Bangladesh J. Fish. Res., 6(1), 2002: 75-81

Population dynamics of two jewfishes (*Jhonius argentatus* and *Johnieops vogleri*) in the coastal waters of Bay of Bengal, Bangladesh

H. Rashid*, S. Dewan, M.G. Mustafa[1] and M.M. Haque
Department of Fisheries Management, Bangladesh Agricultural University
Mymensingh 2202, Bangladesh
[1]Marine Fisheries & Technology Station, BFRI, Cox'S Bazar
*Corresponding author

Abstract
Population parameters of *Jhonius argentatus* and *Johnieops vogleri* in coastal waters of Bay of Bengal, Bangladesh were estimated by using FiSAT programme. The von Bertalanffy growth parameters, extreme length (cm) and growth constant K (year $^{-1}$) were found to be 46.50 and 0.59 for *J. argentatus,* and 33.50 and 0.85 for *J. vogleri.* The $L\infty$ (cm) and Z/K estimates provided by Wetherall plot were 46.694 and 1.791 for *J. argentatus,* and 31.25 and 2.623 for *J. vogleri.* The annual rate of natural (M) and fishing mortality (F) were estimated as 1.12 and 0.78 for *J. argentatus,* and 1.56 and 1.28 for *J. vogleri.* Rate of exploitation (E) was estimated as 0.41 for *J. argentatus* and 0.45 for *J. vogleri.* About 80.04% of *J. argentatus* were found to be recruited during peak pulses (April-May) and 19.96% during lean pulses (October-November) and 85.75% *J. vogleri* during peak pulses (May-July) and 14.25% during lean pulses (September-October). The growth performance index (ϕ') was 3.11 for *J. argentatus* and 1.93 for *J. vogleri.* The total length and body weight relationship was found to be $W = 0.0403\ TL^{2.5723}$ for *J. argentatus* and $W = 0.0907\ TL^{2.3482}$ for *J. vogleri.*
Key words: Population dynamics, *Jhonius argentatus, Johnieops vogleri*

Introduction

Jhonius argentatus and *Johnieops vogler*, locally called 'Lal poa' and 'Keti poa', are two most commonly appearing Sciaenid in the coastal waters of Bangladesh. These species live in school, usually close to muddy of sandy-mud bottom and along with 18 other Perciforms found so far in this region they account for about 12.8% of the total demersal fish stock in the EEZ of Bangladesh and 66.5% of the demersal fishes found in the continental shelf within 20 m depth of water (Sarker and Rahman 1991). They inhabit shallow coastal waters upto 100 m depth in the Bay of Bengal. These two species pay an important role in the economy of Bangladesh. Recently salted dehydration of these fishes are being done to export to the foreign countries.

The fishing pressure is increasing day by day in the coastal waters of Bangladesh and the indiscriminate operation of Set Bag Net (SBN) and other detrimental gears in the Cox's Bazar region is hampering the pelagic and demersal fish stocks in the region.

However, 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.

Utilizing methods of analysis (FiSAT– The FAO-ICLARM Stock Assessment Tools) of length frequency data, growth parameters ($L\infty$, K) of the von Bertalanffy equation, instantaneous mortality rates (Z, M and F), selection pattern (Lc), recruitment pattern and length-weight relationship have been estimated for *Jhonius argentatus* and *Johnieops vogler*. Phi pharm (ϕ') value was calculated to compare ϕ' value of these two species in this region as well as to establish a guideline of growth performance index.

Materials and methods

The study was conducted from November'99 to October'00. Length and weight data were collected for present study from commercial catches of the fishermen operating three types of gears *viz.*, gill net, set nag net and long line at Cox's Bazar off Bay of Bengal. Samplings were done monthly and all length-frequency data for each month were pooled and pooled data were entered in computer through ELEFAN 0 program. Total length was measured in cm from the tip of the snout to the tip of the tail for a total of 1975 specimen for *J. argentatus* and 2400 specimen for *J. vogleri*.

FiSAT as explained in detail by Gayanilo *et al.* (1994) was developed mainly for the detailed analysis of length frequency data. Length-frequency based computer programs ELEFAN I and ELEFAN II were used to estimate population parameters. $L\infty$ and K values were estimated by ELEFAN I (Pauly and David 1981, Saeger and Gayanilo 1986). Additional estimate of $L\infty$ and Z/K value was obtained by plotting L - L′ on L (Wetherall 1986 as modified by Pauly 1986).

