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Dynamics of the threadfin bream, *Nemipterus japonicus* exploited off Karnataka

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ABSTRACT

The growth parameters of *Nemipterus japonicus* exploited from the Arabian Sea off Karnataka are estimated as L_M = 33.0 cm and K=1.0 yr^1. The approach using data after correction for selection gives better estimates when compared with the estimates from uncorrected data. The M estimated was 1.87 and the mean Z value 5.65 with the exploitation rate of 0.68. The virtual population analysis reveals that the maximum fishing mortality occurs at 25.5 cm. The Thompson and Bell analysis shows that the present yield of 3,416 t can be increased to the MSY level of 3, 5011 by increasing the effort by 10 % whereas the MSE would be at 80 % of the present fishing effort.

Introduction

Threadfin breams are important marine demersal fishes of India exploited mainly from 40-100 m depth. During 1995, the estimated quantity of threadfin breams caught in India was 69,549 tonnes (t) accounting for 3.1 % of the marine fish production. Karnataka ranks fifth among the Indian maritime states for the production of threadfin breams with an estimated catch of 5,668 t during 1995. Threadfin breams are exploited exclusively by multi-day-fleet trawlers (MDS) and contribute to 7-9 % of the trawl catch from Karnataka. *Nemipterus japonicus* is the dominant species among threadfin breams and forms on an average 77 % of the catch of this group. The annual catch of *N. japonicus* during 1988-'95 ranged between 4,677 t (1988) and 1,389 t (1990) with an annual average of 2,768 t.

Although several studies have been made on the stock estimates of threadfin breams from India (Murty, 1983,1984, 1987; Vivekanandan and James, 1986; Devaraj and Gulati, 1988; John, 1989) the study from Karnataka is limited to that of Murty *et al.* (1994) which formed part of a study carried out on an all India basis. The present paper deals with the estimation of growth parameters, mortality rates and stock assessment of *N. japonicus* off Karnataka coast.

Material and methods

The data from MDF trawlers operating off Karnataka during 1988-'95 were used in the present study. Length data of *Nemipterus japonicus* was collected from Mangalore and Malpe fishing ports for eight days every month. On each observation day, length (from tip of snout to tip of lower caudal lobe) and weight measurements (nearest g) of at least 50 specimens were recorded. These data were grouped into 1 cm class intervals. The length frequencies were suitably weighted to get monthly estimates. The species composition and length composition data of the observation centres were weighted to get estimates for Karnataka.

For estimating growth parameters, the pooled length-frequency data concerning to 1993, 1994 and 1995 were analysed following the FiSAT package (Gayanilo *et al.,* 1996). The procedures given in Isa (1988) and Sparre and Venema (1992) were followed. An initial estimate of L_m was made using the Powell-Wether all plot. The data were subjected to Bhattacharya analysis to separate the modes and growth parameters and were estimated by the modal progression analysis (MPA) using the Gulland and Holt plot and ELEFAN I methods. Further, the data were corrected for gear selection using the probabilities of capture and the corrected growth parameters were again estimated.

The annual total mortality rate (Z) was estimated using the length-converted catch curve method (Pauly, 1983) and and natural mortality rate (M) by Pauly's empirical equation (Pauly, 1980) taking 29.5°C as the mean sea water temperature off Karnataka.

The length-based Virtual Population Analysis (Jones, 1984) was carried out for different years (1988-'95) using the annual length-frequency data taking the annual F as the terminal F and length-weight relationship of the species was used to estimate the yield and biomass. The Thompson and Bell analysis (Thompson and Bell, 1934) in the FiSAT package was run to find the effect of change in fishing effort on the yield and value using the pooled data for the years 1993, 1994 and 1995 and the length-wise market price of *N. japonicus.*

Results and discussion

Fishery

Threadfin breams are exploited exclusively by MDF trawlers and contribute to 7-9 % of the trawl catch from Karnataka and are caught during September-May with the peak catch occurring from December to March. The major fishing ports in the state are Mangalore, Malpe, Honnavar, Tadri and Karwar (Fig. 1) with the former two alone accounting for 40 % of the state's annual threadfin bream catch.

