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Fishery of threadfin breams with some aspects on the biology and stock assessment of *Nemipterus mesoprion* (Bleeker, 1853) off Malabar coast

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ABSTRACT

The average annual catch of threadfin breams along the Malabar coast was 16,754 t during 1998-2005. The fishery was constituted by *Nemipterus japonicus* (46.8 %) and *N. mesoprion* (53.2 %). Peak landings were noticed during August-September. Studies on *N. mesoprion* revealed that there is no significant difference in the length weight relationship between sexes, and hence a common equation was fitted as Log W = -3.9620+2.8298 Log L. The asymptotic length ($L\alpha$) and growth coefficient (K) were estimated as 299 mm and 0.79 y^{-1} respectively. *N. mesoprion* grows to 164, 238, 271 and 287 mm at the end of first, second, third and fourth years. The total mortality, fishing mortality and natural mortality were 4.93 y^{-1}, 3.41 y^{-1} and 1.52 y^{-1} respectively. The length at first capture was 105.4 mm. The resource is over exploited, and hence there is a need for reducing the fishing pressure to sustain the fishery.

Introduction

Threadfin breams are one of the major constituents of demersal fisheries along the Malabar coast. It forms a major catch in multi day trawlers, which operate beyond 100m. *Nemipterus mesoprion* and *N. japonicus* are the major constituents of threadfin bream fishery. There are several studies on this resource, the notable among them are those of Murty (1981), Nair and Jayaprakash (1986), Raje (1996), Rao (1989), Vivekanandan (1991), and Zachariah and Nataraja (2003). Although threadfin breams form a major demersal resource exploited along the Malabar coast, there is no published information on this resource from this area, hence the present study was undertaken.

Materials and methods

The data collected on catch and effort from commercial trawlers from the landing centres in Malappuram, Calicut, Kannur and Kasaragod districts during 1998-2005 were utilised in this study. However, there was no landing in July due to the ban on trawling imposed by the state government. Biological studies were carried out on *N. mesoprion*. The length-weight relationship was studied following Le Cren (1951). The stages of gonads were determined following I.C.E.S (Lovern and Wood, 1937). Month wise sex ratio was determined by

dividing number of females with the number of males. Gonadosomatic index (GSI) was calculated using the formula GSI = weight of gonad/weight of fish X 100. A total of 1,932 specimens were used for biological study. The length frequency data collected from the landing centers at weekly intervals during 2004-2005 were used for estimation of population parameters. The data on length were grouped into 10 mm class intervals and the raised monthly frequency distribution was used for the growth studies (Sekharan, 1962). A total of 2,391 specimens in the length range of 52-258 mm formed the material for length frequency study. The growth and mortality parameters were estimated using FiSAT programme (Gayanilo Jr. *et al*., 1996). For estimating natural mortality rate (M), the t_o was considered as 0 (Sparre *et al*., 1989) and the seawater temperature was taken as 27 ^{0}C. The fishing mortality rate (F) was arrived at by subtracting natural mortality (M) from total mortality (Z). The exploitation ratio (E) was estimated by the ratio of fishing mortality to total mortality. The exploitation rate 'U' was estimated by the formula $U = F (1-e^{-Z})/Z$. The annual total stock and standing stock were estimated by Y/U and Y/F respectively, where Y is the annual yield.

Results

Fishery

Trawl is the major gear used for exploitation of threadfin breams. The trawlers are based at Ponnani, Beypore, Puthiappa, Chombala and Azheekal. Nearly 70 % of trawling operations in this region is based at Beypore and Puthiappa. About 1,500 trawlers operate in this region at a distance of 25-50 km from the shore and at a depth of 25-150m. The mesh size of the trawl net is 16-22 mm. Most of the vessels are multi day trawlers and the rest are small trawlers which conduct single day operations.

Along the Malabar region, the landings of thread fin breams have shown wide fluctuations during the study period with lowest of 11,098 t in 1999 and highest of 24,474 t in 2004 and the annual average landing was 16,754 t. The contribution of this resource, which was only 6 % to the trawl catch in 1999, increased to 22 % in 2004, the average being 12 %.

The effort was minimum in 2000 (1.2 million h) and maximum in 2005 (1.86 million h). The c/h was lowest in 2005 (7.4 kg) and highest in 2000 (16.1 kg) and the average c/h was 10.8 kg. After the peak c/h in 2000, the catch rate has shown a steady decline upto 2003, it has shown some improvement in 2004 (14.5 kg) and declined again reaching the lowest towards the end of the study period. Quarterwise analysis of the catch rate showed that highest catch rate was recorded during the third quarter (July-September) of the year (61.8 kg/h) with a contribution of 53.5 %. The catches suddenly declined from the third quarter to 16.3 % in the fourth quarter. The average monthly contribution of threadfin breams shows that it formed 49.9 % of trawl catch in August and 17.6% in September, indicating the abundance of this resource in the coastal waters during the southwest monsoon (Fig. 1).

