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Note

Stock assessment of *Otolithes cuvieri* (Trewavas) off Mumbai

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Abstract

The lesser tigertooth croaker, *Otolithes cuvieri,* contributes nearly 22% to the total sciaenid landings at Mumbai. The asymptotic length (L_∞) and growth coefficient (K) for the species were found to be 403mm and 0.61/year respectively. The total, natural and fishing mortalities were estimated as 2.42, 1.19 and 1.23 respectively. The exploitation ratio and rate were found to be 0.45 and 0.46 respectively. The length at first capture was 22.6cm. Relative yield–per-recruit study shows that the E_{max} 0.52 is very close to the present exploitation rate (E) of 0.51. However, the optimum biomass per recruit can be obtained at E of 0.32. The results indicate that the exploitation of this resource is around the MSY level and no further increase in effort is desirable as it may result in decline of catches.

Sciaenids are one of the important demersal fishery resources of India. The All India landings of this resource during 2004 was 1.22 lakh t contributing 4.7% to the total marine landings and 18% to the exploited demersal fishery resources. Gujarat (40,090t) followed by Maharashtra (29,660t) were the major contributors to all India sciaenid landings (Anon, 2005). The catch at Greater Mumbai was 11,120t which formed 38% of this resource landed in Maharashtra. Both large growing and smaller varieties are exploited off Bombay which contributed to 21% and 79% respectively to the total sciaenid landings in the state. *Otolithes cuvieri* is one of the important species contributing to the lesser sciaenid fishery off Mumbai.

Information on growth, fish population dynamics and stock assessment of sciaenids off west coast of India are available from the work of Rao (1971), Jayaprakash (1976), Muthiah (1982), Chakraborty (1989), Rao *et al.* (1992), Chakraborty *et al.* (1994), Chakraborty *et al.* (1997) and Chakraborty *et al.* (2000). Sustainable management of fishery resources requires continuous assessment and monitoring. It is in this context that a study on stock assessment of *O. cuvieri* off Mumbai was carried out.

Materials and methods

Length frequency data of 9818 specimens of *O. cuvieri* in the length range of 40 - 379 mm were collected for three years from April, 2000 to March, 2003 by weekly sampling at New Ferry Wharf and Sassoon Docks in Mumbai. The length measurements were grouped into various size groups and the frequencies were raised to the days catch and subsequently to the monthly estimated catch following Sekharan (1962). The length frequency data for the period 2000-2003 were pooled for further analysis. Growth parameters were estimated using von Bertalanffy's (1938) growth equation:

$$L_t = L_\infty (1-e^{-K(t-to)}) \quad ;$$

Where, L_∞ is the asymptotic length,

K is the curvature parameter or growth coefficient and t_o is the hypothetical age at which the fish would have been zero in length provided it would have grown according to von Bertalanffy's equation. The growth parameters were estimated by ELEFAN employing FiSAT programme (Gayanilo *et al.*, 1996). This programme does not give an estimate of t_o and in this study it was taken as '0' (Sparre *et al.*, 1989).

The total mortality (Z) was calculated by Pauly's (1984) length converted catch curve method. The natural mortality (M) was estimated by following the empirical formula suggested by Pauly (1980). The mean annual surface sea temperature was taken as 28.2°C. The fishing mortality coefficient was computed by subtracting M from Z. The method of Pauly (1987) was used to analyse the probability of capture using the ascending left arm of the length converted catch curve. Plotting of cumulative probability of capture against mid length gives the resultant curve from which the length at first capture was taken corresponding to cumulative probability at 50%.

The model of Beverton and Holt (1966) as modified

by Pauly and Soriano (1986) was used to compute the relative yield-per-recruit.

The relative biomass per recruit was estimated by the formula

$$B'/R = \frac{(Y/R)'}{F}$$

The exploitation rate (E_{max}) which produced the maximum yield was also calculated by relative yield per recruit model of Beverton and Holt (1966).

Results and discussion

Length of *O. cuvieri* in the landings varied from 4.5 to 39 cm. Juveniles with length range of 4.5 to 8.5 cm were landed during August – September and December. It supports observations of Chakraborty *et al.* (2000) who reported that this species spawns during July and December off Mumbai. The growth parameters L_∞ and K in the present study were estimated to be 40.3 cm and 0.61 per annum respectively. The computed growth curve produced with these parameters is depicted over restructured length distribution. Rao *et al.* (1992) estimated growth parameters of *O. cuvieri* based on the data collected during 1979-1988. Chakraborty (1989) estimated L_∞ and K of *O. cuvieri* off Bombay waters as 39.5 cm and 0.53 per annum respectively based on the data collected from 1979-80 to 1984-85. Chakraborty *et al.* (1997) and Chakraborty *et al.* (2000), based on the data collected during 1987-90 and 1980-94 respectively from New Ferry Wharf in Mumbai estimated L_∞ = 39.8cm and K = 0.52 per annum. It is clear that the results of the present study are in close agreement with the earlier studies, though K estimated in the present case is slightly higher (Table 1).

The total mortality estimated based on length converted catch curve analysis was 2.42 (Fig.1). The coefficient of natural mortality estimated from Pauly's (1980) empirical equation was found to be 1.19. The fishing mortality coefficient F obtained by subtracting M from Z was 1.23.

The total mortality estimated by different authors for this species exploited off Mumbai varied from 1.2 to 2.64, while natural mortality varied from 0.86 to 1.30 per annum. The exploitation ratio (E) was found to be around 0.5 except by Chakraborty *et al.* (1997) who reported the value to be 0.28. The value estimated in the present study is around 0.50, indicating that the stock is presently optimally exploited.