The growth performance of *J. argentatus* and *J. vogleri* population in terms of length growth was performed based on the ϕ' index of Pauly and Munro (1984).

$$\phi' = \text{Log}_{10}K + 2\text{log}_{10}L\infty \quad \text{---------- (1)}$$

The ELEFAN II estimated Z from catch curve based on equation as:

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

where L is the mean length in the sample, computed from L′ (upper) and L′ (lower) limit of the smallest length class used in the computation of L (Beverton and Holt 1956). The parameter Z of equation 2 estimated using the routine ELEFAN II (Pauly 1983, Saeger and Gayanilo 1986) which is based on the method of catch curve analysis and an extract solution found using the recursive model, i,e,;

$$\ln (Ni/(-e^{-zj\ dti})) = a - zj + 1 * ti \quad \text{---------- (3)}$$

where dti is the time needed to grow through class i, ti the relative age corresponding to the lower limit of class i, zj is an initial value of Z and Ni is the number of fishes (Pauly 1984). The parameter M was estimated using the empirical relationship derived by Pauly (1980), i.e.;

$Log10M = 0.0066-0.279Log10L\infty+0.6543Log10+0.463Log10T$ ---------- (4)

where $L\infty$ is expressed in cm, T(°C) is the mean annual environment temperature (here it was taken as 28°C). The estimate of F was taken by subtraction of M from Z. An additional estimate of Z value was obtained by ELEFAN II (Jones and van Zalinge 1981). The exploitation ratio E was then computed from expression:

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

Length-weight relationship

Total length in centimeter and total weight in gram were recorded. The relationship between length-weight was calculated by a computer program followed after Sparre (1985). The intercept (a) and slope (b) of regression line were calculated by using the following formula: $W = a . L^b$.

Results and discussion

Growth parameters

Growth parameters of von Bertalanffy growth formula were estimated as $L\infty = 46.5$ cm and $K = 0.59$ per year for *J. argentatus* and $L\infty = 33.5$ cm and $K = 0.85$ per year for *J. vogleri* (Fig. 1). For these estimates through FiSAT the response surface (ESP/ASP) were 0.151 for main line (solid line) and 0.131 for secondary line (dotted line) in case of *J. argentatus*. In case of *J. vogleri* the ESP/ASP were 0.136 for main line (solid line) and 0.114 for secondary line (dotted line). The t_0 value was taken as 0. The $L\infty$ and K values for *J. argentatus* (50.0 cm and 0.72 $year^{-1}$) reported by Shahanaz (1996) were close to the values of the present study. Whereas, $L\infty$ and K values for *J. argentatus* reported by Ashraful (1998) were 46.1 cm and 0.86 $year^{-1}$ respectively from the Bay of Bengal.

Estimation of $L\infty$ and Z/K

The modified Wetherall (1986) plot analysis incorporated in the FiSAT yielded the regression line $Y = 16.73 + (- 0.358)*X$ and $r = 0.972$ for *J. argentatus* and $Y = 8.62 + (- 0.276)*X$ and $r = 0.996$ for *J. vogleri*. Based on these points from 21.5 cm show a good linear relationship and that points of lengths below 43.5 cm smoothly approach the extended line from which $L\infty = 46.69$ cm and $Z/K = 1.791$ were obtained in case of *J. argentatus* and also from 21.5 cm show a good linear relationship and that points of lengths below 29.3 cm smoothly approach the extended line from which $L\infty = 31.25$ cm and $Z/K = 2.623$ were obtained in case of *J. vogleri* (Fig.2).

The growth performance index (ϕ') obtained were 3.11 and 1.93 for *J. argentatus* and *J. vogleri* respectively.

