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POPULATION DYNAMICS OF *LYSMATA ENSIROSTRIS* IN THE KUTUBDIA CHANNEL OF THE BAY OF BENGAL, BANGLADESH

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Abstract

FiSAT (FAO ICLARM Stock Assessment Tools) programme was used to estimate population parameters of *Lysmata ensirostris* from length frequency data. The $L\infty$ (asymptotic length) and K (growth coefficient) were found to be 7.3 cm and 2.2/year, respectively and the growth performance index (ϕ') was found to be 2.069. An additional estimate of $L\infty$ and Z/K was found to be 7.057 cm and 1.086, respectively. The annual rate of natural mortality (M), fishing mortality (F) and total mortality (Z) were found to be 8.44, 0.92 and 9.36, respectively. The selection pattern (L_{50}) was found to be 5.642 cm. The stock of *L. ensirostris* was not over exploited. This species is recruited in the fishery during April and August.

Key words : Asymptotic length, Growth-coefficient, Natural mortality, Recruitment pattern, Exploitation rate.

Introduction

L. ensirostris (Kemp, 1914) belonging to the family Hippolytidae is one of the commonly appearing shrimps in the behundi net catches in the shallow coastal areas of Bangladesh. According to FAO (1983) out of ten genera only *L. ensirostris* is reported to be economically important in the fishing area of the West Indian Ocean. Loghurst (1970) stated that along the north-west coast of India the present species together with *Nematopalaemon tenuipes* are caught in enormous numbers and are the dominant caridean species in the trawl catches. Information on fishing pressure and sustainable stock position is limited and little information on population dynamics and status of exploitation in the coastal waters of Bangladesh is available. For conservation and sustainable exploitation of the fishery, scientific management based on population dynamics studies is the most important issue. However, population dynamics on different fish and shrimp of the Bay of Bengal are available, based on length-frequency data (Mustafa *et al.* 1987, Mustafa 1993, 1994, 1996, Mustafa and Khan 1988). Considering the importance of this species, efforts have been made to get knowledge about the population dynamics of this shrimp fishery.

In the present investigation an attempt was made to study the asymptotic length ($L\infty$), growth-coefficient (K), natural mortality (M), fishing mortality (F), total mortality (Z),

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selection pattern (Lc), recruitment pattern and exploitation rate (E) of *L. ensirostris* in the Kutubdia Channel of the Bay of Bengal.

Materials and Methods

The present study was undertaken at the south-eastern part of the Kutubdia Channel of Bangladesh coastal water. The study was conducted from September, 1995 to July, 1996. Samples were collected monthly. Random measurements for 550 specimens of *L. ensirostris* (Table 1) were taken for length-frequency analysis. The shrimps were collected by MSBN (Marine Set Bag Net) or behundi Jal. All length-frequency data were pooled, and pooled data were entered in computer through ELEFAN 0 programme. All pooled data were entered after a definite time series of one month to link the lower cohort with upper length cohort. Computer based FiSAT (FAO-ICLARM Stock Assessment Tools) as explained in details by Gayanilo *et al.* (1994) programme was used to estimate the population parameters [Asymptotic length ($L\infty$), growth co-efficient (K), natural morality (M), fishing mortality (F), total mortality (Z), selection pattern (Lc), recruitment pattern].

As explained in detail by Pauly and David (1981) and Saeger and Gayanilo (1986), growth parameters $L\infty$ and K of Von Bertalanffy (1938) equation ($Lt = L\infty (1\text{-}e^{-k(t\text{-}to)})$) for growth in length are estimated by the Electronic Length Frequency Analysis (ELEFAN-I) using a microcomputer programme through objective method.

Growth performance index of *L. ensirostris* was estimated following the equation:

$$\phi' = \log_{10} K + \log_{10} L\infty \text{ (Pauly and Munro 1984)}$$

where, K and $L\infty$ (Von Bertalanffy growth parameters) were used from this study.

The ELEFAN-II routine was used for preliminary estimation of $L\infty$ and Z/K, obtained by plotting L on L' (Wetherall 1986), as modified by Pauly (1986), i.e.,

$$L - L' = a + bL' \quad (1)$$

where, $L\infty = a/(-b)$ and $Z/K = (1+b)/-b$.

Mortality estimates

The ELEFAN-II estimates the Z from the catch curve based on the equation:

$$Z = \frac{K (L\infty - L)}{L - L'} \quad (2)$$

Table 1. Monthly length-frequency data of *Lysmata ensirostris*.

