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Population dynamics of the ribbon fish, *Lepturacanthus savala* (Cuvier 1829) from the north-eastern part of the Bay of Bengal

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Abstract
Population parameters of *Lepturacanthus savala* from the trawl catches in the north-eastern part of the Bay of Bengal, Bangladesh were investigated based on length frequency data, using compleat ELEFAN computer program. The asymptotic length ($L\infty$) and growth constant (K) were estimated to be 106.50 cm (total length) and 0.80/year respectively. Based on these growth parameters, the total mortality (Z) was estimated to be 1.89. The estimated values for natural mortality (M) and fishing mortality (F) were 1.08 and 0.81 respectively. The estimated value for the exploitation rate (E) using the length converted catch curve was 0.43. The recruitment pattern showed two peaks per year. The estimated sizes of *L. savala* at 25, 50 and 75 percent probabilities of capture were 57.49, 60.39 and 63.28 cm respectively. The estimated length weight relationship for combined sex was $W = 0.00093\ TL^{2.97}$

Key words: Population dynamics, *L. savala*, Bay of Bengal

Introduction

Lepturacanthus savala (F. Trichiuridae) is the most abundant and commercially important fish in the Bay of Bengal. It is locally known as "Chori Mach". It forms about 2.5% of the total demersal trawl catch (Lamboeuf 1987) and account for 0.83% of the estimated total shrimp trawl production for 1989-90 (Mustafa and Khan 1992). They feed on teleostean fishes, shrimps, other crustacean and cephalopods (Mustafa and Begum 1994). Dried fish is very popular all over the country and also exported to the other countries like U.K., Singapore, Middle-East and SriLanka.

There is no published information on population dynamics of *Lepturacanthus savala* in Bangladesh. In the present study, the population parameters of *L. savala* were estimated to assess its stock in the north-eastern part of the Bay of Bengal.

Materials and methods

Collection of data

Length frequency data of *L. savala* were collected from trawler catches in the north-eastern part of the Bay of Bengal during the period October 1996 to September 1997 by making regular fortnight field visits to the major fish landing centres in Firingibazar, Chittagong. More than eight trawlers of Sea Resources Group Companies Ltd. Bangladesh were sampled randomly. On each sampling day, total lengths of 100-200 fish obtained by random sampling were measured to the nearest 0.1cm using a measuring scale.

Analysis of data

Monthly length frequency distribution of *L. savala* for each month was analysed using compleat ELEFAN computer program (Gyanilo *et al.* 1989). The program was also used to estimate the parameters of the von Bertalanffy growth equation. The fitting of the best growth curve was based on the ELEFAN I program, which allows the line to pass through the maximum number of peaks of the length frequency distribution. With the aid of the best growth curve the growth constant (K) and the asymptotic length ($L\infty$) were estimated. Additional estimate of $L\infty$ and Z/K value were obtained by plotting $\bar{L}$ minus L' on $\bar{L}$ (Wetherall 1986 as modified by Pauly 1986), i.e.

$L - L' = a + bL'$

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

where $\bar{L}$ is defined as the mean length, computed from L' upward, in a given length-frequency sample while L' is the limit of the first length class used in computing a value of $\bar{L}$.

The growth performance of *L. savala* population in terms of length growth was compared using the index of Pauly and Munro (1984). i.e.

$\phi' = \text{Log}_{10} K + 2 \text{Log}_{10} L\infty$. (Where $L\infty$ is the asymptotic length in cm and K is the growth constant per year).

The instantaneous total mortality coefficient (Z) was estimated using the length converted catch curve method which has been incorporated into the compleat ELEFAN computer program (Gayanilo *et al.* 1989). Natural mortality rate (M) was estimated using Pauly's empirical relationship (Pauly 1980) i.e.

$\text{Log}_{10} M = - 0.0066 - 0.279 \text{Log}_{10} L_\infty + 0.6543 \text{Log}_{10} K + 0.4634 \text{Log}_{10} T$

where L_∞ is expressed in cm and T, the mean annual environmental water temperature in °C (here it was 28°C).

Fishing mortality (F) was obtained by subtracting M (natural mortality) from Z (total mortality) and exploitation rate (E) was obtained from F/Z (Gulland 1971). Recruitment pattern was obtained by backward projection on the length.

