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Study on Mortality and Recruitment Pattern of *Etroplus suratensis* (Bloch, 1790) from Chilika Lagoon, Odisha, India

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A B S T R A C T

Mortality and recruitment pattern of *Etroplus suratensis* (Bloch, 1790) from Chilika Lagoon, Odisha was studied using length-frequency based analysis to evaluate the length at age, mortality rates and recruitment pattern. The study revealed that the total mortality, Z (2.265/yr) natural mortality, M (0.87/yr) and fishing mortality, F (1.3/yr). The present study also revealed that the probability of capture at L_{25}, L_{50} and L_{75} as 19.06 cm,21.75cm and 24.45 cm respectively and E_{10}, E_{50} and E_{max} as 0.504,0.322 and 0.649 respectively. The study of the recruitment patterns of *E. suratensis* also revealed of two annual recruitment.

Introduction

The Chilika lagoon is the largest brackish water lakes of the Aisa, a Ramsar site. Chilika lagoon is a unique assemblage of marine, brackish and fresh water ecosystem with estuarine characters. It is one of the hotspots of biodiversity and shelters a number of endangered species. The highly productive lagoon ecosystem with its rich fishery resources sustains the livelihood of more than 150,000 fishers who live in and around the Lagoon. Pearl spot *(Etroplus suratensis),* also known as green chromide is widely found in the freshwater and brackish water ecosystems of India and Sri lanka[(1)]. It is endemic to peninsular India extending from South Canara to Malabar on the west coast to Chilka lake on the east coast[(2)]. It is also one of the most popular and very important fish species in Chilika lagoon. This fish is locally known as Kundala and has its economic importance and larger sizes are mostly exported. From the last 10 year studies conducted by Chilika Development Authority (CDA) the average contribution of *Etroplus suratensis* is about 271.056 tons from 2008-09 to 2012-13 and the catches vary greatly during the last ten year [(3)]. However the stock assessment study of *E. suratensis* in the lagoon is very limited.

Therefore in the present study was carried out to evaluate the length at age, mortality rates and recruitment pattern, estimate the age and growth parameters of *E. suratensis* species.

Materials and Methods

In the present study, length based stock assessment method is used and length frequency data of *E. suratensis* species were collected from the major landing centre i.e Balugaon, Sorana and Nairi. The data on individual length and weight of the samples were measured and the total catch of the species were noted on the day of observation. Total length was measured in mm using the measuring board and the weight was measured in gm using a digital balance with corresponding length. The length frequency data was distributed in 10 mm class intervals for the study of growth and the sample was raised for the day and subsequently for the month following the method of Sekharan[4].

In the present study the pooling of more than one year data, September, 2016-February 2018 was taken into account during the result analysis. Length-frequency data of more than one year was also reported by a number of scientists [5,6,7,8]. Data were analyzed using the FiSAT-II (FAO-ICLARM Stock Assessment Tools)[9] in the computer software package. Additional estimate of Prediction of the maximum length from the extreme values of *Etroplus suratensis* in Chilika lagoon was also carried out. The growth performance (Ø)in terms of length growth was calculated by FISAT-II using the parameters L∞ and K and also using index [10] as per the formula give below

$$Ø = \{=Log10K+2Log10L_{\infty}\}$$

Total mortality (Z) was estimated using the length converted catch curve method as implemented in ELEFAN I. Natural mortality rate (M) was estimated using Pauly's empirical relationship [11] as mentioned, below.

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

where, L_{∞} is expressed in cm and T, the mean annual environmental temperature in °C which is here 29°C.

Fishing mortality (F) was obtained by subtracting M from Z and exploitation rate (E) was obtained from F/Z [E = F/Z = F/ (F+M)] [12]. Recruitment patterns were obtained by backward projection on the length axis of a set of length-frequency data as described in the FiSAT-II routine. Probability of capture, size at first capture (L_c) and recruitment pattern was also obtained by means of ELEFAN I.

Estimation of recruitment pattern analysis was carried out using the length frequency raised data using the FiSAT-II (FAO-ICLARM Stock Assessment Tools).

Results and Discussion

Growth parameters

Growth parameters of von Bertalanffy growth formula *viz* L_{∞} and K were analysed by FISAT-II for *E. suratensis* in Chilika lagoon and the values of L_{∞} and K was estimated at 24.78 cm and 0.30/yr respectively with the response surfaces (Rn) used for the curves was 0.237. The growth parameter was estimated through ELEFAN-1 (Fig. 1).

It was also found in his study[13] on Cichlidae inhabiting lake Manzala, Egypt also found the range of L_{∞} value between (21.53 -28.88) and K value between (0.27 - 059). The value of growth curvature (K) also found between 0.12-0.23/yr[21].

Mortality

Total mortality 'Z' was calculated from the length converted catch curves in FISAT-II where L∞ (24.78 cm) and K(0.3/yr) as input value.