The catch of *N. japonicus* from Karnataka fluctuated between 4,677 t and 1,3891 during the study period with an average of 2,768 t (Fig. 2). The highest catch was observed during 1988 (4,677 t) and the lowest during 1990 (1,389 t). In 1994, the catch increased remarkably but again fell by 1,000 t in the following year. The fishing effort almost remained steady from 1988 to

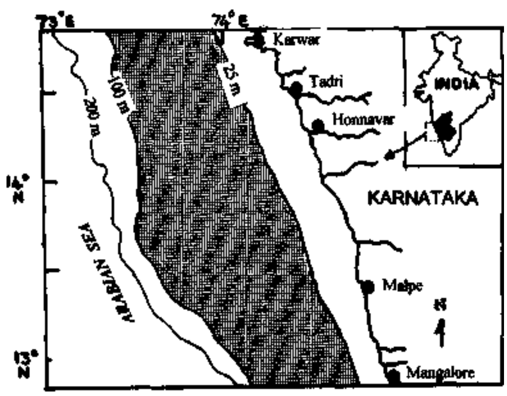

Fig. 1. Map of Karnataka coast showing the major trawl landing centres and the fishing grounds of MDF trawlers.

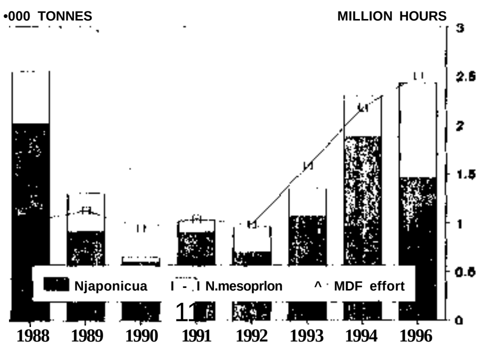

Fig. 2. Estimated effort (trawling hours) of MDF trawlers during 1988-'95 and the catch of threadfin breams from Karnataka.

1992 but showed sudden spurt in 1993 and reached 2.5 million hours in 1995. The average annual fishing effort during the period was 1.42 million hours. Threadfin bream catch of Karnataka state has shown a declining trend since the beginning of the study but the improvement in 1994 is mainly due to the increased effort by MDF during September-October. A recent study (Zacharia *et al.,* 1996) revealed a rapid increase in fleet strength of MDF and a corresponding increase in fishing effort owing to the increased profits of MDF operations. MDF operation during September-October is generally for catching cuttlefishes but good quantity of theradfin breams, mainly *Nemipterus mesoprion,* is also obtained (Fig. 2).

Growth and mortality parameters

The L_M estimated from Powell-Wetherall method was 29.4 cm and the Z/K was 3.31. Using the ELEFAN method without correction the parameter values obtained were L_m = 33.5 cm and K=0.90 yr^1. When the data were corrected for gear selection using the L-50 (14.8 cm) and L-75 (16.6 cm) values, the VBGF parameters estimated were L_M = 33 cm and K=1.0 yr^1. As the latter values showed better goodness of fit and are also close to those obtained after the modes were separated by Bhattacharya method and modal progression analysis, these were selected as final growth parameter estimates for *N. japonicus.* The restructured data with the fitted growth curves are shown in Fig. 3.

In this study the L_M value obtained from the corrected data is slightly smaller and the K value slightly higher than those obtained with uncorrected data. The growth parameters obtained after correction for selection probably give better estimates (Isa, 1988). The parameters of growth estimated by

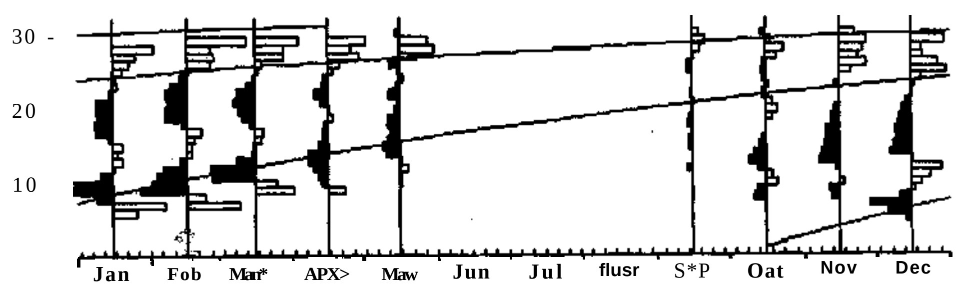

Fig. 3. Restructured length-frequency data of *N. japonicus* fitted (1993-'95 pooled) with growth curves (no data during June-August due to suspension of fishing in monsoon period).

earlier workers from India and other parts of the world using different methods show that the value of L_M ranged from 23.5 to 38.2 cm and K from 0.12 to 1.004 (Murty *et al.,* 1994). The values obtained in the present study fall in this range. Also, the ϕ' index calculated with the estimates ranged from 2.51 to 2.97 and the present estimate of 3.04 is very close to this. The M/K value of 1.78 in the present study in well within ranges known in fishes.

