Fishery of lizardfishes off Veraval with stock assessment of *Saurida tumbil* (Bloch)

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ABSTRACT

The lizardfishes form an important demersal fishery resource off Veraval with average annual estimated landings of 455 t, forming 0.74% of the total trawl production. Two species viz. *Saurida tumbil* and *S. undosquamis* contributed to the fishery of which, *S. tumbil* formed 85% of the lizardfish landings. Asymptotic length (L_∞) and growth coefficient (K) estimated for *S. tumbil* are 577 mm and 0.70 y^{-1} respectively and the size at first capture (t_c) is 202 mm. The estimated mortality rates Z, F and M are 3.46 y^{-1}, 2.30 y^{-1} and 1.16 y^{-1} respectively. The exploitation ratio (E) and Exploitation rate (U) were estimated separately as 0.66 and 0.64 respectively. The yield per recruit study shows that the species has reached close to the optimum level of exploitation in the present fishing ground. The annual estimated stock is 587 t.

Introduction

Lizardfishes of the family Synodontidae form an important demersal fishery resource along the northwest coast of India. In Gujarat coast, the lizardfishes constituted mainly by *Saurida tumbil* and *S. undosquamis,* form an important constituent in the landings of multi-day trawlers operating from Veraval. These trawlers fish up to a depth of 80 m in the vast continental shelf area of Gujarat. Lizardfishes constitute about 1 % of the total trawl landings at Veraval from the present depth of operation. Only very little information is available on this fishery from this area. The earlier reported works on the lizardfishes in Indian waters included the studies by Kuthalingam (1959), Rao (1983 and 1984), Nair and Raghu (1990), Nair *et al.* (1992), Gulati *et al.* (1994), Muthaih (1996) and Sivakami *et al.* (2003). The trend of the fishery based on 11 years data along with population characters and stock assessment of *S. tumbil* is presented in this account.

Materials and methods

The data collected on catch and effort of lizardfishes by Central Marine Fisheries Research Institute from Bhidia and Old light House landing centres at Veraval during 1985-1996 were utilized in this study. The length frequency data collected from the landing centers at weekly intervals from September 1993 to November 1996 were used for estimation of population parameters. The length weight relationship was studied following Le Cren (1951). A total of 2868 specimens of *S. tumbil* in the

length range of 72-548 mm were measured. The data on length was grouped into 10 mm class intervals and the raised monthly frequency distribution was used for the growth studies (Sekharan, 1962). The growth and mortality parameters were estimated using FiSAT programme (Gayanilo Jr. *et al.*, 1996) after pooling the annual data for the period 1993-1996. For estimating natural mortality rate (M), the t_0 was considered as 0 (Sparre *et al.*, 1989) and the surface seawater temperature was taken as 27 ^{0}C. The fishing mortality rate F was arrived at by Z-M. The exploitation ratio (E) was estimated by the ratio of fishing mortality to total mortality. The exploitation rate 'U' was calculated by the formula $U = F (1-e^{-Z})/Z$. The average annual total stock was estimated by Y/U and the annual standing stock was estimated by Y/F, where 'Y' is the average catch of the species and 'F" is the fishing mortality.

Results

Fishery

Fishing is carried out by shrimp trawls with the cod end mesh size ranging from 8-15 mm in the depth range of 20-80 m during most of the months. Trawling commences by September every year, after a prolonged monsoon break of about four months and continues up to the end of May.