Mid length (cm)	Date										
	15/09/95	15/10/95	15/11/95	15/12/95	15/01/96	15/02/96	15/03/96	15/04/96	15/05/96	15/06/96	15/07/96
1.40							1				
1.80							4				
2.20						2	8				
2.60			1			2	6	2			
3.00		1	0			3	2	1	3		
3.40	7	2	8			8	7	3	8		
3.80	8	7	5			5	14	5	19	1	
4.20	9	9	11	1		11	9	11	8	0	
4.60	4	9	11	4		7		7	6	8	1
5.00	4	6	9	4	1	5		7	3	4	0
5.40	4	7	4	17	8	3		3	3	7	4
5.80	8	6	2	14	3	3		10		17	10
6.20	3	4	1	10	21			1		11	15
6.60	2				16					2	18
7.00											1
Total	550										

Where, L is the mean length of the sample, computed from the cut-off length L' (upward) (Beverton and Holt 1956, 1957).

The parameter M has been estimated using the empirical relationship derived by Pauly (1980), i.e.:

$$Log_{10}M = -0.0066 - 0.279Log_{10}L\infty + 0.6543Log_{10}K + 0.4634LogT \quad (3)$$

Where, $L\infty$ is expressed in centimeter, T (^0C) is the mean annual environmental temperature (here it was taken as 28^0C).

The estimate of F was taken by subtraction of M from Z. The exploitation ratio E was then computed from the Gulland's (1971) expression:

$$E = F/Z = F/(F+M)$$

Selection pattern was determined using the routine ELEFAN II i.e. plots of probability of capture by length (Pauly 1984) on extrapolating the catch curve and calculating the number of fish that would have been caught.

Recruitment pattern is obtained by backward projection, on the length axis, of a set of length frequency data (seasonally growth curve) according to the routine ELEFAN II.

Results and Discussion

Growth parameters: The growth parameters of the Von Bertalanffy growth formula, $L\infty$ and K (per year) have been estimated for *L. ensirostris.* The $L\infty$ and K were found to be 7.3 cm and 2.2 (per year), respectively. For the estimates through ELEFAN-I response surface (Rn) was 0.145 for the main curve (solid line) and 0.13 for the secondary line (dotted line). The computed growth curve produced for *L. ensirostris* with those parameters are shown over its restructured length distribution in Fig. 1. The t_0 value was taken as 0. The modified Wetherall plot (1986) analysis yield the regression line Y= 2.52 + (0.345)*X, and r = 0995. Based on these points from 5.5 cm show a good linear relationship and those points of length below 7.0 cm smoothly approach the extended line. The Wetherall plots are shown in Fig. 2. The corresponding estimates of $L\infty$ and Z/K for *L. ensirostris* are 7.057 cm and 1.086, respectively. Growth performance index (ϕ') was estimated as 2.0691.

Mortality: Natural (M), Fishing (F) and total mortality (Z) rate computed for the *L. ensirostris* were 8.440, 0.920 and 9.360, respectively. Fig. 3 presents the catch curve utilized in the estimation of Z. The darkened quadrilaterals represent the points used in calculating Z through least square linear regression. The blank circles represent points either not fully recruited or nearing to $L\infty$ and hence discarded from the calculation. Good fit to the descending right hand limits of the catch curve was considered. For the regression, the correlation coefficient were 0.998 (a = 15.38 and b = – 9.36).