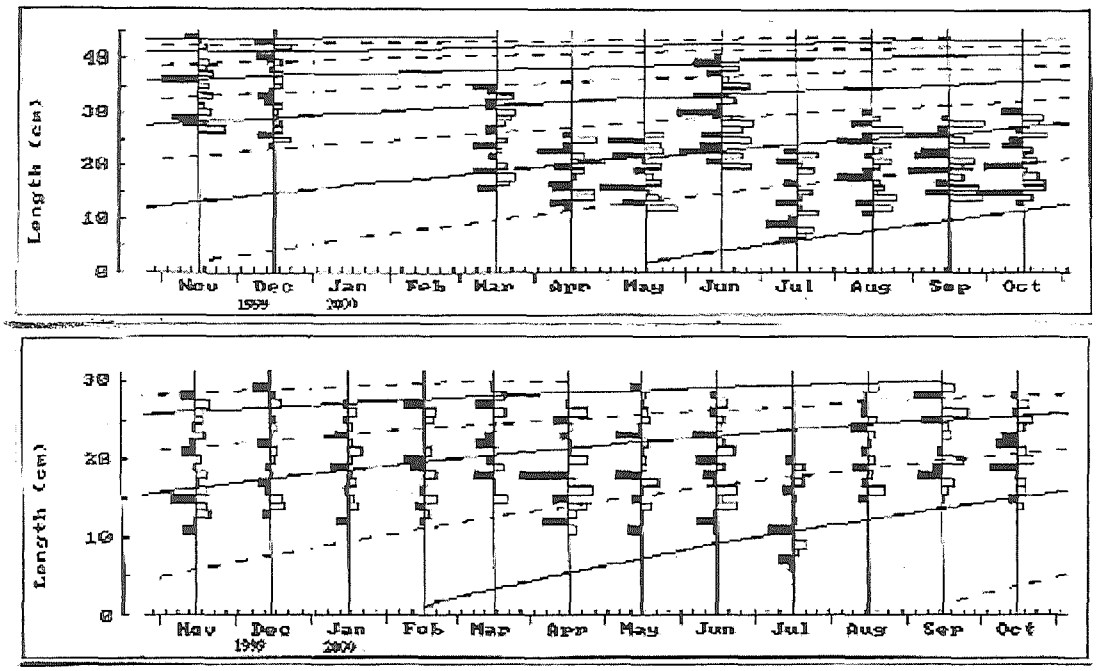

Fig. 1. Growth curve superimposed over the restructed length-frequency data of *Jhonius argentatus* (a) and *Johnieops vogleri* (b) from the Bay of Bengal.

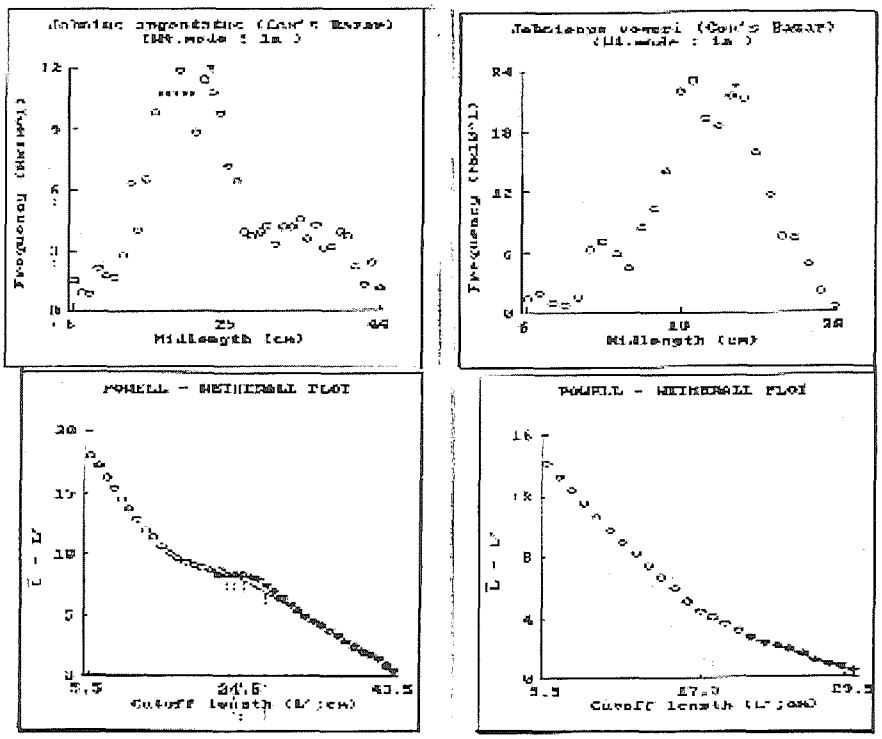

Fig. 2. Estimation of L∞ and Z/K using the methods of Wetherall for *Jhonius argentatus* (a) (L∞=46.69 cm and Z/K=1.791) *and Johnieops vogleri* (b) (L∞=31.25 cm and Z/K=2.623).

