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Biology and population dynamics of *Nemipterus mesoprion* (Bleeker) off Cochin

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ABSTRACT

Biology and population dynamics of *Nemipterus mesoprion* from the trawling grounds off Cochin were studied. The length weight relationship is Log W=-4.700+2.926 Log L. The major food items were fishes, crustaceans and squids. The estimated length at first maturity was 106mm and the spawning season extends from May to November. The estimated von Bertalanffy parameters were L_{∞} =274.5mm, K= 0.85year^{-1} and t_o= -0.01 year. The total mortality, fishing mortality and natural mortality were 3.12, 1.856 and 1.26 respectively. Maximum yield could be 694t at 120% of the present effort but yield increase will be 101% of present. The cod end mesh size has to be doubled to get maximum yield.

Introduction

There are only limited studies on the threadfin breams off Cochin although it forms a major resource. The earlier studies are concentrated on the catch and effort and biology, (Silas, 1969; Tholasilingam *et al.*, 1973; Vincy, 1983; Nair and Jayaprakash, 1986 and Murty *et al*., 1992 a,b) and population dynamics of *Nemipterus japonicus* (John, 1987). The present work is on the biology and population characteristics of *N. mesoprion* off Cochin.

Materials and methods

The data on effort and catch, length, weight and species composition of *N. mesoprion* were collected from commercial trawlers operating off Cochin at fortnightly intervals during 1998- 2002. The details of sex, stages and maturity condition of 478 specimens with a length range of 70-200mm were taken from fresh specimens. Length-weight relationship of 315 specimens of length rage 40-270mm was calculated following LeCren (1951). The stomach contents of 478 fish with length range of 40-260mm were analyzed based on the microscopic examination with respect to quality and quantity of food by analysis of percentage of occurrence of various species and gravimetric methods (Natarajan and Jhingran, 1961).

The length frequency data for the years 1998-2002 were pooled and used for estimation of von Bertalanffy growth parameters (VBGF) using FiSAT. The growth and age were estimated using von Bertalanffy growth equation $Lt = L_{\infty} (1- e^{-K (t- to)})$. The rate of total instantaneous mortality (Z) and exploitation rate (E) were estimated by length converted catch curve of Pauly (1983) and natural mortality (M) was estimated using empirical equation of Pauly (1980). For this purpose temperature in the fishing ground was

taken as 27° C (Suseelan and Rajan, 1989). The fishing mortality (F) was calculated by subtracting M from Z.

For determining the length at first maturity (L_{50}), specimens with ovary IV and V stages were taken as mature and its proportion in each length group was determined. The length, at which 50% of the fish are mature, has been taken as the L_{50}.

The mid-point of the smallest length group in the catch during the period 1998- 2002 was taken as length at recruitment (L_r). The length corresponding to the first value in the descending limb of the length converted catch curve was taken as the length at first capture (L_c). Yield per recruit and biomass per recruit at different levels of F was estimated using LFSA package (Sparre, 1987).

For studying the effects of change in the effort and cod-end mesh size, Beverton and Holt's (1957) yield per recruitment analysis was done by using different values of F and t_c. The value of W_∞ was derived from the value of L_∞ and the estimated length-weight relationship. The L_c values were converted to t_c values using inverse VBG equation.

Results and discussion

Fishery

Threadfin breams formed 11-20 % of the total trawl landings. *N. mesoprion* formed a maximum of 70% (1998) and minimum of 35% (2000) in the threadfin landings. Maximum catch of 937 t was recorded in 1998 and lowest of 510 t in 2001 with a mean (1998-2002) of 688t (Table 1). The monthly average landing and CPUE of *N. mesoprion* are given in Fig.1. The catch rate was maximum during June–August when the monsoon fishery was in progress. During May-September, *N. mesoprion* forms 67-81 % of the annual landing. The movement of fish towards the shore for spawning is one of the reasons for their heavy landing in monsoon months. According to Banse (1959) strong upwelling takes place from 8° N to at least 15° N during whole southwest monsoon season along the west coast. The threadfin breams are more abundant in relatively deeper waters along the west coast and move into shallower depths of 35-40m during monsoon to avoid oxygen deficient areas (Nair and Jayaprakash, 1986). Thus the threadfin breams are available in large quantities in the intermediate depth zones during monsoon.

