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Population Dynamics of *Johnius argentatus* (Houttuyn) from the Northeastern Part of the Bay of Bengal, Bangladesh

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Abstract

Population parameters of *Johnius argentatus* from the trawl catches in the northeastern part of the Bay of Bengal, Bangladesh were estimated from length frequency data, by using Compleat ELEFAN computer programs. The asymptotic length (L_∞) and growth constant (K) were estimated to be 46.1 cm (total length) and 0.86/year respectively. Based on these growth parameters, the total mortality coefficient (Z) during the study period was estimated to be 2.02. The estimated value for natural mortality (M) was 1.44 hence the fishing mortality coefficient (F) was 0.58. The estimated values for the exploitation rate (E) using the length converted catch curve was 0.29. Recruitment was continuous with two peaks per year. The estimated sizes of *Johnius argentatus* at 25, 50 and 75 percent probabilities of capture were 20.13, 22.13 and 24.13 cm respectively. The length-weight relationship was $W = 0.0298TL^{2.69^{o}}$.

Introduction

Johnius argentatus (Silver jewfish) is a common fish in the Bay of Bengal. It is one of the commercially important and popular fish in Bangladesh. There is a demand for this species in the international market in places such as Saudi Arabia, Quiet, Qater, Middle East and other Arab countries.

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In Bangladesh, about 50% of the landings of these fish in fresh state are utilized as food for people. Some are exported while the rest are sun dried. The air bladders are dried and exported for making glue and gelatin.

Although *J. argentatus* is one of the most abundant species in the coastal water of Bangladesh, there is no published information on population dynamics. In the present study, some population parameters of *J. argentatus* were estimated to assess the stocks in the northeastern part of the Bay of Bengal.

Materials and Methods

Collection of data

Length frequency data of *J. argentatus* were collected from trawler catches in the northeastern part of the Bay of Bengal (Fig.1) during the period October 1996 to September 1997 by making regular fortnightly field visits to the major fish landing center in Firingibazar, Chittagong. More than eight trawlers of the Sea Resources Group of Companies Ltd., Bangladesh were sampled randomly. On each sampling day, total lengths

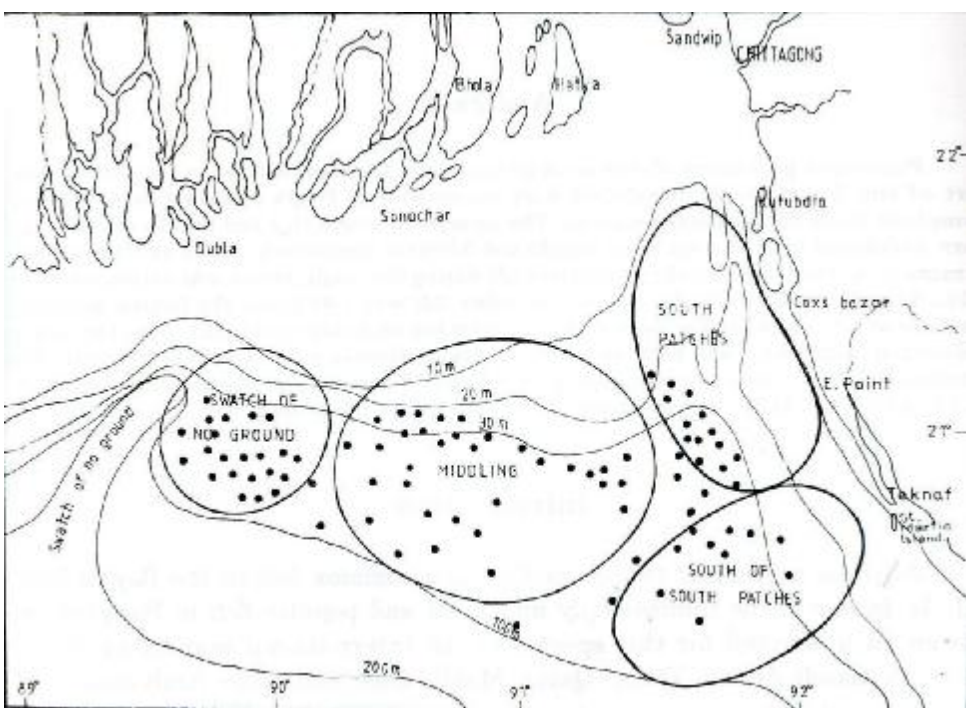

Fig.1. Geographical location of trawlnet fisheries in the northeastern part of the Bay of Bengal.

of 100 to 200 fish obtained by random sampling were measured to the nearest 0.1 cm using a plastic measuring scale. The total sample size was 2207.

