Fishery of the spinycheek grouper, *Epinephelus diacanthus* (Valenciennes), off Calicut along the Malabar Coast

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Abstract

Groupers constitute one of the important demersal resources off Malabar Coast. They contributed to 4 % of the trawl landings with an annual average catch of 2,727 t during 1992 to 2002. Their exploitation has registered a sharp increase with highest catch of over 5,000t in 1996 and 2002. The spiny-cheek grouper, *Epinephelus diacanthus* formed nearly 90% of the groupers landed. The length weight relationship of the species is Log W = - 4.03+2.8203 Log L (r = 0.9899). The fish attained a length of 244, 372, 439, 474 and 492 mm at the completion of 1 to 5 years respectively. L_∞ is 512 mm and K=0.65 y^{-1}. The natural mortality (M) and fishing mortality (F) were found to be 1.16 y^{-1} and 1.75 y^{-1} respectively. The exploitation ratio (E) was higher than the E_{max}, indicating greater fishing pressure on this species.

Key words: Groupers, spiny-cheek grouper, fishery, population parameters

Introduction

The fishes of the sub family Epinephelinae belonging to the family Serranidae, popularly known as groupers or rock cods constitute an important component of demersal fishery resources of India. On an average they form 2 % of total marine landings in India (Grace Mathew, 2003). In Malabar also these fishes are in good demand and constitute an important component in the trawl landings at Calicut. *Epinephelus diacanthus* is an important species, which constitutes nearly 90 % of the groupers, landed along this region.

The information available on *E. diacanthus* is limited to the works of Chakraborty (1994), Chakraborty and Vidyasagar (1996) and Zacharia *et al.,* (1995) on age, growth, stock assessment and fishery from Bombay and Dakshina Kannada coast. Grace Mathew (2003) discussed the status of perch fishery including serranids in India. Talwar and Kacker (1984) described the distribution of different species of serranids along the Indian coast. In the present study an attempt was made to study the fishery and population dynamics of groupers of the Malabar coast with particular reference to *E. diacanthus.*

Material and methods

The data collected on catch and effort of groupers landed by trawlers during 1992-2002 were utilised in this study. The length frequency data collected from the landing centers at weekly intervals from April, 1999 to March, 2002 were used for estimation of population parameters. The length-weight relationship was studied following Le Cren (1951). A total of 170 males ranging in total length from 328 - 472 mm (310 - 820 g weight) and 202 females of 142 - 468 mm (40 - 1050 g wt.) were examined for this purpose. 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 *et al.*, 1996) after pooling the annual data for the period 1999-2002. For estimating natural mortality rate (M), the t_o was considered as '0' (Sparre *et al.*, 1989) and the surface seawater temperature was taken as 28 ^{0}C. The fishing mortality rate (F) was estimated by subtracting the value of M from Z. The exploitation ratio (E) was estimated by the ratio of fishing mortality to total mortality.

Results and discussion

Fishery

The trawl fleet consists of 32'-58' OAL vessels fitted with 37.5-125 HP engines. The boats are designed for stern trawling with power winches. The gear employed consisted of two or four seam shrimp trawls. The cod end mesh size ranged from 10 mm to 15 mm. The fishing operation is carried out up to a depth of 60m. The annual estimated landings of groupers by trawl during 1992-2002 varied from a minimum of 1081 t in 2000 to a maximum of 5068 t in 2002 with an average contribution of 2727 t. The groupers constituted 2-8% of the total catch of the gear. The landing of this resource by trawl at Calicut accounted for nearly 90% of the total groupers exploited off the Malabar Coast. Wide fluctuations in the fishery, as in any other demersal resource, have been noticed during the eleven-year period (Table 1).

The catch rate ranged from 2 - 12 kg/h and the average for the eleven year period was 4 kg/h. A comparison of effort, catch and catch rate showed that, even though the effort input increased there was no such corresponding trend in the landing of groupers during most of the study period. However, better catch and catch rate of 12kg/h was obtained in 1996. The monthly catch analysis for the period 2000-02 indicated that peak landings were observed during August to September (Fig. 1). The pooled data of all these years showed that August, September, January and May are periods of peak abundance of this species in the fishing grounds.