TABLE 1: *Trawl effort and catch of* Nemipterus mesoprion *landed at Cochin during 1998-2002*

Year	Effort (units)	Catch of threadfin breams(t)	Catch of *N. mesoprion*(t)	CPUE (kg/unit)	Percentage of *N. mesoprion* in threadfin bream catch
1998	19500	1300	937	48	70
1999	14478	990	620	43	68
2000	11776	1730	610	52	35
2001	9440	1150	510	54	45
2002	6894	1750	765	111	44
Average	12418	1373	688	55	50

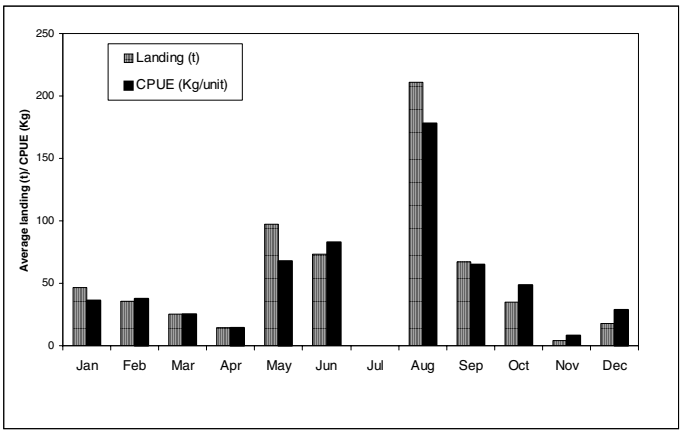

Fig. 1 Effort (CPUE) and landings (t) of *Nemipterus mesoprion* at Cochin Fisheries Harbour during 1999-2002 (average) by trawlers.

Species composition

N. mesoprion and *N. japonicus* formed about 90% of the landings and the rest by *N. delagoae, N. tolu* and *N. luteus* at Cochin. *N. mesoprion* was dominant in all months except post monsoon months when *N. japonicus* was dominant. Murty *et al.* (1992 b) observed that *N. mesoprion* is most dominant species at Cochin during monsoon season and the contribution is very poor during the other periods. But the present observation clearly indicates that there is a shift in the landing pattern of the two species. The change in the species composition may be due to the introduction of multiday trawlers, which resulted in the change in the fishing area.

Length-weight relationship

A sample of 117 females, ranging from 40-250 mm total length and 198 males ranging from 40-270 mm were collected from Cochin were used. The relationship was as follows:

Males: Log W= -4.6905+ 2.9203 log L

Females: Log W= -4.7129+ 2.9353 log L

The significance of variation between b values of the sexes was tested by ANOVA (Snedecor and Cochran, 1967); the difference was not significant at 5% level. Therefore by pooling all the data, a common relationship was obtained.

Pooled: Log W= -4.7007+ 2.9268 log L

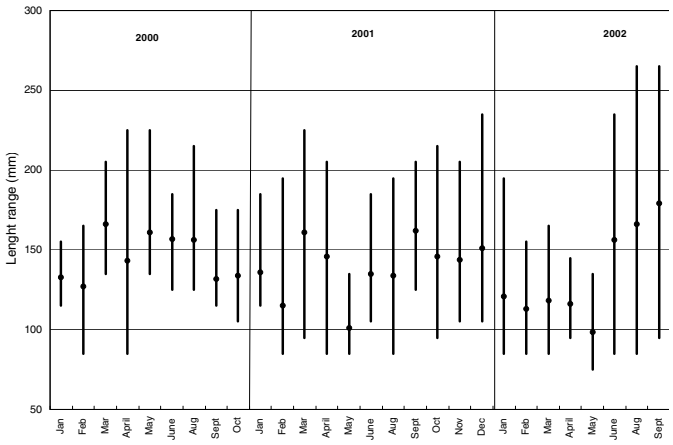

Fig. 2 Range and mean length (mm) of *Nemipterus mesoprion* in the trawl landings at Cochin during 2000-2002.