N. mesoprion and *N. japonicus* were the two species found in the fishery. *N. mesoprion* was the dominant species found in the landing from January to March and in September and average composition of this species for this period was 53.2 %.

Length weight relationship

A total of 300 males ranging from 52

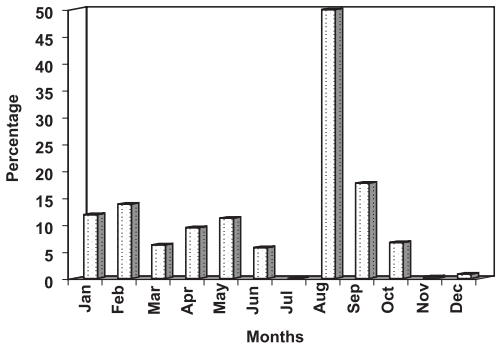

Fig. 1. Monthly contribution of threadfin breams to the trawl landings along the Malabar coast during 1998-2005

to 251 mm total length and from 7 to 550 g weight and 306 females ranging from 68 mm to 249 mm total length and from 8 to 580 g weight were examined for this purpose. The relationship has been calculated separately for males and females as:

Male Log W= -4.08638 + 2.8770 Log L (r= 0.9982)

Female Log W = -3.1485 + 2.5451 Log L (r = 0.9892)

The regression coefficient of males and females was analysed using analysis of covariance (Snedecor and Cochran, 1967). Since there was no significant difference between the regression coefficients of the sexes, the data on both sexes were pooled and a common equation was derived as follows.

Pooled Log W = -3.9620 + 2.8298 Log L (r = 9937)

Sex ratio and size at first maturity

The sex ratio was 1:0.9. No significant difference was found in monthly variation. The study indicates that *N. mesoprion* (females) was immature up to 90 mm total length. It was found that 50 % of individuals were mature at 128 mm. Therefore, it can be stated that the size at first maturity of females of *N. mesoprion* along the Malabar coast is 128 mm.

Spawning season and gonadosomatic index

The mature females appeared in the fishery from March to December with highest percentage during May-December, which clearly indicates the spawning season. Appearance of ripe and partially spent females during September – December indicates the peak spawning season of *N. mesoprion* along this coast (Fig. 2). The gonado-

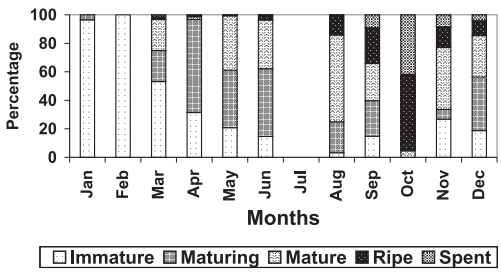

Fig. 2. Monthly abundance of different stages of maturity in *N. mesoprion*

somatic index (GSI) during different months showed that it was almost same from January to March, increased from June onwards and reached a peak in October. The GSI started to decline from November onwards. This shows that the peak period of spawning of *N. mesoprion* is September – November. The GSI value has shown marginal increase in April indicating another spawning season of short period along the Malabar coast (Fig. 3).

Growth and mortality parameters

Using the length frequency data for 2004 and 2005, growth and mortality parameters were estimated. In the FiSAT programme, the restructured length frequency diagram indicated a distinct brood originating in that year (Fig. 4). This brood contributed

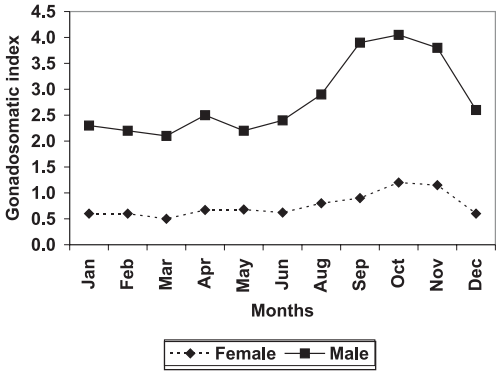

Fig. 3. Gonadosomatic index of *N. mesoprion* along the Malabar coast

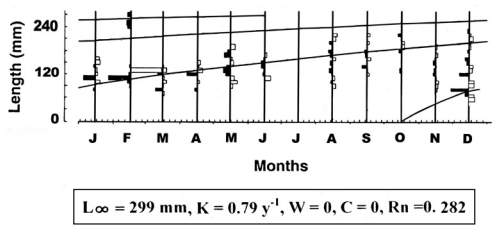

Fig. 4. Plot of FiSAT analysis of *N. mesoprion* exploited off Malabar coast

substantially to the fishery during the following years.

The growth parameter L α and K for the pooled sample for the period 2004 and 2005 was estimated as 299 mm and 0.79 y^{-1} respectively. The VBGF for *N. mesoprion* can be written as

$$Lt = 299\ (1-e^{-0.8\ (t-t_0)})$$

The fish grows to 164, 238, 271 and 287 mm at the end of first, second, third and fourth year respectively along the Malabar region. The largest fish measured in this study is 258 mm, the age estimated as 3 years. The mean size of exploitation was 138 mm, from which it is clear that major share of the landings of this species is of '0' year class along the Malabar coast.

