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Fishery of sciaenids off Veraval with special reference to growth, mortality and stock assessment of *Otolithes cuvieri* (Trewavas, 1974)

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ABSTRACT

Sciaenids form an important demersal finfish resource off Veraval and contribute about 12 % to the total marine landings. They are exploited mainly by trawls and gillnets with an annual average landing of 9086 t and 323 t respectively during 1986-95. Nearly 16 species contribute to the sciaenid fishery of which, *Otolithes cuvieri* and *Johnius glaucus* contributed 52.6% and 13.8 % respectively. In gill net seven species contribute to the landings, dominated by *Otolithes cuvieri* and *Protonibea diacanthus*. The peak landing of sciaenids was noticed in September and January. Studies on *O. cuvieri* revealed that there was no significant difference in the length weight relationship between the sexes, and hence a common regression was fitted as Log W = -4.4632 + 2.9701 Log L (r=0.9036). The asymptotic length (Lα) and growth coefficient (K) were estimated as 382 mm and 0.89 y-1 respectively. *O. cuvieri* grows to 225, 317, 354, 371 and 382 mm at the end of 1st, 2nd, 3 rd, 4th and 5th years. The fishery mainly consisted of 0 and 1 year classes. The average instantaneous rates of total, natural and fishing mortalities were 2.86 y-1, 0.81 y-1 and 2.05 y-1 respectively. The length at first capture was 148 mm at which the age works out to be 0.5 year. The exploitation ratio is higher than the Emax estimated indicating that the resource is overexploited. In view of the heavy fishing pressure, there is a need for reducing the fishing effort to sustain the fishery.

Introduction

The fishes of the family Sciaenidae occupy an important position among the demersal fishery resources of India. There are 32 species belonging to 12 genera available in Indian waters (Mohan, 1969). They are the chief constituents of the trawl catch at Veraval contributing about 12 % of the total catch. Though it is a multi species fishery, *Otolithes cuvieri* contributes about 53 percent of the total sciaenids. The information on the sciaenids exploited along the North West coast of India is limited to the works of Rao (1985), Gulati (1987), Chakraborty (1989), Rao *et al.*, (1992), Chakraborty *et al.*, (2000), Mohanraj *et al.*, (2003) and Manojkumar (2003). A detailed study on the fishery of sciaenids with information on the growth, mortality, length at first capture, yield per recruitment and stock assessment of O. cuvieri is not available

from Veraval, hence an attempt is made to study these aspects in this account.

Materials and methods

The data on the landing of sciaenids at Veraval by trawlers and gill netters for the period 1986-95 was collected following the Stratified Random Sampling Design adopted by CMFRI. The length frequency data of *O. cuvieri* collected from the landing centers at weekly intervals from 1993 to 1995 were used for estimation of growth and population parameters. A total of 2096 specimens in the length range of 52-368 mm formed the base data for the study. The data on length was grouped into 10 mm class intervals and the raised monthly frequency distribution was used for the growth studies following Sekharan, (1962). The length-weight relationship was studied following Le Cren (1951). The growth and mortality parameters were estimated using FiSAT programme (Gayanilo Jr. *et al*., 1996) after pooling the annual data for the period 1993-1995. Natural mortality (M) was estimated from the empirical formula as in Pauly (1980), by taking the mean seawater temperature as 28^0C and the total mortality (Z) from the catch curve as in Pauly (1983). The exploitation ratio (E) was estimated by the ratio of fishing mortality to total mortality. The exploitation rate 'U' was estimated by the formula U = F/Z* (1-e-Z). The annual total stock and standing stock were estimated by Y/U and Y/F respectively, where 'Y' is the annual average catch of this species.