Length composition

The highest mean length was recorded in the monsoon months and the lowest during December-February with a length range of 40-260 mm (Fig.2). The mean length of *N. mesoprion* off Cochin is larger during monsoon due to the

movement of larger fish from relatively deeper water into shallower areas consequent up on upwelling (Murty *et. al.*, 1992 b). Weber and Jothy (1997) and Pauly and Mortosubroto (1980) found a positive correlation between size of nemipterids and depth in the South China Sea. Nair and Jayaprakash (1986) and Vivekanandan (1991) too observed larger *N.japonicus* in deeper waters and smaller fish in shallower regions.

Food and feeding

A total of 478 specimens collected from January 2001-December 2002 were utilized for food and feeding studies. *N. mesoprion* is a carnivorous fish. The percentage of chief items of food present in the stomach is shown in the Fig. 3. The food item includes fishes (25%), crustaceans (59%) and squids(12%). The major fish species observed were *Stolephorus* and *Leiognathus*, and crustaceans were dominated by prawns, mysids, crabs, *Squilla*, *Acetes* and deep-sea prawns. The present observations are comparable with similar studies on this species from Vishakapatnam (Rao, 1989) and Mangalore (Zacharia and Nataraja, 2003).

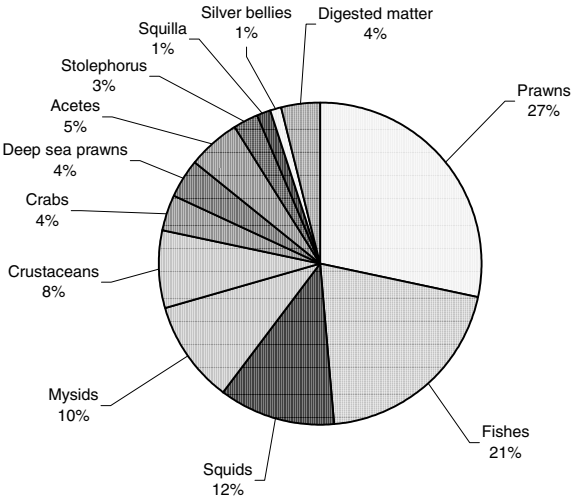

Fig. 3 Percentage of different food items found in the stomach contents of *Nemipterus mesoprion* landed at Cochin during 2001-2002.

Length at first maturity

A total of 215 female specimens collected during the year 2000-2001 were used to study the length at first maturity. Fishes above 95 mm had mature ovary and 50% of fish mature at 106 mm, which may be considered as the length at first maturity of *N. mesoprion*. 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 present result falls within the range of available values.

Spawning

Fishes in stage IV of maturation were seen from May to November. During June–August, mature and ripe fishes were available in greater percentage indicating the peak-spawning season. It is known that Indian threadfin breams are fractional spawners having extended spawning periods (Murty, 1981; Vivekanandan and James, 1986). Past studies indicate that the peak spawning was during December-April at Kakinada (Murty, 1981); February-March at Chennai (Vivekanandan, 1991); June–August at Mumbai (Murty *et al.*, 1992 a,b); September -March at Veraval (Raje, 1996) and August-November at Mangalore (Zacharia and Nataraja, 2003).

Age and growth

The L_{∞} value for the pooled sample for the period 1998-2002 was estimated as 274.5mm. The annual growth rate K ranged from

0.85 to1.008 and the estimated value for the pooled sample was 0.85year^{-1}. The t_0 was -0.01.

At Kakinada the estimated L_∞, K and t_0 of *N. mesoprion* were 219 mm, 0.832 year^{-1} and 0.255 year respectively (Murty,1981). At Mumbai the estimated L_∞ was 274 mm, K as 0.76289 year^{-1} and t_0 –0.011764 year (Chakraborty, 2002). At Chennai the estimated L_∞ was 207 mm, K= 1.080 and t_0 =-0.1927 (Vivekanandan, 1991). Using the ELEFAN programme Murty *et al.* (1992 a) estimated L_∞, and K off Cochin as 244-273 mm and 0.51- 0.62 year^{-1}. The results obtained in the present study agree with the earlier studies.