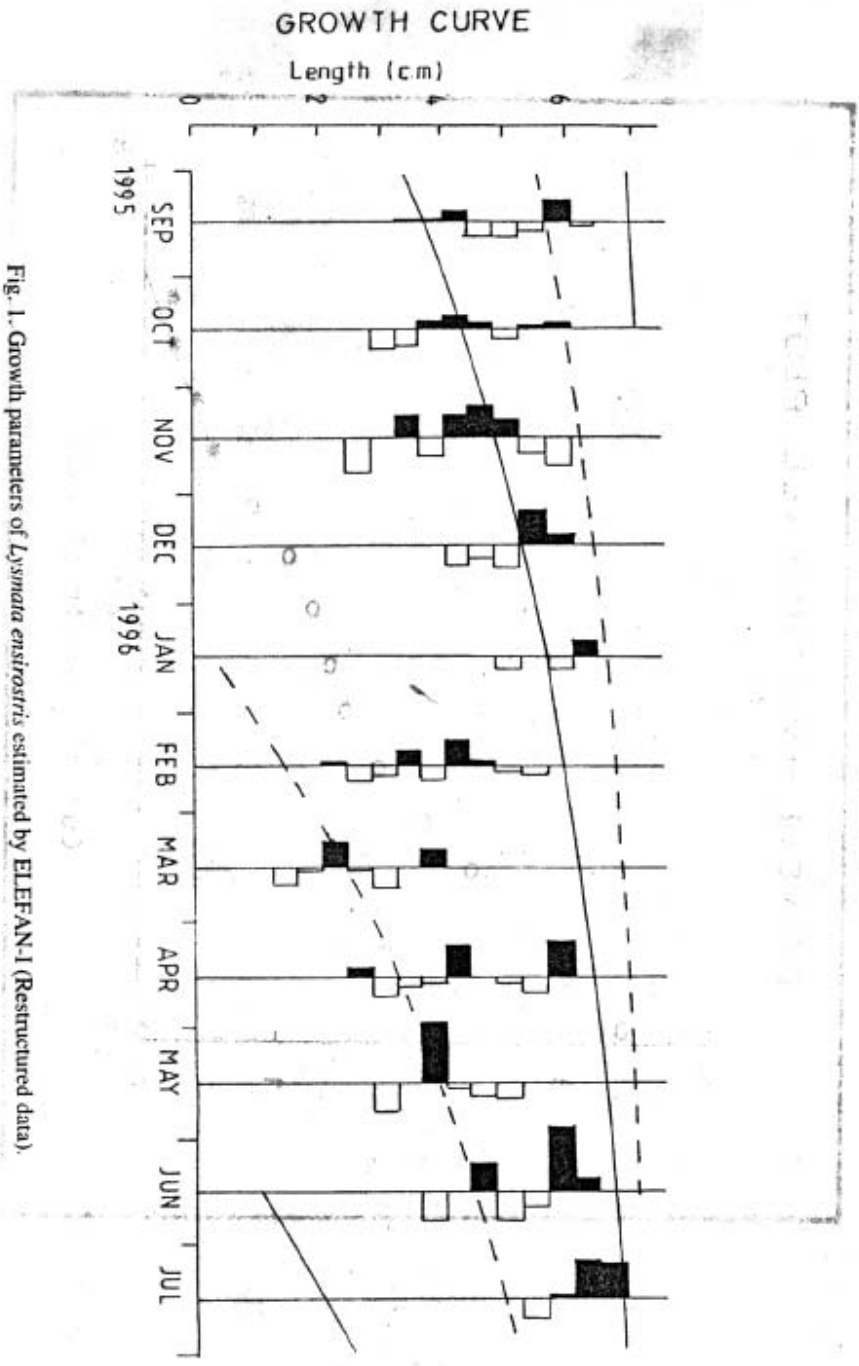

Fig. 1. Growth parameters of *Lysmata ensirostris* estimated by ELEFAN-I (Restructured data).