Results

Fishery : Sciaenids are mainly caught at Veraval by wooden trawlers of 12-16 m OAL, fitted with diesel engines of 87-105 HP. The gear used have head rope length of 22-28 m and otter boards of 2.5' x 5' to 3' x 6' and trawl at a speed of 2-4 knots up to a depth of 120m at a distance of 5-90 km from the shore depending upon the season and availability of the fish. Sciaenids are also caught by gill net units. Two types of crafts are used, wooden and dug out canoes fitted with out board engines and plank built boats without engines. Three types of gear viz. surface drift net (65-85 mm), surface or bottom gill net (140-160mm), and Jada Jal (160-240 mm), are used by the gill net units.

The annual catch by trawlers ranged from 6273 t (1987) to 12953 t (1994), and on an average it formed 9086 t forming 14.79 % of the total trawl landing and 95 % of sciaenid landing. The annual fishing effort by trawlers ranged from 38374 units (1988) to 76718 units (1994) with an average of 61891 units. After the introduction of large scale trawling by multi-day trawlers, the fish production showed a gradual increase in the beginning and touched a peak in 1992 and 1994 due to very high effort input (Fig. 1). The catch rate showed a similar pattern of the catch and the annual average catch rate of sciaenids for this period was 147.6 kg/boat.Monthly average landings

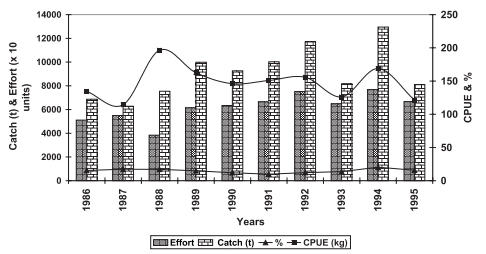

Fig. 1. Estimated annual catch of sciaenids in trawl

of sciaenids showed that peak landings were observed in January and September (Fig. 2).

In gill net, the effort has shown a declining trend in the second half of this period. This was due to some operational

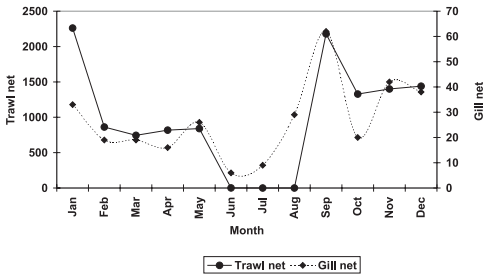

Fig. 2. Average monthly landing (t) of sciaenids at Veraval

changes in the number of fishing days from daily trip to 2-3 days fishing. Sciaenid landing showed a declining trend during the second half of this period, but showed an improvement towards the end of the study period. The annual average catch of sciaenids was 323 t with a catch rate of 9.4 kg. Month wise fluctuations in the catch showed that peak landings were recorded in September and January.

Species composition: Sixteen species of sciaenids belonging to 7 genera were observed in the trawl catch. The species composition appears to change depending upon the season and area of fishing. *Otolithes cuvieri* (52.6%), *Johnius glaucus* (13.8%), *Otolithoides biauritus* (3 .0%) and *Protonibea diacanthus* (4.4%) were the dominant species found in the landing by trawlers and these four species occurred in the fishery regularly. The catch of *O. cuvieri* and *J. glaucus* is found to have significant influence on the landings of sciaenids.

In gill net, *O. cuvieri* and *P. diacanthus* together contributed 70.3 % of the catch followed by *O. biauritus* (10.2 %), *J. glaucus* (7.1 %), *O. ruber* (6.8 %), *Johnieops macrorhynus* (4.2 %) and *J. vogleri* (3.8%). Since *O. cuvieri* was the most dominant species, further studies on growth and stock assessment were carried out on this species.