Analysis of data

Monthly length frequency distributions of *J. argentatus* for each month were analyzed using the Compleat ELEFAN computer program (Gayanilo 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. Additional estimates of $L\infty$ and Z/K values were obtained by plotting $\bar{L}$ minus L' on $\bar{L}$ (Wetherall 1986 as modified by Pauly 1986), i.e.

$$\bar{L} - L' = a + bL'$$

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

where $\bar{L}$ is 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 *J. argentatus* 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_{∞} is the asymptotic length in cm and K is a 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 (M) was estimated by using Pauly's (1980) empirical formula, 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 (total length) and T (^{o}C) is the mean annual environmental temperature (here it was taken at 28^{o}C).

The estimate of fishing mortality (F) was taken by subtracting M from Z; the exploitation rate (E) was then computed using Gulland's expression (Gulland 1971) i.e.

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

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

The probabilities of capture by length (Pauly 1984), were estimated by calculating the ratio between the points of the extrapolated descending arm and the corresponding ascending arm of the length converted catch curve.

Relative yield-per-recruit (Y/R) and biomass-per-recruit (B/R) were calculated obtained from the estimated growth parameters and probabilities of capture by length (Pauly and Soriano 1986) and by using the Compleat ELEFAN package (Ingles and Pauly 1984).

A length-weight relationship was estimated for both sexes combined using simple linear regression (Zar 1984). For this purpose 337 specimens of *J. argentatus* were measured. Total length varied from 16.0 cm to 45.0 cm and the body weight varied from 65 g to 950 g.

Results and Discussion

Length-weight relationship

The length weight relationship of *J. argentatus* was LogW = -1.5256 +2.6908 log TL and in exponential form, this equation is $W = 0.0298TL^{2.690}$. The log length and log weight of the fish are linearly related to a coefficient of correlation (r = 0.997, t = 68.51, p = 0.001)

Growth parameters

The length range obtained in the fishery was 16 to 45 cm, the majority of the catch being between 17 and 42 cm. The length frequency distribution of *J. argentatus* for the one year study period is shown in figure 2. The asymptotic length (L_∞) and the von Bertalanffy growth coefficient (K) estimated for the stock were 46.1 cm and 0.86/year, respectively. The Powell-Wetherall plots are shown in figure 3. The corresponding estimates of L_∞ and Z/K for *J. argentatus*

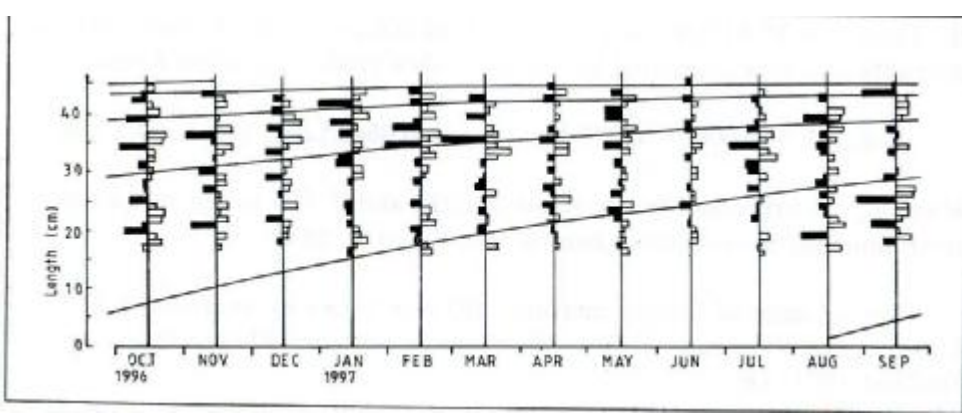

Fig. 2. Monthly restructured length frequency distributions of *Johnius argentatus* during the study period with the estimated growth curves.

are 46.69 cm and 2.316 respectively. This additional estimate of L_∞ is slightly higher than the one estimated through ELEFAN-1.