During the period 1985-96 the effort expended by trawlers has shown an increasing trend up to 1994 thereafter wide fluctuation in the effort was noticed and the average annual effort for this period was 60648 units. The annual fishing hours also followed almost the same trend of fishing units. This indicates that the fluctuation in the number of units and fishing hours have direct relationship. The fluctuation in the effort indicates that the number of hours of fishing by trawlers has not changed much (Table 1). Month wise

TABLE 1: *Yearwise catch and effort of lizardfishes landed by trawlers at Veraval during 1985-1996*

Year	Effort (Units)	Fishing hours	Catch (t)	CPUE (kg)	C/h (kg)	Total fish landing (t)	Percentage to total catch
1985	40254	463832	482	11.97	1.04	37879	1.27
1986	51089	567449	179	3.49	0.31	44606	0.40
1987	54884	575414	85	1.55	0.15	36356	0.23
1988	44374	614793	512	11.55	0.83	44465	1.15
1989	53639	733961	579	10.80	0.79	67049	0.86
1990	63398	712787	887	13.99	1.24	78081	1.14
1991	66463	760646	928	13.96	1.22	102900	0.90
1992	75125	783655	327	4.35	0.42	96484	0.34
1993	64483	633563	405	6.29	0.64	59859	0.68
1994	76718	773458	411	5.36	0.53	63855	0.64
1995	66611	612865	315	4.73	0.51	51373	0.61
1996	70733	675523	348	4.92	0.52	54137	0.64
Average	60648	658996	455	7.75	0.68	61420	0.74

fluctuation in the effort shows that it was highest during October-April.

The landing of lizardfishes showed a steady increase until the beginning of early nineties, there after drastic decline in the catch was observed. The average annual landing of lizardfishes was 455 t forming 0.74 % of the trawl landing. The catch rate was highest during 1988-91 period with peak in 1990 and the lowest was in 1987. The average CPUE was 7.75 kg. The catch per hour ranged from 0.31 kg (1987) to 1.24 kg (1990). Highest catch per hour was recorded in 1990 and the average catch per hour for the period 1985-1996 was 0.68 kg.

Seasonal abundance

Abundance of lizardfishes was more during the first and last quarters of the year. The fishing season for lizardfishes is for a period of 7 months starting from October and declining in April. The peak production was in October and minimum in September. The catch and catch rate were also highest during this period. The catch rate was high in October, which gradually declined in November and reached lowest in May.

Species composition

Two species of lizardfishes viz., *S. tumbil* (85.4 %) and by *S. undosquamis* (14.6 %) constituted the fishery.

Length-weight relationship

A total of 373 specimens in the range 85-520 mm of total length and 32-1260 g weight were used for determining the length weight relationship of *S. tumbil*. The length-weight relationship was estimated by the least square method and the regression equation for both the sexes were:

Male: Log W= -5.1612 + 3.1381 Log L (r= 0.9994)

Female: Log W = -5.4380 + 3.1910 + Log L (r = 0.9998)

The analysis of covariance showed that there was no significant difference at 5% level between sexes and the common equation was
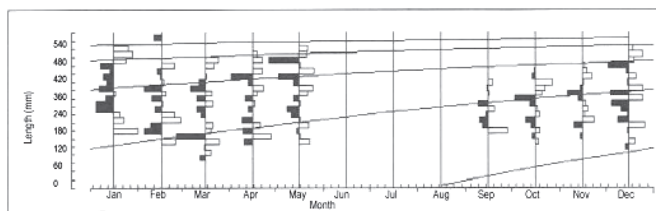
Log W = -5.2620 +3.1522 Log L (r=0.9995)

Fig 1. Restructured growth curve of *S. tumbil* off Veraval
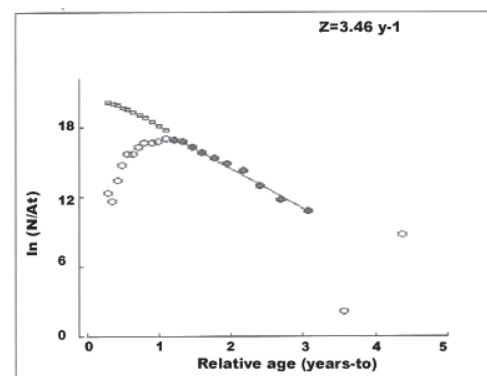L_{00} = 577 mm, K= 0.70 y^{-1}, C=0, WP= 0, Rn =183