Species composition

A total of four species of groupers belonging to the Genus *Epinephelus* were landed at Calicut by trawl. *E. diacanthus* (89 %) was the major species followed by *E. tauvina*   (5 %), *E. malabaricus* (5 %) and

Table 1. *Catch (t) and effort of groupers landed at Calicut (District) by trawlers during 1992-2002*

Year	Total trawl catch (t)	Groupers (t)	Fishing hours	C/h (kg)	% groupers in trawl
1992	52451	2130	369834	6	4
1993	96775	2442	628808	4	3
1994	53354	1796	445484	4	3
1995	49106	2174	424307	5	4
1996	68658	5062	424068	12	7
1997	96420	2346	1140710	2	2
1998	58229	3322	608685	5	6
1999	42502	1099	557148	2	3
2000	55151	1081	683205	2	2
2001	71531	3480	889641	4	5
2002	60418	5068	1033962	5	8
Average	64054	2727 *	655077	4	4

* 85 % of the total groupers landing along the Malabar region
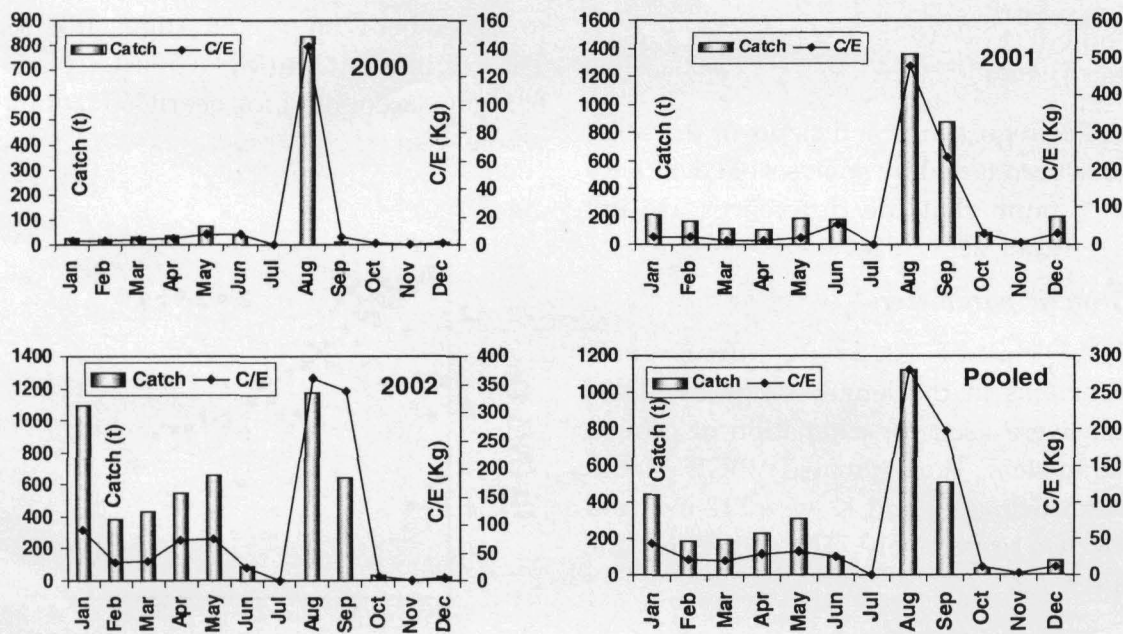
Fig. 1. *Seasonal abundance of groupers at Calicut during different years*

E. chlorostigma (1 %). Month wise varia- tions in the abundance of different species indicated that *E. diacanthus* dominated the landings during most of the period except in July when there was no landing due to ban on trawling (Fig. 2).
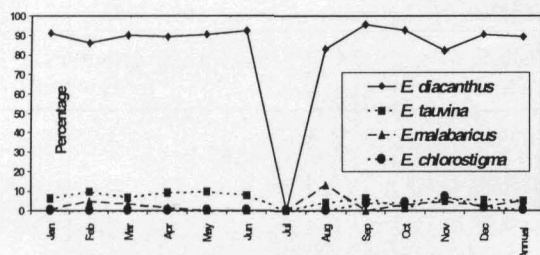
Fig. 2. *Species composition of groupers in the trawl landings*