The natural mortality rate (M) estimated using the empirical equation was 1.78. Total mortality rate (Z) was estimated separately for different years; the value ranged between 5.01 (1994) and 6.48 (1991) and the mean value was 5.65 (Table 1). The value of F ranged

TABLE 1. *Year-wise Z, F and E obtained from catch curve analysis (M = 1.78)*

Year	Z	F	E
1988	5.62	3.84	0.70
1989	5.76	3.98	0.67
1990	6.22	4.44	0.67
1991	6.48	4.70	0.70
1992	5.36	3.58	0.63
1993	5.28	3.50	0.66
1994	5.01	3.23	0.65
1995	5.48	3.70	0.71
Mean	5.65	3.78	0.68

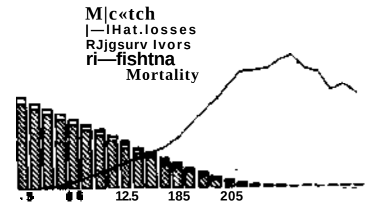

Fig. 4. Output of the length structured VPA using FiSAT for *N. japonicus.*

between 3.23 (1994) and 4.70 (1991) and the mean value was 3.78. The exploitation rate was high throughout the period of study with an average of 0.68.

Virtual population analysis

The values of 'a' and 'b' of length-weight relationship were estimated as 0.038606 and 2.663916 respectively. Results of the VPA for the data pooled for all the years show that the F increases to a maximum of 5.01 at 25.5 cm (Fig. 4). Maximum numbers were caught in the size group 17-18 cm. Yearwise analysis of the population (Table 2) reveals that stock number of *N. japonicus* were very high during the beginning of the study whereas they fell to the lowest during 1990 and abain revived to reach the highest in 1994. The numbers caught and biomass (sur-

TABLE 2. *Results of the VPA analysis showing mean F, E, population number, catch number and mean number for different years*

Year	Stock number (million)	Catcch number (million)	Biomass number (million)	Mean F	Mean E
1988	1,272.73	52.01	53.12	0.98	0.35
1989	860.62	44.97	34.82	1.29	0.42
1990	568.27	18.24	24.45	0.75	0.29
1991	822.91	31.02	34.67	0.89	0.33
1992	690.60	28.01	28.96	0.97	0.35
1993	1,079,50	35.46	46.20	0.77	0.30
1994	1,671.03	49.43	72.17	0.68	0.28
1995	1,304.10	40.96	55.90	0.73	0.29
Mean	1,033.72	37.51	43.78	0.88	0.33

vivors) also showed similar trend and were maximum during 1994. However, the number caught fell in 1995 notwithstanding the high number of survivors during 1994 which may be due to fishery independent factors.

Yield prediction by Thompson and Bell analysis

The results using the data for the years 1993, 1994 and 1995 show that MSY of 3,501 t for Karnataka can be obtained by increasing the fishing effort by 10 % (Fig. 5). The average yield during 1993-'95 was 3,416 t and the MSY level can be reached by increasing the yield by 85 t which is only 2.4 % more than the present catch. However, a recent study by Murty *et al.* (1994) using Thomposn and Bell analysis showed that effort level at MSY (f_{MSY}) corresponds to 80 % of the effect for Karnataka. The MSE of Rs. 58.74 million can be obtained at 0.8 times the present fishing effort which shows that the effort has to be decreased by 20 % of the present to get the maximum sustainable economic yield. Since MSE figures are more relevant for fleet operators, this may be advised when evolving management and conservatory measures for threadfin bream resources of Karnataka.

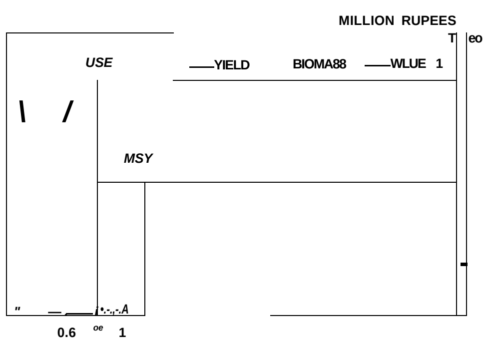

Fig. 5. Results of Thompson and Bell analysis for Karnataka population of *N. japonicus* indicating maiximum sustainable yield (MSY) and maximum sustainable economic yield (MSE).

The study shows that a slight increase in effort will give MSY, but the MSE corresponds to a reduced effort. Any concrete management option cannot emerge from the study of a single species in a multispecies context. The present study, nevertheless, is relevant as it reveals the present status of the threadfin bream fishery along Karnataka and is definitely useful when studies of a multispecies nature are undertaken in future.

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