Fig 2. Length converted catch curve of *S. tumbil* off Veraval

Growth and mortality parameters

The asymptotic length (L_∞) and growth coefficient (K) estimated for *S. tumbil* were 577 mm and 0.70 respectively (Fig. 1). The estimated total mortality (Z) for *S. tumbil* was 3.46 y^{-1} and 'r' value of Z estimates (Fig. 2) was 0.995. The natural mortality coefficient
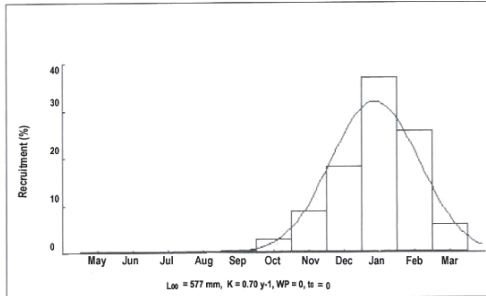
Fig 3. Recruitment pattern of *S. tumbil* off Veraval

(M) was estimated as 1.16y^{-1} and the fishing mortality (F) calculated was 2.30 y^{-1}.

Recruitment pattern

The recruitment pattern (Fig. 3) of *S. tumbil* indicates unimodal pattern during October-March. Peak recruitment was observed in January when 37.03 % was recruited. During this period trawl net fishery is very active and the availability of *S. tumbil* in the trawl catches was the highest indicating that juveniles formed a major share of the trawl catches.

Length at first capture

Length at first capture of *S. tumbil* was taken as the 50 % value of length in the probability of capture curve, which is 202 mm. The length at first recruitment is taken as the smallest mid length in the length frequency distribution and in the case of *S. tumbil* it is 75 mm.

Yield per recruit

Beverton and Holt's yield per recruitment model is diagrammatically represented in Fig. 4. The relative yield per recruit (Y/R) is maximum for an exploitation ratio (E) of 0.76. The optimum yield per recruit is 4.5 g and the corresponding relative biomass per recruit is 0.375 g, which seems to be reasonable since increasing E to MSY level reduces biomass per recruit (B/R) from the present level. The present exploitation ratio (E=0.66) is below the maximum allowable limits of the yield.

Stock estimates

The average annual yield of *S. tumbil* off Veraval is 455 t at an exploitation ratio (E) of 0.66 and exploitation rate (U) of 0.64. The annual total stock and standing stocks were estimated as 587 t and 168 t respectively.
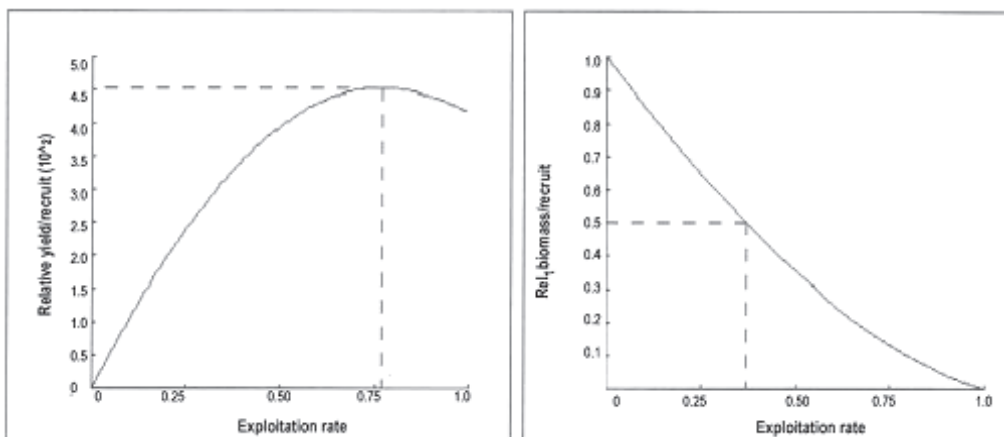