Mortality

The mortality rates M, F and Z were found to be 1.12, 0.41 and 1.90 for *J. argentatus* and 1.56, 0.45 and 2.84 for *J. vogleri* respectively. Fig. 3 presents the catch curve utilized in the estimation of Z. The darkened circles in the figure represent the points used in calculation Z via least squares linear regression. The correlation co-efficient for the regression was 0.964 for *J. argentatus* and 0.975 for *J. vogleri*.

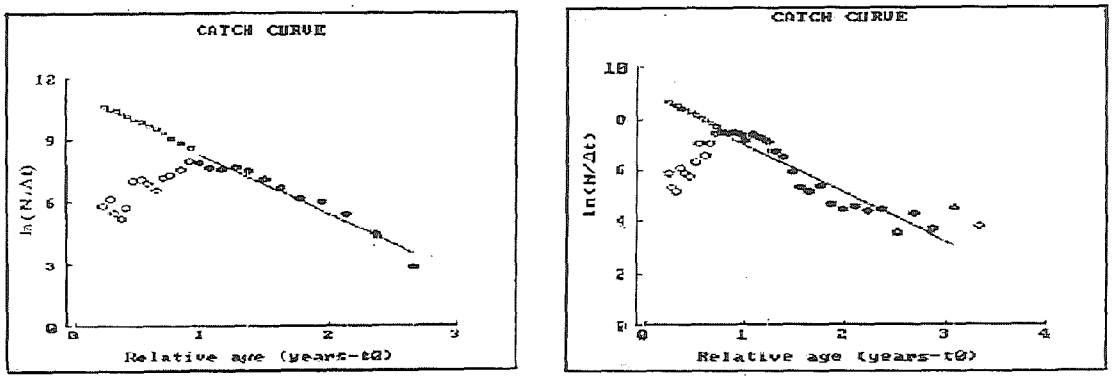

Fig. 3. Length-converted catch curve of *Jhonius argentatus* (a) and *Johnieops vogleri* (b).

Exploitation rate

The exploitation rate E was estimated from the Gulland's (1971) equation E=F/F+M. Thus from the range of values F and F+M it can be shown that the rate of exploitation, E was 0.41for *J. argentatus* and 0.45 for *J. vogleri*.

Recruitment pattern

The recruitment pattern determined through FiSAT (Fig. 4) suggested that annual recruitment consists of two uneven seasonal pulses one in April-May (peak recruit) and other in October-November (lean recruit) in *J. argentatus* and May-June (peak recruit) and September-October (lean recruit) in *J. vogleri*. It appears from original pattern of recruitment with superimposed normal distribution that *J. argentatus* is recruited 80.04% during peak pulses and 19.96% during lean pulses and *J. vogleri* is recruited 85.74% during peak pulses and 14.25% during lean pulses.

Length-weight relationship

In the present study 244 specimen of *J. argentatus* were measured where total length varied from 6.00 to 44.00 cm and the body weight varied from 7.00 to 795.00 g during one year samples. On the other hand, 218 specimen of *J. vogleri* were measured where total length was between 6.00 and 28.00 cm and the body weight was between 7.00 to

245.00 g. From the regression analysis of the length and weight the relationship was found to be $W = 0.0403\ L^{2.5723}$ in *J. argentatus* and $W = 0.0907\ L^{2.3482}$ in *J. vogleri.*

The value of 'b' in this study was lower than 3 in both the fishes. The equation shows that the fishes increased in weight a power lesser than the cube of length i.e., their growth was allometric.