The estimated values of total mortality (Z) were found as 2.2/year using the Jones and Van Zalinge Plot. The natural mortality rate 'M' was estimated from Pauly's empirical equation (Fig. 2). It was calculated as 0.869/yr [22]. The fishing mortality rate was estimated by subtracting 'M' from 'Z'. Thus the values of F obtained as 1.76. From the present study as the value of Z/K more than 2 indicating mortality was predominant over growth and the stock was mortality dominated which corroborate the finding of [14,15,16].

Fig.1 Estimation of growth curves of *Etroplu suratensis* using ELEFAN-1

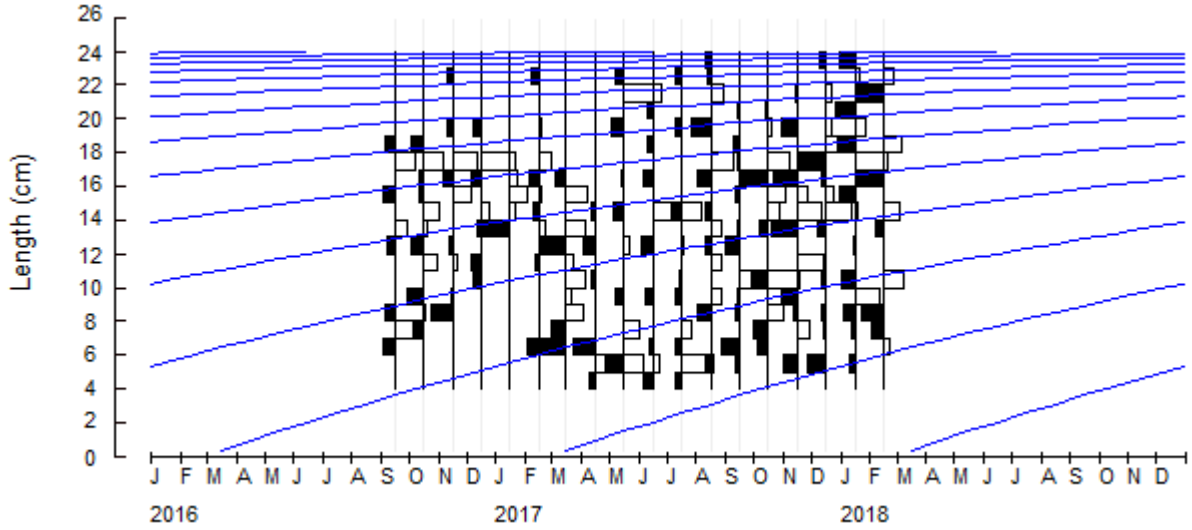


Fig.2&3 Estimation of 'M' using Pauly's empirical equation & Estimation of probability of capture using length converted catch

