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 $L_\infty = 274.5$mm, $K = 0.85 \text{year}^{-1}$ and $t_0 = -0.01 \text{year}$. 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; 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 range 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 $L_t = L_\infty (1 - e^{-K (t - t_0)})$. 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 \((L_{m})\), 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 \(L_{m}\).

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 LFLSA 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 \(W_{\infty}\) was derived from the value of \(L_{\infty}\) 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 688 t (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

<table>
<thead>
<tr>
<th>Year</th>
<th>Effort (units)</th>
<th>Catch of threadfin breams(t)</th>
<th>Catch of (N.) mesoprion(t)</th>
<th>CPUE (kg/unit)</th>
<th>Percentage of (N.) mesoprion in threadfin bream catch</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>19500</td>
<td>1300</td>
<td>937</td>
<td>48</td>
<td>70</td>
</tr>
<tr>
<td>1999</td>
<td>14478</td>
<td>990</td>
<td>620</td>
<td>43</td>
<td>68</td>
</tr>
<tr>
<td>2000</td>
<td>11776</td>
<td>1730</td>
<td>610</td>
<td>52</td>
<td>35</td>
</tr>
<tr>
<td>2001</td>
<td>9440</td>
<td>1150</td>
<td>510</td>
<td>54</td>
<td>45</td>
</tr>
<tr>
<td>2002</td>
<td>6894</td>
<td>1750</td>
<td>765</td>
<td>111</td>
<td>44</td>
</tr>
<tr>
<td>Average</td>
<td>12418</td>
<td>1373</td>
<td>688</td>
<td>55</td>
<td>50</td>
</tr>
</tbody>
</table>
Biology and population dynamics of Nemipterus mesoprinon

Species composition

N. mesoprinon and N. japonicus formed about 90% of the landings and the rest by N. delagoae, N. tolu and N. luteus at Cochin. N. mesoprinon was dominant in all months except post monsoon months when N. japonicus was dominant. Murty et al. (1992 b) observed that N. mesoprinon 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

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. mesoprinon off Cochin is larger during monsoon due to the
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movement of larger fish from relatively deeper water into shallower areas consequent up on upwelling (Murty et al., 1992 b). Weber and J othy (1997) and Pauly and Mortobrotro (1980) found a positive correlation between size of nemipterids and depth in the South China Sea. Nair and J ayaprakash (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. mesopion 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).

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. mesopion. The length at first maturity of N. mesopion 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

Fishess 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

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Fig. 3 Percentage of different food items found in the stomach contents of Nemipterus mesopion landed at Cochin during 2001-2002.
0.85 to 1.008 and the estimated value for the pooled sample was 0.85 year\(^{-1}\). The \(t_0\) was -0.01.

At Kakinada the estimated \(L_\infty\), \(K\) and \(t_0\) of \(N.\) mesoprion were 219 mm, 0.832 year\(^{-1}\) and 0.255 year respectively (Murty, 1981). At Mumbai the estimated \(L_\infty\) was 274 mm, \(K\) as 0.76289 year\(^{-1}\) and \(t_0\) -0.011764 year (Chakraborty, 2002). At Chennai the estimated \(L_\infty\) was 207 mm, \(K\) = 1.080 and \(t_0\) =0.1927 (Vivekanandan, 1991). Using the ELEFAN programme Murty et al. (1992 a) estimated \(L_\infty\), and \(K\) of 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

\[ L_t = 274.5 \left(1 - e^{-0.85(t - (0.01))}\right) \]

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

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

<table>
<thead>
<tr>
<th>Year</th>
<th>(Z)</th>
<th>(F)</th>
<th>(M)</th>
<th>(E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>2.71</td>
<td>1.45</td>
<td>1.26</td>
<td>0.54</td>
</tr>
<tr>
<td>1999</td>
<td>2.58</td>
<td>1.32</td>
<td>1.26</td>
<td>0.51</td>
</tr>
<tr>
<td>2000</td>
<td>3.50</td>
<td>2.24</td>
<td>1.26</td>
<td>0.64</td>
</tr>
<tr>
<td>2001</td>
<td>3.97</td>
<td>2.71</td>
<td>1.26</td>
<td>0.68</td>
</tr>
<tr>
<td>2002</td>
<td>2.82</td>
<td>1.56</td>
<td>1.26</td>
<td>0.55</td>
</tr>
<tr>
<td>Mean</td>
<td>3.12</td>
<td>1.85</td>
<td>1.26</td>
<td>0.58</td>
</tr>
</tbody>
</table>
The \( W_\infty \) was estimated as 262.6g from length-weight relationship and the \( t_c \) as 0.2 taking 40cm as the smallest length at recruitment and \( t_c=0.582 \) from \( L_c=125\text{mm} \). These values were used as input for yield/recruit analysis.

Yield assessment with reference to \( t_c \)

The yield per recruitment against different values of \( F \) keeping the values of \( t_c \) and \( M \) as constant shows that \( Y_{w/R} \) increases with \( F \) reaching the maximum of 20.3g for the corresponding \( B/R \) of 8.46g (Fig. 5). The optimum \( Y_{w/R} \) 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 688t 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 of 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 \( N. \) mesoprion over the years.

Yield assessment with reference to \( t_c \)

The \( Y_{w/R} \) 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
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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References