Mortality and exploitation rate

The values for instantaneous total mortality coefficient (Z), natural mortality coefficient (M), fishing mortality coefficient (F) and the exploitation rate (E) calculated from figure 4 were 2.02, 1.44, 0.58 and 0.29, respectively. This suggests that the stock of *J. argentatus* in the investigated area is not under high fishing pressure.

Recruitment pattern

Results of the analysis of the recruitment pattern of *J. argentatus* during the study period are shown in figure 5. This can be interpreted as a continuous recruitment throughout the year, but with two peaks, one around March and the other around July. The means of two pulses of recruitment are separated by an interval of four months. The first pulse produced 11.5% of the recruits while the second produced 15.4%.

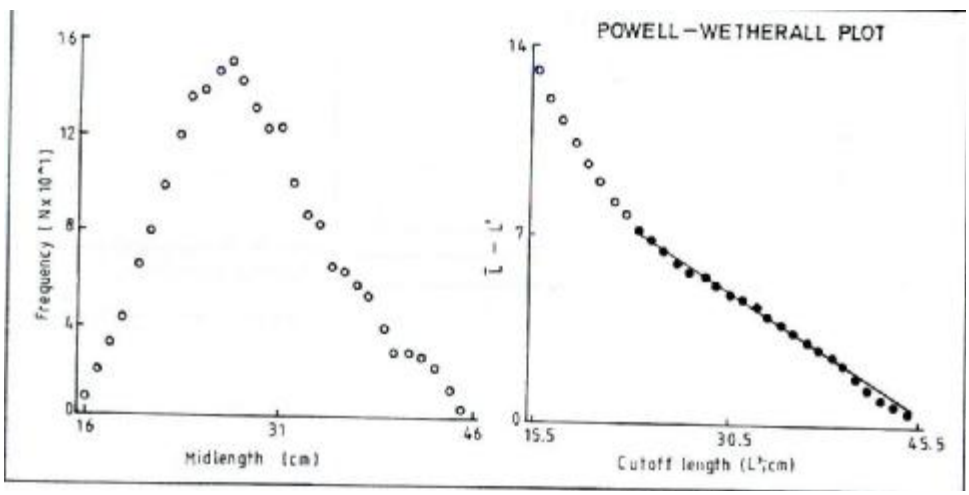

Fig. 3. Powell-Wetherall plot of *Johnius argentatus* (L_∞ = 46.69 cm and Z/K = 2.316).

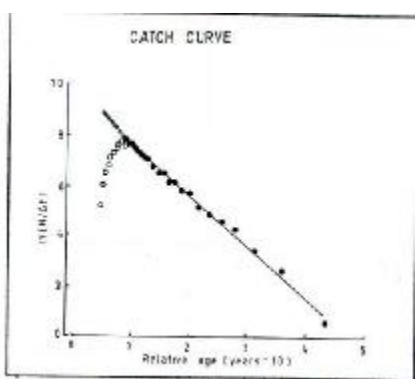

Fig. 4. Length-converted catch curve of *Johnius argentatus*.

Probabilities of capture

The probabilities of capture of *J. argentatus* are shown in figure 6. The estimated sizes of *J. argentatus* at 25%, 50% and 75% probabilities of capture were 20.13 cm, 22.13 cm and 24.13 cm respectively. The length at first capture (Lc) was 22.13 cm.

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 0.48 and 1.67 respectively. Figure 7 shows that the present exploitation rate (E= 0.29) does not exceed the optimum exploitation rate (Emax = 0.57). Emax value was found from the yield-per-recruit and biomass-per-recruit model.