The VBGF can be written as

$$Lt = 274.5\ (1- e^{-0.85\ (t-(-0.01))})$$

According to this equation *N. mesoprion* reaches 158, 224 and 253 mm at the end of first, second and third year respectively off Cochin (Fig.4). The length obtained by LFSA package was 159 mm, 218 mm, 244 mm, and 254 mm at the end of I-IV years.

The total mortality (Z), fishing mortality (F) and exploitation rate (E) calculated using catch curve method is given in Table 2. The natural mortality (M) in the present observation was estimated as 1.26. The M was estimated as 1.57 from Mumbai (Chakrborty, 2002) from Cochin as 1.36 (Murty *et.al.*, 1992 a). The M value obtained in the present observation falls within the range of

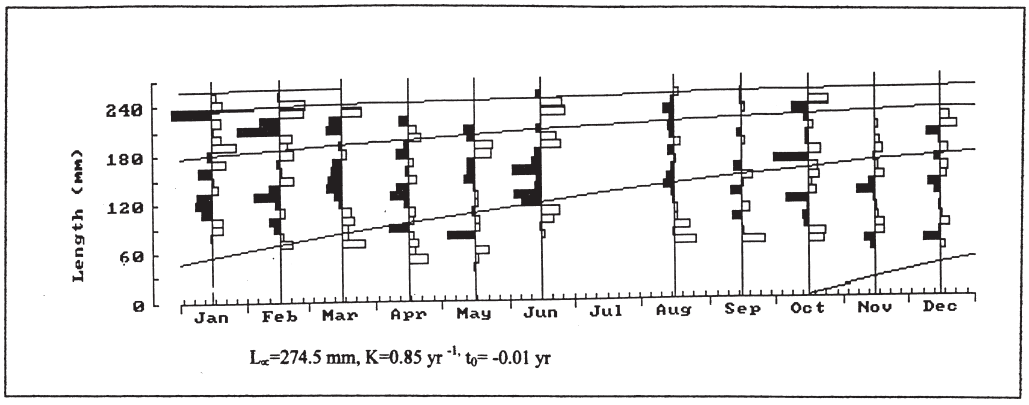

Fig. 4 Restructured growth curve (FiSAT) of *Nemipterus mesoprion* off Cochin during 1998-2002.

TABLE 2: *Estimated values of population parameters of* Nemipterus mesoprion *at Cochin during 1998-2002.*

Year	Z	F	M	E
1998	2.71	1.45	1.26	0.54
1999	2.58	1.32	1.26	0.51
2000	3.50	2.24	1.26	0.64
2001	3.97	2.71	1.26	0.68
2002	2.82	1.56	1.26	0.55
Mean	3.12	1.85	1.26	0.58

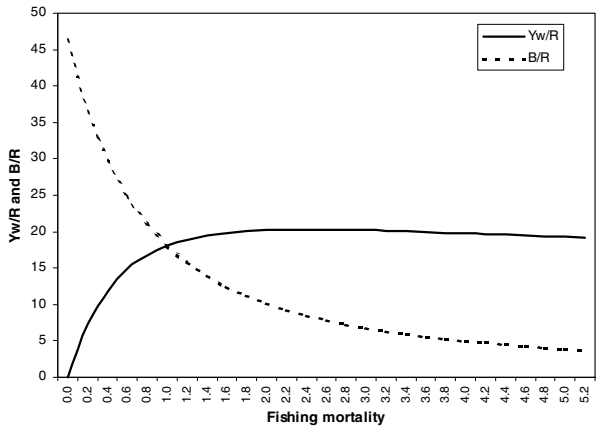

Fig. 5 Yield per recruit (g) and biomass per recruit (g) in *Nemipterus mesoprion.*