The length at first capture LC_{50} was estimated as 22.6 cm based on trawl selection analysis (Fig.2). Chakraborty *et al.* (1997) and Chakraborty *et al.* (2000) estimated L_c/L_∞ as 0.4, while in the present study it was found to be

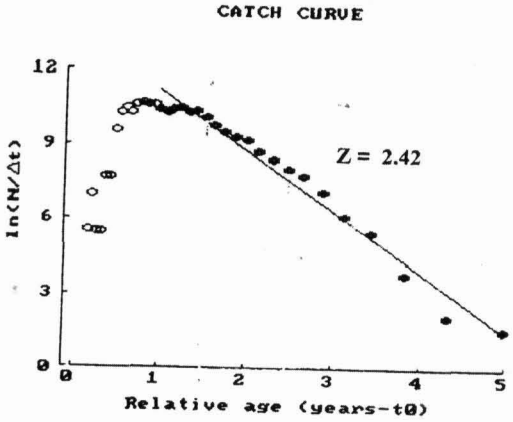

Fig. 1. Length converted catch curve of *O. cuvieri*

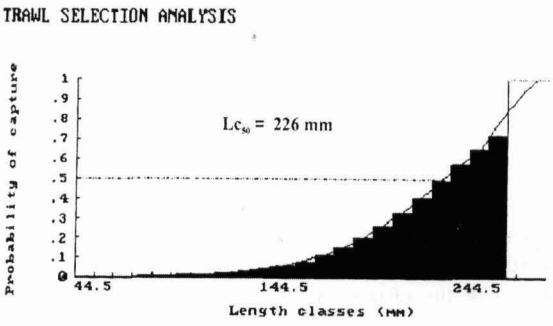

Fig. 2. Selection pattern of *O. cuvieri*

Table 1. *Population parameters of* Otolithes cuvieri *off Mumbai estimated by different authors*

Author(s)	L_∞	K	Z	M	F	E
Chakraborty (1989)	39.5	0.53	2.64	1.30	1.34	0.51
Rao *et al.* (1992)	39.8	0.52	3.12	1.82	1.30	0.41
Chakraborty *et al.* (1997)	39.8	0.52	1.20	0.86	0.34	0.28
Chakraborty *et al.* (2000)	39.8	0.52	1.83	1.00	0.83	0.45
Present study	40.3	0.61	2.42	1.19	1.23	0.51

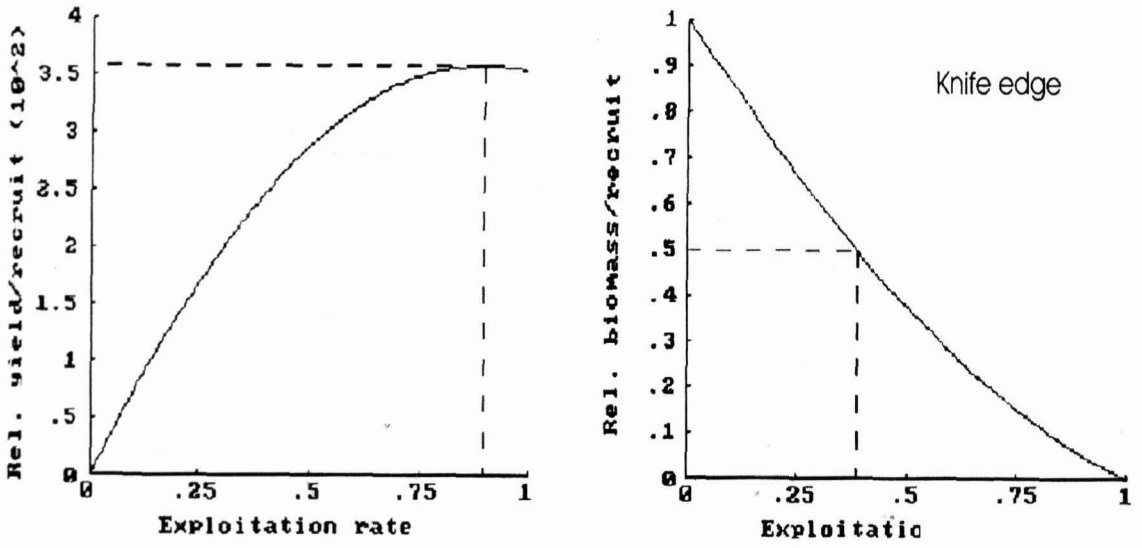

Fig. 3. Relative yield per recruit and biomass per recruit

0.56, indicating that the length at first capture has increased in recent years. The length at first maturity of the species is 17 cm at Mumbai (Rao *et al.*,1992) and hence the present mesh size appears optimal as it gives an opportunity for fish to spawn at least once. E_{max} in the present study determined from the relative yield per recruit was found to be 0.52, which is very close to the present exploitation rate (E=0.51). The optimum biomass per recruit can be obtained at an exploitation rate of 0.32 (Fig.3). But with the present exploitation rate, the biomass per recruit is around 0.34 as against preferable level of around 0.5. As the present exploitation rate is very close to E_{max} the yield per recruit is not affected though the relative biomass per recruit is slightly lower. The results of the present study therefore indicate that the resource is being exploited at around MSY level and no further increase in effort level should be allowed, to avoid further decline in biomass per recruit and ensure sustainability of the fishery.

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