Using Pauly`s empirical equation for theoretical age at length zero (Pauly 1979) a very approximate estimate of theoretical age at length zero was obtained. The equation used as follows:

$\text{Log}_{10} (-t_o) = - 0.3922 - 0.2752 \log_{10} L\infty - 1.038 \log_{10} K$

The recruitment pattern was also derived using the compleat ELEFAN computer program (Gayanilo *et al.* 1989).

The probabilities of capture by length (Pauly 1984) of *L. savala* were estimated by calculating the ration between the points of the extrapolated descending arm and the corresponding assending arm of the length converted catch curve.

Relative yield-per-recruit Y/R and biomass-per-recruit B/R were obtained from the estimated growth parameters and probabilities of capture by length (Pauly and Soriano 1986). The calculations were carried out using the compleat ELEFAN package developed at ICLARM (Ingles and Pauly 1984).

Length weight relationship was estimated for combined sex using simple linear regression (Zar 1984). For this purpose 352 specimens of *L. savala* were measured and varied from 12.0 cm to 32.0 cm in total length and 25g to 340g in body weight during one year samples.

Results and discussion

Growth parameters

The length range obtained in the fishery was 32-104 cm. In addition, the length range, which contributed significantly to the fishery, was within 56-70 cm. The length frequency distribution of *L. savala* for one year study period are shown in Fig. 1. The best growth curves estimated by the compleat ELEFAN computer program (Gayanilo *et al.* 1989) are shown in this figure. The values for asymptotic length ($L\infty$) and the von Bertalanffy growth co-efficient (K) estimated for the stock were 106.50 cm and 0.80/year respectively. The powell-wetherall plot is shown in Fig. 2. The corresponding estimates of $L\infty$ and Z/K for *L. savala* are 106.90 cm and 2.38 respectively. This additional estimate of $L\infty$ is slightly higher than the estimated through ELEFAN I.

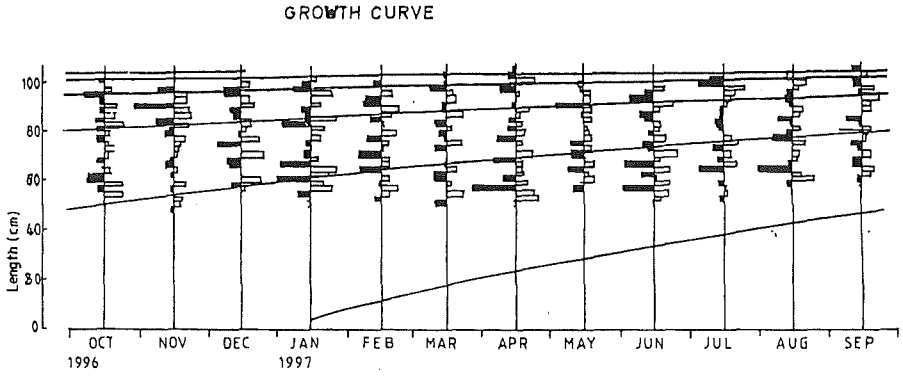

Fig. 1. Monthly length frequency distribution of *Lepturacanthus savala* during the study period with the estimated growth curves.

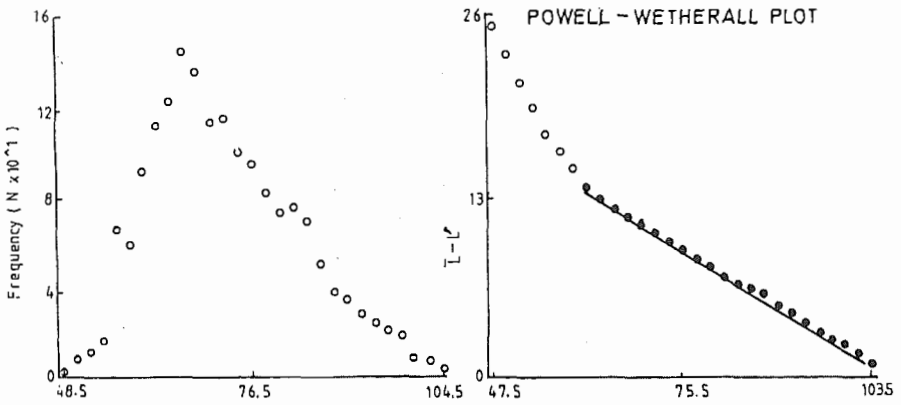

Fig. 2. Powell-wetherall plot of *Lepturacanthus savala* (L∞= 106.90cm and Z/K=2.38).