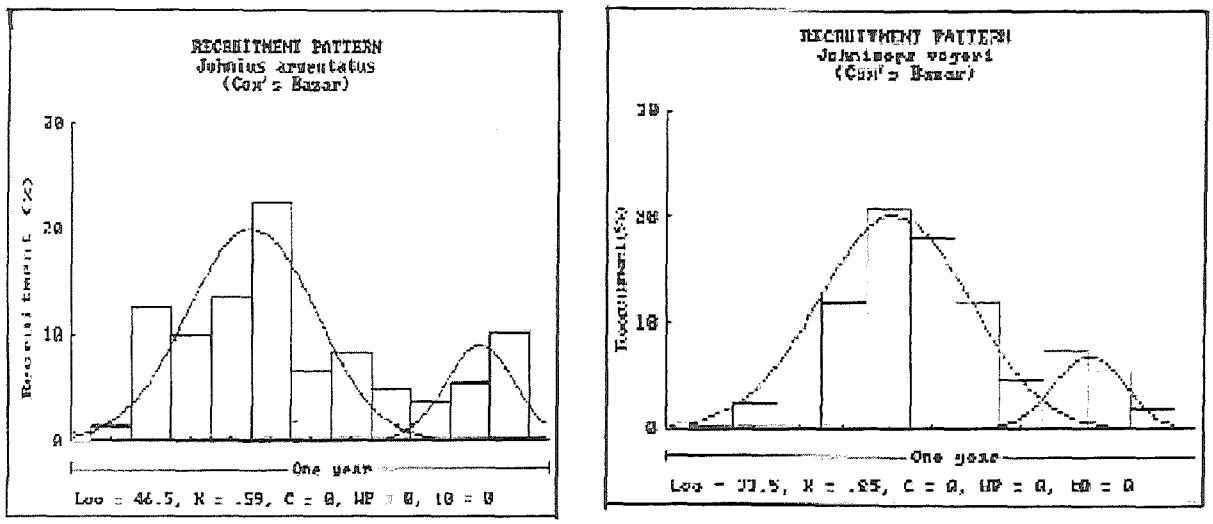

Fig. 4. Recruitment pattern showing recruitment season for Jhonius argentatus and *Johnieops vogleri .*

References

Ashraful, H.A., 1998. Population dynamics of five commercially important marine fishes in north-eastern part of the Bay of Bengal. M.Sc. Thesis, Inst. of Marine Sciences, University of Chittagong, Chittagong, Bangladesh, 131 pp.

Beverton, R.J.H. and S.J.Holt, 1956. A review of method for estimating mortality rates in fish population, with special references to sources of bias in catch sampling. Rapp. P-V. Reen. *Cons. Inst. Explor. Mer.,* 140: 67-83.

Gayanilo, F.C.Jr., P. Sparre and D.Pauly, 1994. The FAO-ICLARM Stock Assessment Tools (FiSAT) User's Guide. FAO Computerized Information Series (Fisheries) No. 6. Rome, FAO. 186pp.

Gulland, J.A., 1971. The fish resources of the Oceans, West byfleet, Survey, Fishing News Books, for FAO 255.

Jones, R. and N.P. van Zalinge, 1981. Estimation of mortality rate and population size for shrimp in Kuwait waters. *Kuwait Bull. Mar. Sci.,* 2: 273-288.

Pauly, D., 1980. On the interrelationship between natural mortality growth parameters and mean environmental temperature in 175 fish stock. *J. Cons.Int.Explor.Mer.,* 39(3): 175-192.

Pauly, D., 1983. Some simple methods for the assessment of tropical fsih stocks. *FAO. Fish. Tech. Pap.,* 235: 52.

Pauly,D.,1984. Fish population dynamics in tropical waters: a manual for use with programmable calculator. *ICLARM Stud.Rev.,* 8: 325.

Pauly, D., 1986. On improving operation and use of the ELEFAN programs. Part II. Improving the estimation of L∞. *Fishbyte,* 4(1): 18-20.

Pauly, D. and J.L.Munro, 1984. Once more on growth comparisons in fish and invertebrates. *Fishbyte,* 2(1): 21.

Pauly, D. and M.L.Soriano., 1986. Some practical extentions to Beverton and Holt's relative yield-per-recruit model, p149-495. In: First Asian Fisheries Forum (eds. J.L. Maclean, L.B. Dizon and L.V.Hosillos), Asian Fisheries Society, Manila, Philippines.

Saeger, J. and Jr.F.Gayanilo, 1986. A revised graphics orientated version of ELEFAN 0, I and II basic programs for use on HP 86/87 microcomputers. Tech. Rep. *Dept. Mar. Fish. Tech. Rep.,* 8: 1-233.

Sarker, M.N. and A.K.A. Rahman, 1991. Jew fish (Sciaenidae: Perciformes) fishery in the Bay of Bengal. *Bangladesh J. Zool.*, 19(2): 161-166.

Shahanaz, B., 1996. ELEFAN based population dynamics of silver jew, *Johnius argentatus* (Fowler 1933) from Bay of Bengal, Bangladesh. M.Sc. Project, Department of Zoology, University of Chittagong, Chittagong, Bangladesh. 33 pp.

Sparre, P., 1985. Introduction of tropical fish stock assessment. CCP/INT/392/DEN, FAO. Manual-1. 384pp.

Wetherall, J.A., 1986. A new method for estimating growth and mortality parameters from length-frequency data. *Fishbyte,* 4(1): 12-15.

(Received on 19 April 2001)