for the study of growth of *M. monoceros*, three modes were observed before reaching 155 mm size which was attributed to three year classes (George, 1959) whereas when males and females were separately analysed, they were found to attain a length of 142 mm and 162 mm respectively in one year and 163 mm and 187 respectively in 1 ½ years (Rao and Krishnamoorthy, 1990). In the present study also differential growth of males and females was evident. The L_∞ and K values derived from the present study are higher than those derived by Rao and Krishnamoorthy (1990) and Nandakumar and Srinath (1999). Higher values of L_∞ and K for the species studied from Saurashtra waters than those observed from southern coast of India was earlier noticed in the case of *Parapenaeopsis stylifera* (Dineshbabu, 2005) also. This phenomenon need to be studied in detail in the light of the findings of Madhupratap *et al.* (2001), that there is a seasonal current from east coast of Africa and from the coast of Saudi Arabia that replenishes the coastal waters along the northwest coast of India. Due to this circulation, it is possible that there is a regular replenishment of fish stocks which have different stock characteristics from those found in the

southwest coast of India. This warrants further studies on stock identification, Even though the fishery of the species along Saurashtra coast was contributed mainly by zero year class (125 to 150 mm in males and 145 to 180 mm in females), considering the reported size at maturity of 118 mm from Bombay waters (Ramamurthy, 1994) and 125 mm from Saurashtra waters (Dineshbabu, 2003), it can be assumed that majority of females are getting an opportunity to breed at least once before they are caught.

Acknowledgements

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