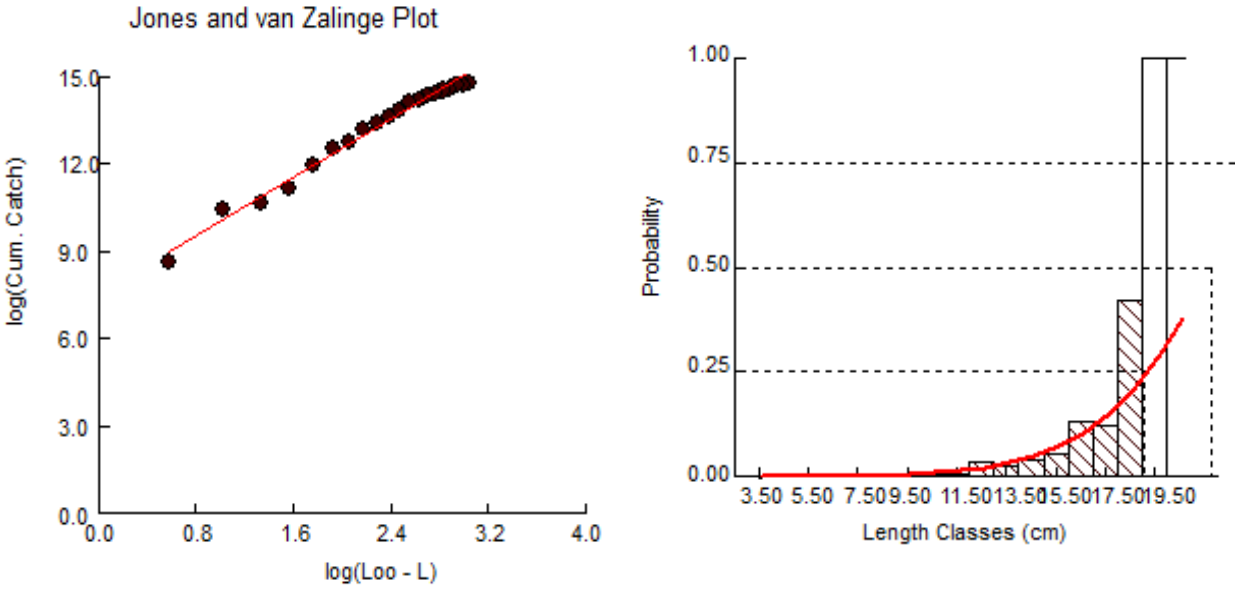
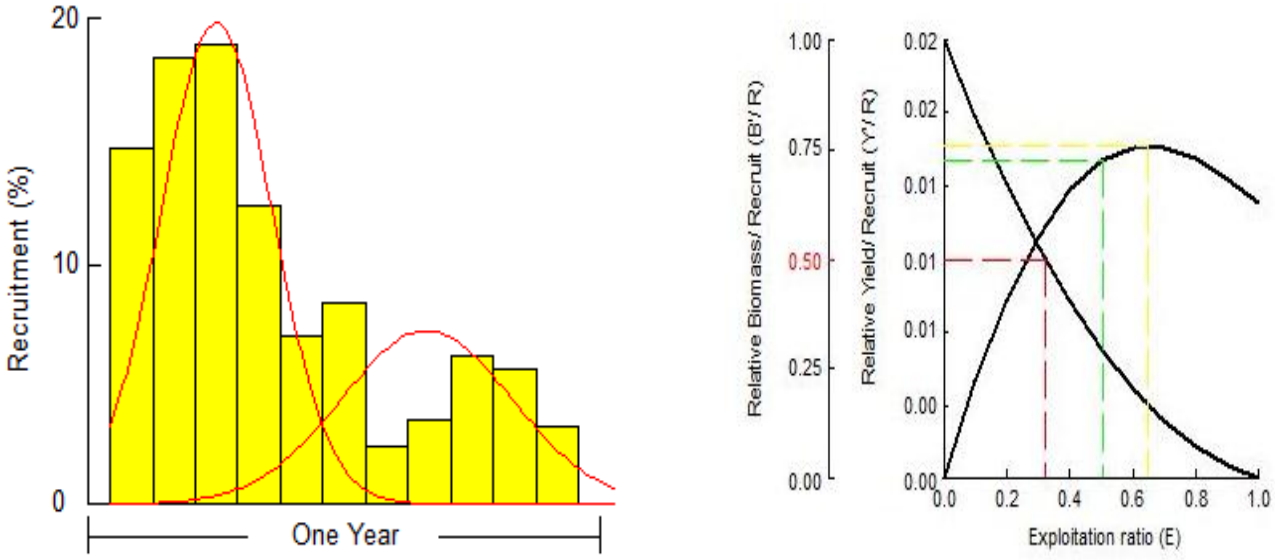


Fig.4&5 Estimation of recruitment pattern using ELEFAN II & Relative Y/R and biomass per recruit



Probability of capture

The probability of capture was estimated from the length converted catch curve using the FiSAT-II (FAO-ICLARM Stock Assessment Tools) From the probability of capture it was found that L_{25}, L_{50} and L_{75} as 19.06 cm,21.75cm and 24.45 cm respectively which indicates that the at 19.06cm length 25% of the fish will be vulnerable to the gear (left hand selection), at 21.75 cm 50% of the fish will be vulnerable to the gear (left hand selection) and at 24.45 cm 75% of the fish will be vulnerable to the gear (left hand selection) (Fig. 3). Similar results also reported by [17,18,19].

Recruitment pattern

The recruitment pattern was determined through the ELEFAN II analysis [20] with the separation of normal distributions of the peaks by means of the NORMSEP program. Figure 4 show indicates the recruitment patterns of *E.suratensis* indicating two annual recruitment, the first recruitment occurred between January to April with a sharp peak in March accounting (18.93%) of the total catch and the second small one occurred between July to September with a sharp peak in June accounting (8.22%) of the total catch. The results of two pulses of recruitment also reported by [21,22,23,24].

Yield-per-recruit and biomass-per-recruit

The relative yield-per-recruit (Y/R) and biomass-per-recruit (B/R) were deter-mined as a function of L_c/L_∞ and M/K respectively (Fig. 5). The L_c/ L_∞ and the values of M/K are 0.350 and 2.86. The exploitation rates (E_{10}= 0.504, E_{75}= 0.322, E_{max}= 0.649) for *E. suratensis*. In the Emax=0.649, the Y/R value is 0.09 that indicates the 18% virgin biomass is left. From the present study the exploitation rate as U=0.43 and exploitation ratio calculated as E=0.60.[16,25].

From the above study it can be concluded that the present level of exploitation of *E. suratensi* is quite higher than the optimum level of exploitation. So it is recommended to

reduce the effort at least by 35% to recover the stock.

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