

Stock assessment of *Scomberomorus commerson* along the Indian coast

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ABSTRACT

Analysis of length frequency data on *Scomberomorus commerson* gave the growth parameters as L_{∞} , 146 cm and K , 0.78. Taking M/K as 1 and 1.5, the MSY values for Kerala were estimated as 5 823 tonnes and 5 030 tonnes respectively. The annual average catch here stood at 4 909 tonnes. Yield per recruit studies revealed the exploitation as beyond the MSY level. A reduction in exploitation rate is necessary to bring the yield back to MSY level.

The estimated total mortality (Z) for Tamil Nadu was 3.09. MSY stood at 4 417 tonnes and 3 624 tonnes for M/K values of 1 and 1.5 respectively. With the average annual yield of 3 488 tonnes during 1984-88, a reduction in the exploitation rate is required here also.

The estimates raised to all-India catch gave an MSY value of 23 284 tonnes and 19 733 tonnes for M/K values of 1 and 1.5 respectively. The average annual all-India catch at 19 171 tonnes showed the *Scomberomorus commerson* fishery slightly beyond MSY. Further increase in exploitation rate can only reduce the catch whereas a decrease will give an increased yield and CPUE.

Seerfish fishery contributes about 2% to the total marine fish landings in India. But, being a valued table fish, it is an important resource for the artisanal fishermen. Motorization of the country craft and its subsequent development (Yohannan and Balasubramanian 1989) had no marked improvement in the catches of seerfishes. An attempt is made here to study the condition of the stock of

Scomberomorus commerson, the most important species of seerfishes in India.

MATERIALS AND METHODS

The catch and effort data of the fishery of *Scomberomorus commerson* and its length frequency distribution during 1984-88, collected from Calicut, Cochin, Tuticorin, Mandapam and Visakhapatnam, formed the basis of this study. The length frequency distribution collected from centres were raised to the total catch of that centre. Such data from Calicut and Cochin was pooled and raised to the catch of Kerala to estimate the total mortality (Z) for that state. Similarly estimates for Tamil Nadu were made using Mandapam and Tuticorin data. Catch data for different states were taken from the Fisheries Resource Assessment Division of the CMFRI.

Growth parameters were estimated using ELEFAN I program (Pauly and David 1981).

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Scomberomorus commerson

Total mortality rates were estimated by length converted catch curve analysis using LFSA package (Sparre 1987). Yield per recruit studies were made using ELEFAN II program (Gayanilo *et al.* 1988). Exploitation rate (E) was estimated as F/Z , where F, fishing mortality and Z, total mortality.

Total annual stock was estimated by the formula Y/U , where Y is the annual average yield of the area and U is estimated by the formula $F/Z (1 - e^{-Z})$. Annual average standing stock was estimated as Y/F .

MSY was estimated by the formula $Y/Y/R_p (Y/R_{max})$, where Y/R_p is the yield per recruit at the present exploitation rate (E) and Y/R_{max} is the yield per recruit at maximum exploitation rate (E_{max}).

Natural mortality (M) was estimated as: $\log_{10} M = -0.0066 - 0.279 \log_{10} L_{\infty} + 0.6543 \log_{10} K + 0.4634 \log_{10} T$, where, T is the annual mean temperature ($^{\circ}C$) of the water in which the stock in question lives (Pauly 1983). In *S. commerson* the M value thus estimated was also multiplied by 0.8 as proposed by Pauly (1983). Another method used for the estimation of M was by multiplying the K value by 1.54.

RESULTS

Fishery

Table 1 gives the catch of seerfishes in India during 1984–88. It shows that *S. commerson* was the dominant species among seerfishes and its catch was almost steady around the annual average of 19 000 tonnes. Table 2 gives the catch figures and the percentage contribution of *S. commerson* from different states. It shows that in southernmost states like Tamil Nadu, Pondicherry, Kerala and Karnataka the bulk of the seerfish catch was constituted by *S. commerson*, whereas in rest of the states other species (mainly *S. guttatus*) dominated. The catch of

Table 1. Total landings (tonnes) of seerfishes in India during 1984–88

Year	<i>Scomberomorus commerson</i>	Other seerfishes	Total seerfishes
1984	18 285	17 808	36 093
1985	16 399	17 383	33 782
1986	22 467	10 057	32 524
1987	18 053	12 617	30 670
1988	20 650	15 730	36 380
Annual average	19 171	14 719	33 890
(%)	(56.57)	(43.43)	(100.00)

Table 2. Annual average catch (tonnes) of *Scomberomorus commerson* and other seerfishes in different states during 1984–88

States	<i>Scomberomorus commerson</i>	Other seerfishes
West Bengal	44.6 (24.89)	134.6 (75.11)
Orissa	448.4 (36.39)	783.8 (63.61)
Andhra Pradesh	2 232.8 (40.72)	3 250.4 (59.28)
Tamil Nadu	3 487.6 (84.51)	639.4 (15.49)
Pondicherry	145.0 (95.52)	6.8 (4.48)
Kerala	4 909.2 (70.47)	2 057.2 (29.53)
Karnataka	2 812.6 (86.06)	455.6 (13.94)
Goa	159.6 (22.85)	538.8 (77.15)
Maharashtra	3 044.4 (46.01)	3 572.8 (53.99)
Gujarat	1 886.6 (36.52)	3 279.6 (63.48)
Total	19 171.0 (56.57)	14 719.0 (43.43)

Figures in parentheses indicate percentages.

S. commerson from different states and percentage contribution of each state to the total catch of the species in the country during 1984–88 are shown in Fig. 1. Kerala topped the list with a contribution of 25.61 per cent.