Fig 4. Yield/recruit and biomass/recruit of *S. tumbil* off Veraval

Lc/L$_{oo}$ = 0.35, M/K = 1.66, Emax = 0.76

Discussion

The environmental parameters are known to influence the yield, recruitment and spawning of any marine fish resource (Banse, 1959; Ramamirtham and Rao, 1974 and Jayaprakash, 2002). Fluctuations are further affected by fishery related factors like fishing intensity, fishing techniques, changes in the fishing pattern, fishing ground, food availability etc. Though the lizardfish landing registered a general increasing trend along the Veraval region until early nineties, a drastic reduction was observed during the subsequent years. The effort expended also showed a declining trend. Such fluctuations in the fishery are common due to several biotic and abiotic factors. The all India lizardfish landings also showed a declining trend during the second half of last decade (Sivakami *et al.,* 2003).

Nair *et al.* (1992) reported equal catch rates during pre-monsoon and post-monsoon months, there being no landings during monsoon season. The lizardfish fishery in the Veraval coast is a post monsoon fishery with maximum landings in the last quarter of the year with a peak in October. Though the landings gradually declined, thereafter high catches of lizardfishes were also recorded in first quarter of the year.

The dominance of *S. tumbil* and *S. undosquamis* in the trawl landings along the Indian coast was reported by Rao (1983 and 1984) and Nair *et al.* (1992). In the present observation among these two species of lizardfishes *S. tumbil* was found to be the dominant species in the trawl landings.

The value of growth parameters K and L_∞ estimated for *S. tumbil* by Rao (1984) were 0.249 and 637 mm respectively. Gulati *et al.* (1984) estimated the values of L_∞ as 498 mm and K as 0.96 y^{-1} for the species. Yeh *et al.* (1977) reported varying growth parameters in the southern part of East China Sea and Gulf of Tokin, the maximum size recorded in his study being 636 mm (fork length) along the China Sea where it attained 560 mm in 6 years. The specimens above 562mm were, however, not observed from the trawl catches. The growth parameters L_∞ and K estimated in the present study are 577 mm and 0.70 y^{-1} respectively. The annual K of this species is within the range of K values estimated by various species of lizardfishes (Ingles and Pauly, 1984). The rate of growth of this species appears to be faster as compared to the other species studied by Chakraborty *et al.* (1994) and Muthaih (1996).

Recruitment to the fishable stock of *S. tumbil* is more or less a continuous process and 55 % catch is composed of specimens above 201 mm (Dighe, 1977). According to him the spawning period is prolonged and the individual breeds only once a year and the juveniles appear during January-February. Ingles and Pauly (1984) in their study made in Philippines observed a single recruitment pulse in *S. tumbil* as has been made in this investigation.

According to Pauly (1984), type of catch curves obtained is typical of such species where there is a marked post spawning mortality, superimposed on the mortality characteristics of juveniles stage. The value of 'M' to the extent of 1.16 y^{-1} gives an indication of intensive natural mortality and is moderately higher for *S. tumbil*. The fishing mortality F=2.30 is also an indication of intensive fishing in the present depth of fishing of this species as also revealed by exploitation rate 0.66. The current

exploitation rate from the present area of fishing is close to the optimum rate estimated. Thus for the benefit of the stock it is better if the efforts are confined at the present level only.

The exploratory trawling operations of Fishery Survey of India vessels indicated the availability of lizard fishes in the entire shelf area of the west coast with highest average catch of 3 kg /hr from the northwest coast with highest concentration in 100-200 m depth zone (Joseph and John, 1986). Nair and Reghu (1990) based on the demersal trawling operations of FORV *Sagar Sampada* observed that lizardfishes composed mainly of *Saurida tumbil* and *S. undosquamis*, were abundant along northwest coast. However, in the bottom trawl catches of M.T. Muraena along the northwest coast of India, nearly 80% of the lizardfish catch was recorded from 91-125 and 126-360 m depth range with catch rates at 5.91 and 5.69 kg/hr respectively (Bapat *et al.*, 1982). This shows that if fishing operations are carried out in deeper water it may result in higher yield of lizardfishes.

Acknowledgement

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