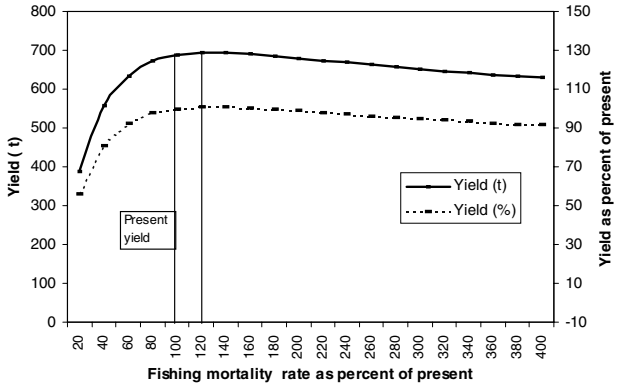

Fig. 6 Estimated yield of *Nemipterus mesoprion* as function of different F values.

recorded M value of the species.

Estimation of yield per recruit

The W_{∞} was estimated as 262.6g from length-weight relationship and the t_r as 0.2 taking 40cm as the smallest length at recruitment and t_c=0.582 from L_c=125mm. These values were used as input for yield/recruit analysis.

Yield assessment with reference to F

The yield per recruitment against different values of F keeping the values of t_c and M as constant shows that Yw/R increases with F reaching the maximum of 20.3g for the corresponding B/R of 8.46 g (Fig. 5). The optimum Yw/R and B/R can be obtained by increasing the present effort by 160%.

Maximum yield of *N. mesoprion* could be 694t at 120% of the present effort but yield increase will be 101% of present (Fig. 6). The present catch is 688 t and hence there is no scope to increase the yield of *N. mesoprion* by increasing the effort. Analysing the data for the years 1995-99, Murty *et al.* (1992 b) reported that there was scope for increase in the yield of *N. mesoprion* by 36% and the MSY off Cochin could be obtained by increasing effort by 200%. The present study indicates that the effort has increased more than 100%, thereby reducing stock of *N. mesioprion* over the years.

Yield assessment with reference to t_c

Yw/R and B/R of *N. mesoprion* were calculated keeping F as constant at the present level (F= 1.856) with varying t_c. The maximum yield of *N. mesoprion* corresponds to 836t at 180% of present t_c and 122% of effort increase (Fig. 7). The maximum yield in the present level of F will be obtained by increasing the age at first capture by 180% of the present. A cod end mesh increase by 180% from the present level will give maximum yield. Murty *et al.* (1992 a) reported that the maximum yield of *N. mesoprion* could be obtained at 70% of the t_c indicating that 30% decrease in cod-end mesh size is necessary to obtain the MSY. It may be

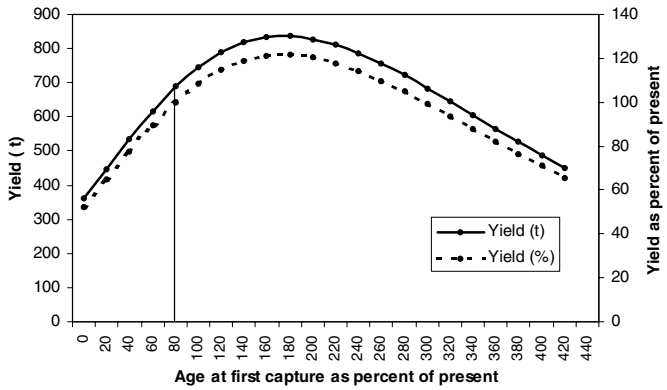

Fig. 7 Estimated yield of *Nemipterus mesoprion* as function of different age at first capture values.

noted that over the last 10 years the cod end mesh size is showing decreasing trend (from 40mm to 20mm) and now the situation calls for cod end mesh size increase by 100% of the present level.

The estimates in the present study have not examined the fishery independent factors like upwelling, predation and other changes in environmental parameters which affects growth and recruitment, and the fishery dependent factors like multiday fishery and change in the fishing grounds. Nevertheless, the study of the present nature on the yield of one component species is not an exercise of futility and such studies will help in arriving at meaningful decisions for management of multispecies fishery (Murty,1990).

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