Length weight relationship : A total of 382 males in the range of 122-342 mm TL (20-385 g weight) and 522 females in the range of 131-358 mm TL (25-410 g weight) were used for determining the length weight relationship of *O. cuvieri*. The length weight relationship of both male and female *O. cuvieri* is described by the following regression equation:

Male : Log W = -4.3962 + 2.9509 Log L (r = 0.9396)

Female : Log W=-4.4541 + 2.9935 Log L (r = 0.8795)

The regression coefficients of the sexes have been tested by analysis of covariance and found that the differences are not significant at 5 % level. Therefore a pooled fit was derived as:

Log W=-4.4632 + 2.9701 Log L (r= 0.9036)

Age and growth : The growth parameters Lα and K were estimated as 382 mm and 0.89 y^{-1} respectively for *O. cuvieri* (Fig. 3). The growth of this species is thus described by the von Bertlanffy equation

Lt = 382 (1-e-0.89 (t-t0))

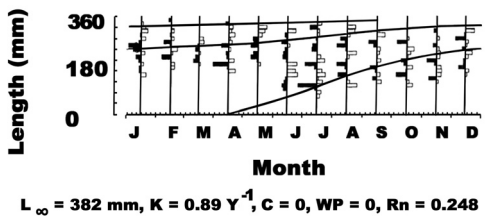

Fig. 3. Plot of Fisat analysis of *O. cuvieri* exploited off Veraval

According to the above equation, it is estimated that *O. cuvieri* attains a length of 225, 317, 354, 371 and 382 mm in the first second, third, fourth and fifth year respectively. The main stay of *O. cuvieri* fishery mostly composed of 0 and 1 year classes.

TABLE 1. *Estimates of mortality (Z), Fishing mortality (F), Natural mortality (M), Exploitation rate (U) and Exploitation ratio (E) of* O.cuvieri

Year	Z	F	M	U	E
1993	2.74	1.93	0.81	0.62	0.70
1994	2.89	2.08	0.81	0.67	0.72
1995	2.95	2.14	0.81	0.74	0.73
Pooled	2.86	2.05	0.81	0.68	0.71

Mortality parameters : The estimated natural, fishing and total mortality rates and exploitation rates obtained for *O. cuvieri* for different years are given in Table 1. The average M estimated to be 0.81 y^{-1}. The total mortality rates varied from 2.74 in 1993 to 2.95 in 1995 with an average of 2.86 y-1. Similarly the fishing mortality varied 1.93 y^{-1} in 1993 and 2.14 y^{-1} in 1995 and the average F for this period was 2.05 y^{-1}. The exploitation ratio (E) ranged from 0.70 in 1993 to 0.73 in 1995 with an average of 0.71, while the exploitation rate (U) ranged from 0.66 in 1993 to 0.69 in 1995 and the average exploitation rate for this period was 0.68.

Length at first capture : The length at first capture is estimated to be 148 mm and the corresponding age at first capture is to '0' years. The length at recruitment (Lr) of *O. cuvieri* was taken as smallest length (52 mm) in the distribution.

Recruitment pattern : The recruitment of *O. cuvieri* indicates an unimodal pattern during July-September. Peak recruitment was observed in August when 37.03 % was recruited. During September-October trawl net fishery is very active and the availability of *O. cuvieri* in the trawl catches was the highest indicating that it formed a major share of the trawl catches.

Yield and biomass per recruit : The relative yield/recruit analysis shows that with the increase in 'E' the yield per recruit increases and it is maximum at the E max, it tends to decline in higher exploitation ratio. The biomass per recruit continues to decline with the increase in 'E' indicating continued decay of the biomass as the fishing effort increases. The exploitation ratio Emax estimated after pooling the 1993-95 data is estimated to be 0.71, which is higher that the above mentioned Emax (0.58) indicating that the resource is over exploited (Fig. 4).

Stock estimates : The average annual yield of *O. cuvieri* was 4779 t at an exploitation rate (U) of 0.68. The average total and standing stocks of *O. cuvieri* off Veraval was estimated as 7027 t and 2331 t respectively.