Length weight relationship

The relationship has been calculated separately for the sexes and the equations are:

Male: log W = - 3.85+2.74 Log L (r= 0.9901)

Female: Log W = - 4.22+2.89 Log L (r= 0.9922)

Pooled: Log W = - 4.03+2.82 Log L (r= 0.9899)

The regression coefficients of the sexes have been tested by analysis of covariance and found that the differences are not significant at 5 % level.

Growth parameters

A total of 2822 specimens of *E. diacanthus* in the length range of 32-492 mm were used for estimation of growth parameters. The estimated VBGE parameters such as L_α and K were 512 mm and 0.65 y^{-1} respectively. The VBGE for the species is

$$Lt = 512 \ (1-e^{-0.65(t-t_0)})$$

The fish attained a size of 244, 372, 439, 474 and 492 mm at the end of 1st, 2nd, 3rd, 4th and 5th year respectively. The largest

fish noticed during the study period measured 492 mm. The mean size of the fish in the fishery was 237 mm. It is evident that major share of the landings of this species is constituted by '0' year class from the present area of fishing.

Mortality parameters

Total mortality arrived from length converted catch curve was 2.91 y^{-1} (Fig. 3). The natural mortality rate (M) estimated following Pauly (1980) for an average temperature of 28°C was 1.16 y^{-1}. The fishing mortality derived for *E. diacanthus* from this study was 1.75 y^{-1}.

Recruitment pattern

The recruitment in the species appeared to be unimodal and occurred during May to September with peak in August (Fig. 4). The recruitment during August-September alone accounted for nearly 60% of the whole year.
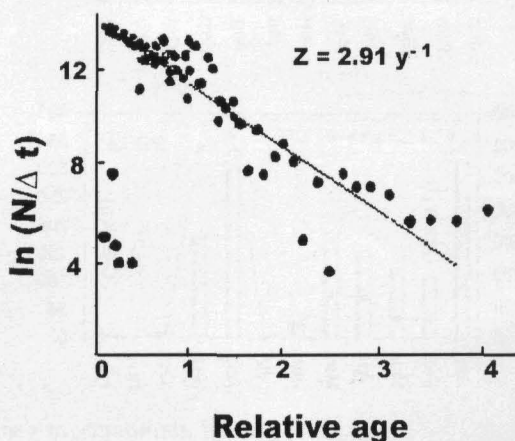

Fig. 3. *Length converted catch curve of* E. diacanthus *off Malabar coast*

Yield per recruit

The length at first capture was estimated using the probability of capture as 119 mm (Fig. 5) and the length at recruit-
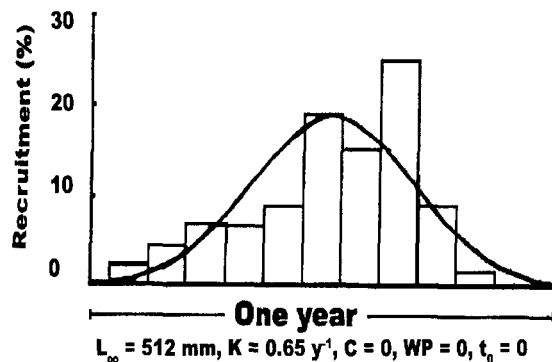

Fig. 4. *Recruitment pattern in* E. diacanthus *off Malabar coast*

ment was taken as the smallest fish observed in the catch, as 32 mm. The optimum value of 'E' is almost equal to 0.50. The exploitation ratio (E) estimated in the present study is 0.60, which is more than the E_{max} 0.48 (Fig. 6). The present exploitation ratio is more than the E_{max} estimated indicating that the fishing pressure on the resource has to be reduced for sustaining the resource on a longtime basis.
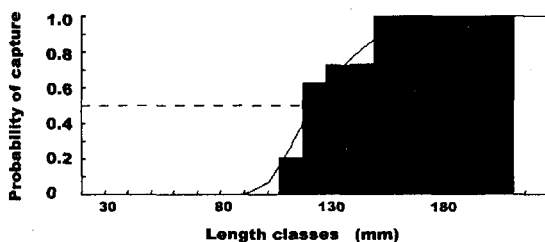