The total mortality rate (Z) was estimated as 4.93 y^{-1} for the years 2004 and 2005. The instantaneous natural mortality rate (M) was 1.52 y^{-1}. The average fishing mortality (F) derived for *N. mesoprion* from this study was 3.41 y^{-1} (Table 1).

Recruitment pattern

The recruitment pattern indicates a unimodal period from February to November with peak in July-September indicating that the recruitment to the fishery occurs within first year. Minimum recruitment was in November (0.1 %) and maximum in August (35.9 %).

Status of the fishery

The intensity of exploitation of *N. mesoprion* was measured in terms of exploitation ratio and yield per recruit. The length at first capture was estimated using the probability of capture as 105.5 mm and the length at recruitment was taken as the smallest fish observed in the catch as 52 mm. The exploitation ratio varied between 0.68 (2004) and 0.71 (2005) and the average for this period was 0.69. The present exploitation ratio is more than the E_{max} (0.59) estimated. The total and standing stocks of *N. mesoprion* were estimated and presented

TABLE 1: *Estimated mortality parameters, exploitation ratio, total stock and standing stock of* N. mesoprion *exploited along the Malabar coast*

Year	Z	M	F	E	E_{max}	U	Yield (t)	Total stock (t)	Standing stock (t)
2004	4.68	1.52	3.16	0.68	0.58	0.67	9089	13566	2876
2005	5.18	1.52	3.66	0.71	0.60	0.70	7857	11224	2147
Average	4.93	1.52	3.41	0.69	0.59	0.69	8473	12395	2512

in Table 1. The average annual stock and standing stock for the period 2004 - 2005 were 12,395 t and 2,512 t respectively.

Discussion

Threadfin breams are available in large quantities from the shallow waters during August-September. Bulk of the catch was taken during the third quarter, which amount to more than 50 % of the annual catch. It is known that the fish move into shallower depths of 35-40 m during monsoon to avoid oxygen deficient areas (Banse, 1959; Nair and Jayaprakash, 1986). After monsoon, the catch declines, which is due to migration of this resource to deeper waters as the upwelling subsides.

Raje (1996), Rao (1989) and Zacharia and Nataraja (2003) observed predominance of males in the fishery. The present study also showed marginal dominance of males in the fishery, which may be due to the differential growth of sexes in threadfin breams as reported by Eggleston (1972).

The length at first maturity of *N. mesoprion* was 134 mm off Veraval (Raje, 1996), 115 mm off Mangalore (Zacharia and Nataraja, 2003), 115 mm off Madras (Vivekanandan, 1991) and 100 mm off Kakinada (Murty, 1981). The results obtained in this study also showed that the length at first maturity of this species as close to the available values from the west coast of India.

Threadfin breams are fractional spawners having extended spawning period and the spawning period of this species at Kakinada is during December-April with peak in April (Murty, 1981). The spawning season of this species off Madras coast is during February-March followed by mild spawning during August-October (Vivekanandan, 1991); August-November followed by a mild spawning during January-May at Mangalore (Zacharia and Nataraja, 2003); September-March with primary peak in September and secondary peak in November-December at Veraval (Raje, 1996) and June-September at Cochin (Murty *et al.*, 1992a). The spawning period of this species along the Malabar coast is also prolonged and this species spawns in two spells, the first one for a longer period and the second one for a shorter period.

Lα and K values for *N.mesoprion* are 219mm and 0.83 y^{-1} from Kakinada. (Murty, 1981); 274mm and 0.76 y^{-1} from Bombay (Chakraborty, 2002); 244-273mm and 0.51-0.62y^{-1} from Cochin (Murty *et al*., 1992b); 274.5mm and 0.85 y^{-1} from Cochin (Joshi, 2005) respectively. The results of this investigation also shows similarity with earlier reports of growth parameters worked out on this species from the west coast of India.

The instantaneous natural mortality (M) estimated by Chakraborty (2002) from Bombay was 1.57 y^{-1}. The estimates of M from Cochin by Murty *et al.* (1992) and Joshi (2005) was 1.36 y^{-1} and 1.26 y^{-1} respectively. The value of instantaneous natural mortality in this species is close to the earlier reports. High fishing mortality rates indicate that fishing pressure on this resource is very high. The current exploitation ratio (E) of 0.69 is above E_{max} (0.59) at which rate optimum yield can be obtained. The results show that *N. mesoprion* at Malabar area is subjected to over fishing. Murty *et al.* (1992b) reported that there was scope for increase in the yield of *N. mesoprion* and the MSY off Cochin which could be obtained by increasing the effort. The study made by Joshi (2005) on this resource in the same area indicates that the effort has increased more than 100 %, thereby reducing stock of *N.*

mesoprion over the years. Under the present conditions, an increase in the effort may adversely affect the stock of *N. mesoprion* along the Malabar coast. It is, therefore, suggested that measures may be taken to reduce the fishing effort to bring the catch to MSY levels for sustaining the fishery.

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