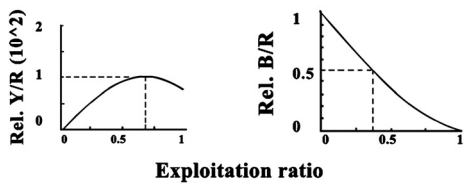

Fig. 4. Relative yield per recruitment of *O. cuvieri* off Veraval

Discussion

A perusal of the sciaenid landings at Veraval showed wider fluctuations with peak landings. The increase in the catch during the second half of this period was because of an increase in the operational area of multi-day trawlers to the Kutch and Jakau of Gujarat. Philipose (1994) while studying the fishery resources of Veraval had reported increase in effort with corresponding increase in marine fish catch and catch rate of trawlers as a

result of extension of fishing area off Kutch. Sciaenid landing from Veraval contributing to an average of 12 % has a significant bearing on the trend of marine landings. Trawlers contribute 95% of the sciaenids landed and the rest by gill netters.

The sciaenid fishery of Veraval is dominated by *O. cuvieri*, which contributes up to 53 % of the trawl and 42 % of gill net landings. Thus the trend of sciaenid fishing is largely determined by the landing of this species. According to Chakraborty et al., (2000), *O. cuvieri* is the major species of sciaenids observed along the North-West coast of India as observed in the present study at Veraval.

Month wise abundance of this fishery shows that sciaenids are abundant in the catch during September-November and January-March, during all other months the fishery was poor. In general, it was observed that at the out set of trawling in September trawlers bring good quantity of sciaenids and this primary peak continues up to mid November. Thereafter, the fishery declines due to decrease in the temperature in the North-West region. The secondary peak is observed towards the end of January when the surface temperature gradually increases.

Gulati (1987) estimated the first and second year growth of *O. cuvieri* as 183 mm and 282 mm respectively, which are lower than the estimates in the present study. The growth parameters estimated by him were $L\alpha$ = 330.66 mm, K = 0.9302 y^{-1} and t0 = -0.00269 years. Chakraborty (1989) estimated $L\alpha$ as 375 mm and K as 0.53 y^{-1} and the fish attains 170, 260 and 318 mm at the end of its first, second and third year of life, while Rao *et al*., (1992) using the length frequency data obtained an asymptotic length of 382 mm and K of 0.58 y^{-1} respectively. In the present analysis of length frequency, it was found that the growth parameters and age at different years were more close to the observations made by Chakraborty (1989) and Rao *et al*., (1992).

The total mortality estimated by Gulati (1987) for the 1972-73 and 1983-84 by Jackson's method was 1.45 y^{-1} and 1.64 y^{-1} respectively. Chakraborty (1989) in his study estimated 'M' of 1.30 y^{-1} and 1.1 y^{-1} by Cushing's and Pauly's method respectively. In the present investigation Z of 2.86 y^{-1}, M = 0.81 y^{-1} and F = 2.05 y^{-1} was estimated. Higher fishing mortality values indicate that this resource is heavily exploited by the trawlers off Veraval coast.

Exploitation ratio (E) indicates whether the stock is overexploited or not (Gulland, 1971). The exploitation ratio of estimated was 0.71, which is higher than the E max estimated indicating that the species is over exploited and any further increase in the effort will be detrimental to the stock of this resource. Mohanraj *et al*., (2003) observed that the exploitation ratios of the sciaenids are above the optimum level along the coast of Gujarat and further increase is detrimental to the stock of sciaenids. It was seen that due to gradual reduction in the cod end mesh size of trawls, the contribution of demersal fishes to the total landings has changed substantially, which is due to increase in the catch of *Acetes* spp. *Acetes* spp. is the major food item of a number of commercially important fishes including *O. cuvieri* along the North -West coast of India (Manojkumar, 2003). The indiscriminate fishing of food organisms like *Acetes* spp. may adversely affect the biological efficiency of the marine ecosystem along the North West coast of India resulting in the decline in the catch of sciaenids and other marine resources

along this region.

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