Fig. 5. *Estimation of length at first capture of* E.diacanthus *using probability of capture analysis*

Discussion

Groupers, in recent years, have assumed commercial importance in view of their good quality meat and greater consumer demand, in local and export markets. They began to form a sizeable portion of the fishery eversince the extension of fishing operations to distant waters by multi-day trawlers. The extension of fishing to new geographical areas was mainly targeting the shrimps and cephalopods.
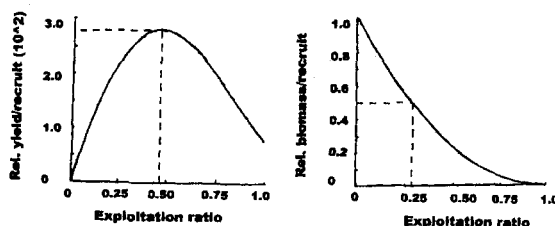

Fig. 6. *Yield/recruit and biomass/recruit of* E. diacanthus *off Malabar coast*

But this has resulted in the landing of sizeable quantities of various demersal resources also including the groupers. The catch and catch rate of groupers showed fluctuations over the years at Calicut. Short- term, long-term and cyclic fluctuations in marine fish landings are common feature and are governed by a complex of biotic and abiotic factors and the exact causes for these variations are largely unknown (Muthiah *et al.*, 2000). Therefore, the fluctuations in the landings observed in the present study can be treated as one such short-term fluctuation. The exploratory surveys conducted along this coast have indicated abundance of grouper resource beyond 100 m. The present study showed that *E. diacanthus* was the dominant species forming nearly

85 % of the grouper landing in the trawl along this region.

Boulenger (1895) and FAO (1984) reported that *E. diacanthus* grows to a maximum size of 520 mm.   Chakraborty (1994) reported the L_∞ and K value of this species as 502 mm and   0.61 y^{-1} respectively. The largest specimen observed by him from Bombay waters was 478 mm. In the present study the estimated L_∞ and K was 512 mm and 0.65 y^{-1}, which is very close to those reported earlier from Indian waters. The natural mortality estimated was lower, which may be due to its highly predatory nature, presence of strong dorsal spines and hence the possibility of this species forming prey to other predators is less. The natural mortality of the fishes varies with size and most probably with predator abundance (Pauly 1980 and 1982).   Since 'M' is related to longevity, relation to growth coefficient is obvious. The 'M' of 1.16 y^{-1}, obtained in the present study appears to be very reasonable. Chakraborty (1994) also reported low natural mortality rate for this species from Bombay waters and this supports the results of the present observation.

The exploitation ratio (E) generated by trawl net is higher   than the optimum ratio and it indicates that *E. diacanthus* is over exploited from the present area of fishing up to 60 m depth. The yield per recruitment also shows that increase in effort can reduce production of this species in the long run from the present fishing area.

Exploratory surveys conducted earlier have indicated the existence of under-exploited resources of serranids in the middle and outer shelf along southwest coast of India (Silas, 1969; Menon and Joseph, 1969; Joseph and John, 1986 and Sudarshan, *et al.,* 1989).   James *et al.,* (1994) and Grace Mathew *et al.* (1996) also observed that perches offer immense scope for increased exploitation along the Kerala coast. According to Talwar and Kacker (1984), *E. diacanthus* is an important component of demersal fishery off Kerala coast in 63-100 m depth.   Since 1956, the erstwhile Indo-Norwegian Project conducted several fishing trips for survey of *Kalava* grounds in 70-150 m depth zone of the continental shelf from Trivandrum to Cannanore and this area is rich in perches including *E. diacanthus* (Grace Mathew, 2003). The results of the present study indicated that for higher yield of *E diacanthus*, the fishing operations have to be extended beyond 60 m. The pressure in the present fishing ground has to be reduced for sustaining the fishery on a long time basis.

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