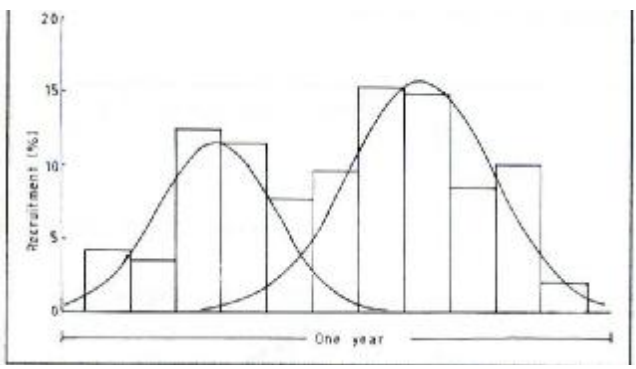

Fig. 5. Recruitment pattern of *Johnius argentatus.*

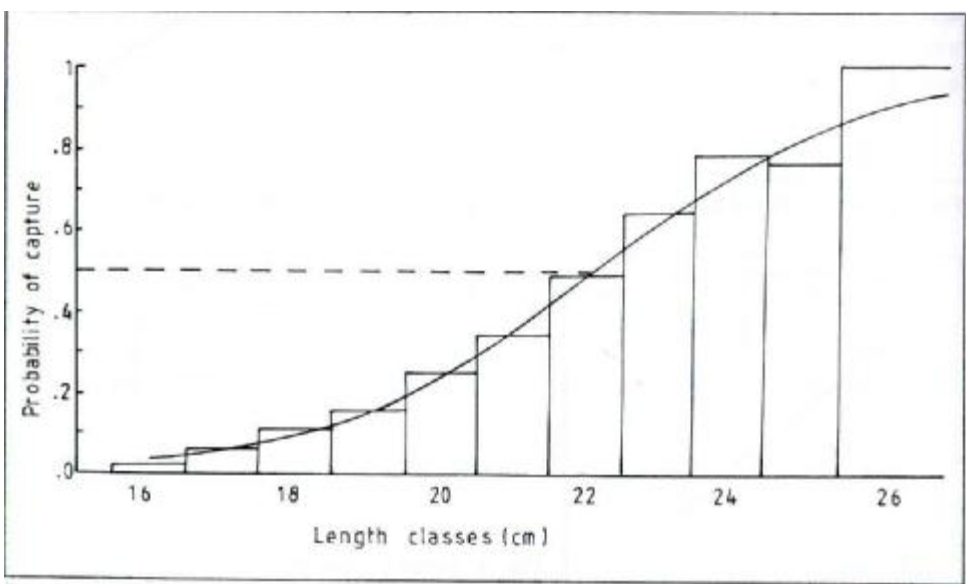

Fig. 6. Probabilities of capture pattern of *Johnius argentatus*.

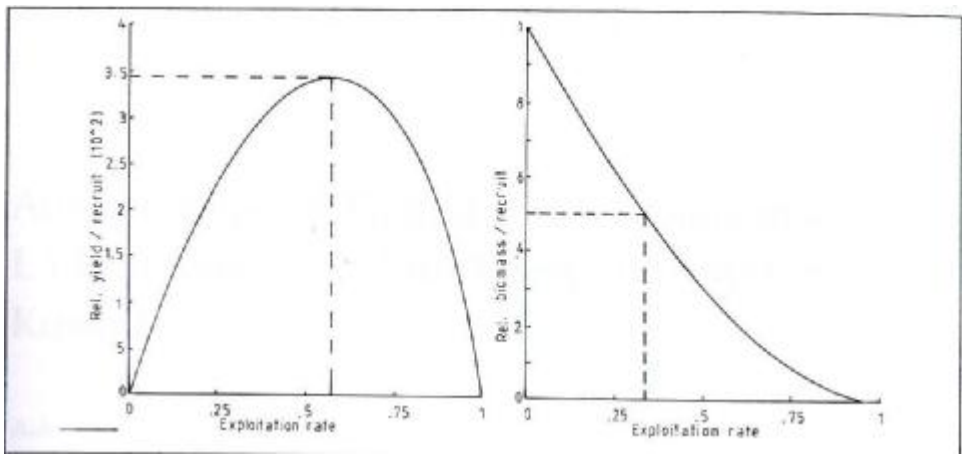

Fig. 7. Relative yield-per-recruit and biomass-per-recruit of *Johnius argentatus*.

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