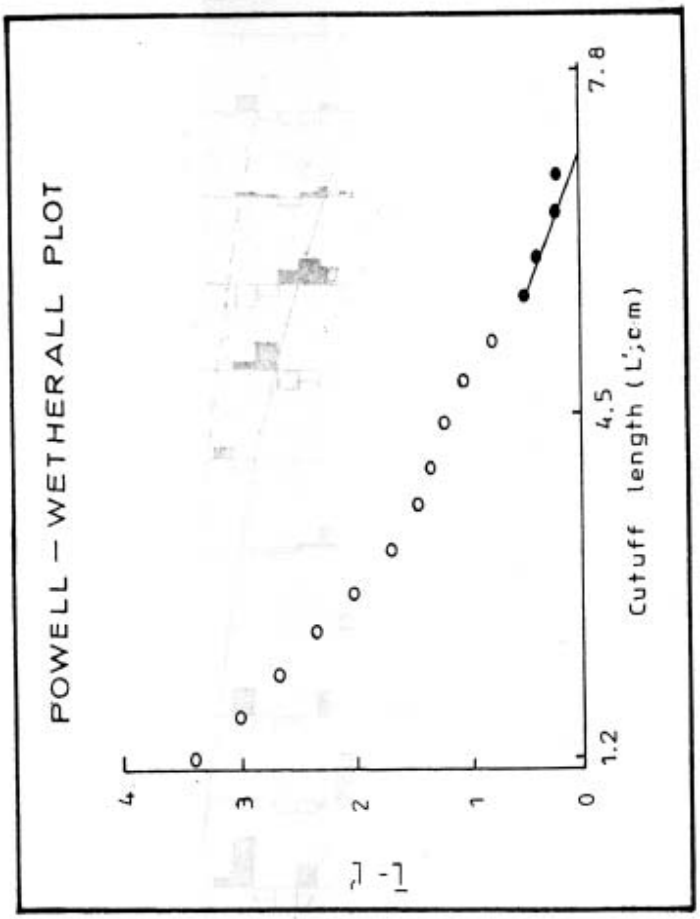

Fig.2. Estimation of L∞ and Z/K using the methods of Wetherall for *Lysmata ensirostris*; the estimated L∞ = 7.057 cm and Z/K = 1.086.

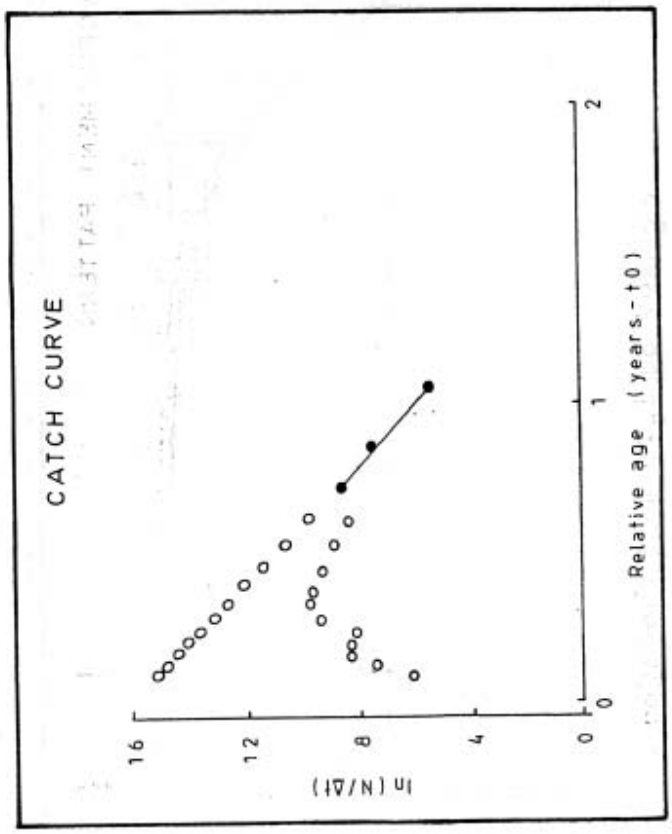

Fig. 3. Length-converted catch curve of *Lysmata ensirostris*.

