Growth Studies of Sciaenids from Mumbai Waters using the Bhattacharya Method

S.K. Chakraborty

Abstract

Length frequency data of six sciaenids (*Johnius macrorhynus, J. vogleri, Otolithes cuvieri, J. sina, Pennahia macrophthalamus, J. dussumieri*) were collected from shrimp trawlers at New Ferry Wharf and Sassoon Docks landing centers off Greater Mumbai. Growth parameters of these species were analyzed via modal progression analysis using Bhattacharya's method. Natural mortality (M) was estimated using Cushing's formula. Comparison of growth parameters was done using the ϕ' index. The growth parameters obtained were compared with the results of earlier growth studies which used other techniques. This study concludes that the growth parameters obtained are consistent with earlier estimates.

Introduction

Sciaenids are one of the chief components of demersal catches in Mumbai waters. They are landed as by-catch of shrimp trawlers and about a dozen species occur in the landings. Landings of sciaenids in India were about 106 000 t/yr for the 1985-93 period. Three of the six species studied – *J. macrorhynus, J. vogleri* and *O. cuvieri* - form nearly 75% of the sciaenid landings. Of the three other species in this study, *J. sina* forms about 5-6% of croaker landings while the other two species (*P. macrophthalamus, J. dussumieri*) are of minor importance. Among methods employed for growth studies, Bhattacharya's method is relatively less used. This study illustrates that the method can also be used with comparative ease and the results obtained agree with other standard methods available for growth studies.

Materials and Methods

Weekly observations were made at New Ferry Wharf and Sassoon Docks landing centres off Greater Mumbai. Samples were placed in 10 mm class intervals and were raised for the day and subsequently for the month, using Sekharan's (1962) method. The data used in this study are for the period 1991 - 1995. Data was pooled and growth parameters estimated using Bhattacharya (1967) and Gulland and Holt (1959) plot. This was done on a microcomputer using the "BHATTAC" and "MODALPR" routines on the LFSA program developed by Sparre (1987). Natural mortality (M) was estimated using Cushing's (1968) formula and comparison of growth parameters was done using "Munro's phi prime (ϕ') index" developed by Munro and Pauly (1983).

Results and Discussion

The growth parameters (L_∞, K), maximum length (L_{max}), natural mortality (M) and phi prime (ϕ') estimates obtained for the six species are summarized in Table 1. Of the six species studied, *O. cuvieri* was the largest with L_∞ of 407 mm and *J. sina* was the smallest with L_∞ of 240 mm. *J. macrorhynus* and *J. vogleri* grow more or less to the same size (L_∞ of 343 and 352 mm) and the same is true for *P. macrophthalamus* and *J. dussumieri* (L_∞ of 273 and 271 mm).

The growth parameters of these species were previously estimated by Appa Rao et al. (1992), Chakraborty (1997) and Chakraborty et.al (1997) using the ELEFAN I method (Gayanilo et al. 1989). These are also presented in Table 1. Cursory comparison indicates that there is not much variation in the parameters obtained using Bhattacharya's method as compared to the results obtained using ELEFAN I. This is further substantiated by the ϕ' values which are fairly close for all the species studied.

Natural mortality (M) is another parameter which is difficult to estimate. The classical method of plotting total mortality against effort time series quite often gives erroneous results as it is difficult to

apportion efforts in a multispecies system. However, indirect methods can indicate the accuracy of the parameters. One indirect method used by tropical scientists is to examine the M/K ratio, which is supposed to be constant for a group of species or closely-related families or taxa. Beverton and Holt (1959) noted that the M/K ratio commonly falls between 1.0-2.5. The M/K ratio for the six species studied here varied from 1.81 to 2.18 indicating the relative constancy of the M/K ratio.

Overall, comparison of growth data, the M/K ratio and ϕ' index indicate that the growth parameters obtained by Bhattacharya's method are comparable with growth parameters obtained using other methods for the same species.

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References

Appa Rao, T., R.S. Lal Mohan, S.K. Chakraborty, V. Sriramachandra Murty, K.V. Somashekaran Nair, E. Vivekanandan and S.G. Raje. 1992. Stock assessment of sciaenid resources of India. Indian J. Fish. 39(1 & 2): 85-103.

Beverton, R.J.H. and S.J. Holt, 1959. A review of the lifespans and mortality rates of fish in nature and their relation to growth and other physiological characteristics, p. 142-180. *In* CIBA Foundation colloquia on ageing. The life span of animals, Edited by Wolstenholme and M.O'Connor, London, Churchill, Vol 5: 142-180.

Bhattacharya, C.G. 1967. A simple method of resolution of a distribution into Gaussian components, Biometrics 23: 115-135.

Chakraborty, S.K. 1997. Growth , mortality and yield per recruit of bearded croaker, *Johnius dussumieri* (Val.) from Bombay waters. Indian J. Fish. 44 (1): 45-49.

Chakraborty, S.K. V.D.Deshmukh, M.Z. Khan, Kaber Vidyasagar and S.G.Raje. 1997. Estimate of growth, mortality, recruitment pattern and maximum sustainable yield of important fishery resources of Maharashtra coast. Indian Jour. Mar. Sci. 26: 53-56.

Cushing, D.H. 1968. Fisheries biology, a study in population dynamics. Madison, Univ. of Wisconsin Press, 200 p.

Gayanilo, F.C. Jr., M. Soriano and D. Pauly. 1989. A draft guide to the Compleat ELEFAN. ICLARM Software 2. 70 p.

Gulland, J.A. and S.J. Holt. 1959. Estimation of growth parameters for data at unequal time intervals. J.Cons. CIEM, 44: 200-209.

Munro. J.L. and D. Pauly. 1983. A simple method for comparing growth of fishes and invertebrates. ICLARM Fishbyte, 1(1) : 5-6.

Sekharan, K.V. 1962. On oil sardine fishery of Calicut during the years 1955-1956 to 1958-1959. Indian J. Fish. 9A(2): 679-700.

Sparre, P. 1987. Computer programmes for fish stock assessment. Length-based fish stock assessment for Apple II computers. FAO Fish.Tech.Pap.(101): Suppl. 2:218p.

Table 1. Growth and mortality parameters of sciaenids from Mumbai waters.

Species	L_∞ (mm)	L_{max} (mm)	K (yr^{-1})	M (yr^{-1})	ϕ'	M/K
Johnius macrorhynus	343	331	0.82	1.49	6.87	1.82
	(350) [a]	(331)	(0.75)	(1.10)	(6.82)	(1.47)
Johnius vogleri	352	336	0.80	1.60	6.89	2.00
	(345)	(326)	(0.72)	(1.20)	(6.75)	(1.67)
Otolithes cuvieri	407	386	0.59	1.07	6.88	1.81
	(398)	(359)	(0.52)	(0.86)	(6.71)	(1.65)
Johnius sina	240	235	0.93	1.96	6.28	2.11
	(240)	(210)	(0.80)		(6.13)	
Pennahia macrophthalamus (Pennahia anea)*	273 (245)	260 (229)	1.94 (0.64)	2.05	6.55 (5.95)	2.18
Johnius dussumieri [b]	271	260	0.92	1.85	6.51	2.01
	(269)	(257)	(0.96)		(6.54)	

a Data in parentheses indicate growth parameters estimated using ELEFAN I (Chakraborty et.al 1997).

b Estimates derived by scattergram technique.

* Valid name in FishBase.

S.K. Chakraborty *is from the Central Institute of Fisheries Education,(Deemed University) Seven Bungalows, Versova, Mumbai-400 061, India.*