Mortality and exploitation rate

The length converted catch curve of *L. savala* is shown in Fig. 3. The values for instantaneous total mortality co-efficient (Z), natural mortality co-efficient (M), Fishing mortality co-efficient (F) and the exploitation rate (E) calculated form the data points of figure were 1.89, 1.08, 0.81 and 0.43 respectively. It appears that the stock of *L. savala* of the investigated area is not under fishing pressure.

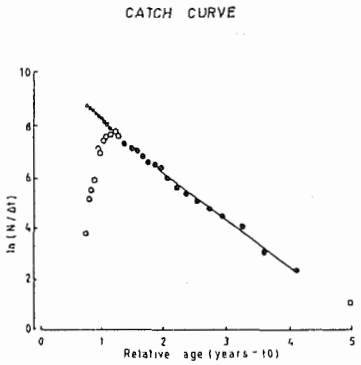

Fig. 3. Length-converted catch curve of *Lepturacanthus savala.*

Theoretical age of length zero (t_o)

The estimated value for t_0 using Pauly`s empirical equation (Pauly 1979) was 0.0708/year.

Recruitment pattern

Recruitment pattern of *L. savala* during the study period are shown in Fig. 4. The recruitment pattern showed two peaks, one around in March and the other around in July. The means of two pluses of recruitment are separated by an interval of four months. The first pulse produced 11.39% of the recruits while the other produced 16.56%.

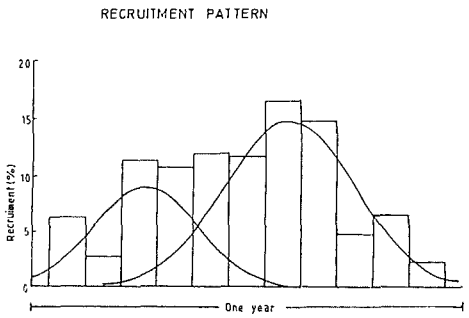

Fig. 4. Recruitment patter of *Lepturacanthus savala.*

Probabilities of capture

The probabilities of capture of *L. savala* is shown in Fig. 5. The estimated sizes of *L. savala* at 25%, 50% and 75% probabilities of capture were 57.49 cm, 60.39cm and 63.28 cm respectively.

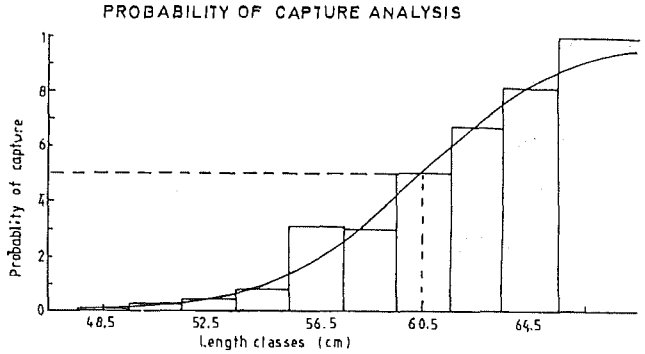

Fig. 5. Probabilities of capture pattern of *Lepturacanthus savala.*

The yield-per-recruit and biomass-per-recruit

The relative yield-per-recruit and biomass-per-recruit were determined as a function of Lc/L∞ and M/K are 0.567 and 1.35 respectively. Fig. 6 shows that the present exploitation rate (E = 0.43) not exceeds the optimum exploitation rate (E_{max} = 0.64).

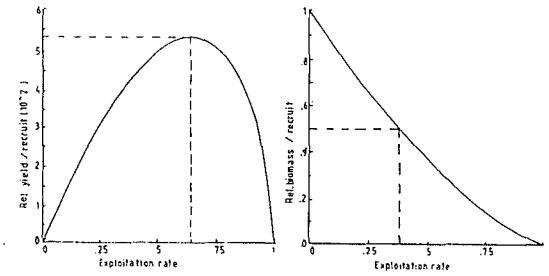

Fig. 6. Relative yield-per-recruit and biomass- per-recruit of *L. savala* (Lc /L∞=0.567, M/K=1.35).

Length-weight relationship

The estimated length weight relationship for the species was Log W = - 3.03 + 2.97 Log TL, in exponential form this equation is $W = 0.00093TL^{2.97}$ The log length and log

weight of the fish linearly related with a co-efficient of correlation ($r = 0.996$, $p = <0.001$, t cal. = 22.08, n = 37 size range).

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