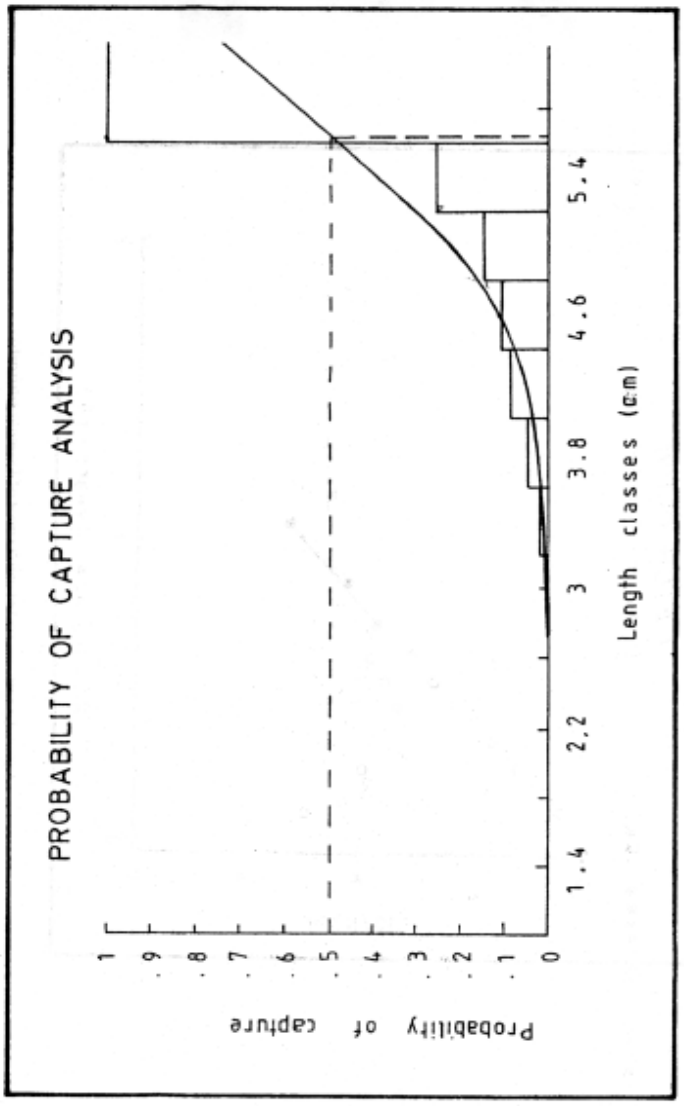

Fig. 4. Selection pattern of *Lysmata enstrostris*.

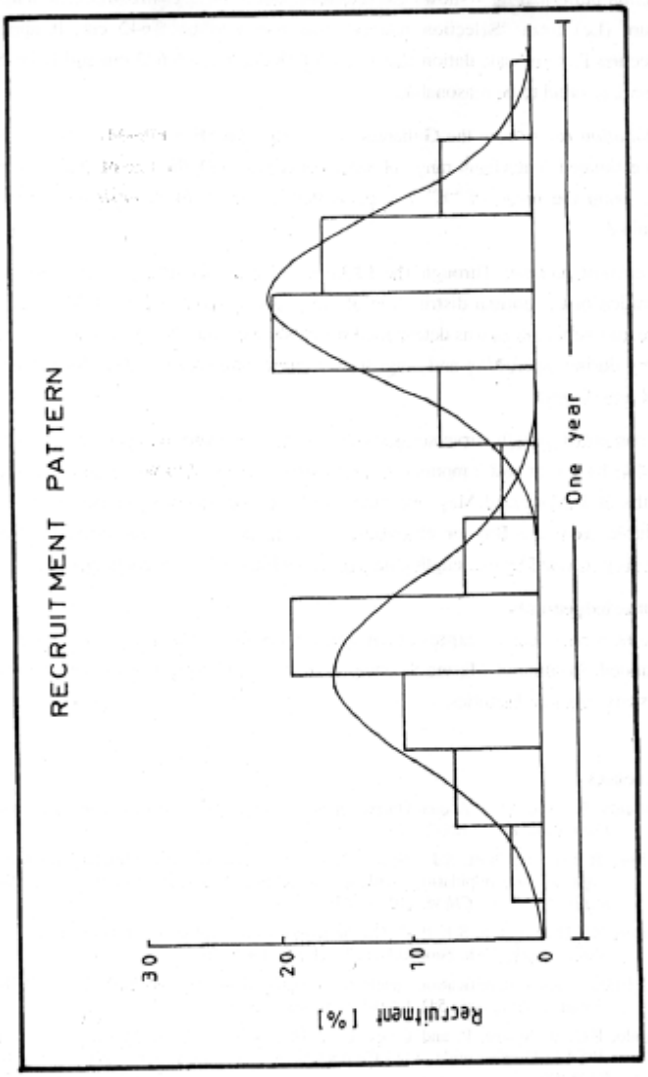

Fig. 5. Recruitment pattern of *Lysmata ensirostris*.

Selection pattern: Fig. 4 shows the selection pattern of *L. ensirostris*. The length at first capture (Lc) from "Selection pattern" was found to be 5.642 cm. It appears from "Selection Pattern" calculation that L_{25} = 5.876 cm, L_{50} = 5.642 cm and L_{75} = 6.208 cm, where, L_{50} found to be reasonable.

Exploitation rate: From the Gullands (1971) equation (E = F/F+M) exploitation (E) has been estimated. Thus from range of values of (F) and (Z), the rate of exploitation (E) was 0.10. From the result of "E" it appears that the stock of *L. ensirostris* was not over exploited.

Recruitment pattern: Through the ELEFAN II analysis (Pauly *et al.* 1981), with the separation of the normal distribution of the peaks by means of the NORMSEP program, the recruitment pattern was determined which showed that the species was recruited in the fishery during April-May and August, September and October (Fig. 5). Peaks appear in April and August.

The computed growth curve suggests that the approximate life span of *L. ensirostris* was found to be 1 year and 3 months. *L. ensirostris* was found to breed and spawn during the months of January and May. No other work on population dynamics of this species is available from the Bay or elsewhere, so comparison was not possible. Recruitment patterns generated by the length data suggests a bimodal recruitment per year.

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