Fig. 2 gives the monthly average catch (percentage) in Kerala, Tamil Nadu and Andhra. In Kerala the season started by July–August and lasted till November–December with peak catches in October. In Tamil Nadu, peaks were in September and June whereas in Andhra Pradesh peak catches were made in July and April.

Details of the gears used in the fishery

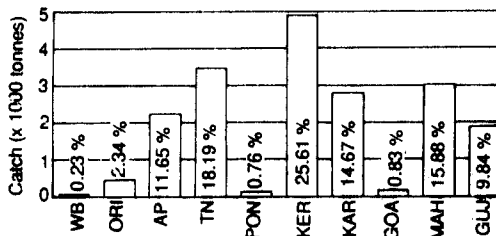


Fig. 1. Average annual catch of *Scomberomorus commerson* from different states and their percentage contribution to the all-India catch of the species during 1984-88.

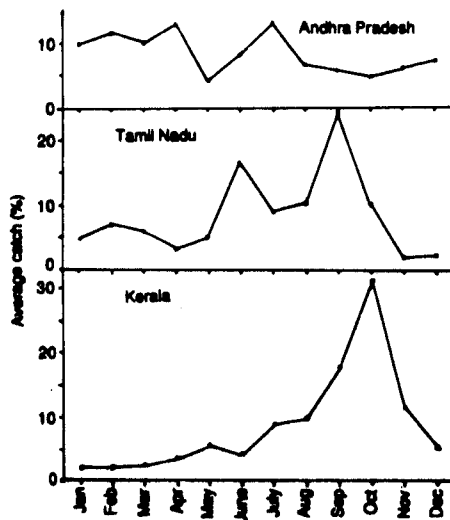


Fig. 2. Average monthly catch (%) of *Scomberomorus commerson* from Kerala, Tamil Nadu and Andhra Pradesh during 1984-88.

have been given by Yohannan and Balasubramanian (1989) and Kasim and Hamsa (1989). The major gear used in the fishery is drift gill net. The nets are made effective to catch all commercial size groups with varying mesh sizes from 7-17 cm in the same net. In these nets the fishes are caught by gilling as well as entangling. In Tamil Nadu, apart from these nets, troll lines, hooks and line, shore seines, trawl nets and gill nets with much smaller meshes are also used in the fishery.

Size composition: In Kerala, where drift gill nets land the bulk of the catch, the length of *S. commerson* ranged from 30-130 cm, with size groups 50-89 cm dominating the catch (Fig. 3). The modal value was at 60 cm for the whole period. In Tamil Nadu, where along with drift gill nets other gears like shore seines, trawlers and small meshed gill nets also land the species, the length ranged from 10-139 cm, but the major catch was from smaller size groups of 25-59 cm, with a modal value at 45 cm.

Stock assessment

Population parameters: Thiagarajan (1989) has given the following relation between fork length (cm) and weight (g) of *S. commerson*:

$$W = 0.0138 L^{2.8296}$$

The monthly size distribution in 10 cm groupings from different centres was subjected to analysis using ELEFAN I to get values of length at infinity L_{∞} and growth coefficient K. The best fitting growth curves for data sets from different centres had L_{∞} values ranging

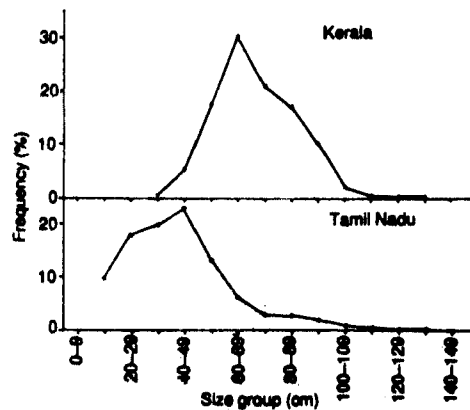


Fig. 3. Average percentage of different size groups of *Scomberomorus commerson* in Kerala and Tamil Nadu during 1984-88.

from 130–150 cm and K values ranging from 0.7–0.8. The mean values were at 146 cm for L_{∞} and 0.78 for K. These values were used for further analysis.

The size at which maximum frequencies were observed and from where the frequencies decreased regularly was taken as the length at first capture, L_c . In Kerala, L_c was found to be at 60 cm whereas in Tamil Nadu it was at 45 cm (all in fork length).

Length frequency data from Kerala and Tamil Nadu were subjected to length converted catch curve analysis for estimation of Z. The value of Z was 4.08 for Kerala and 3.09 for Tamil Nadu.

Natural mortality (M) estimated as per Pauly (1983), with average temperature as 29° C, was 0.99. Being a pelagic fish growing very fast to a large size, this may, perhaps, be an overestimation. Hence, as recommended by Pauly (1983), the value was multiplied by 0.8 to get a revised M as 0.79. Another method of multiplying the K value by 1.54 yielded the M as 1.2. The corresponding M/K values were 1.3, 1 and 1.5. Hence, the stock estimates were made using the minimum (1) and maximum (1.5) values of M/K.

Yield per recruit: Yield per recruit (Y/R) was studied using the following population parameters:

$W_{\infty} = 18370.96$ g; K = 0.78 (annual); M/K = 1 and 1.5; $L_c/L_{\infty} = 0.4$ (for Kerala); $L_c/L_{\infty} = 0.3$ (for Tamil Nadu)

The results for Kerala are given in Fig. 4. Taking M/K as 1 the estimated MSY was 5 823 tonnes at an exploitation rate (E) value of 0.58 (Table 3). The E value of 0.81 during 1984–88 indicated that the fishing was already beyond MSY level. The exploitation rate should be reduced to reach back the MSY level. The situation was almost the same when M/K was taken as 1.5. But the difference between the present E (0.71) and E_{max} (0.60)

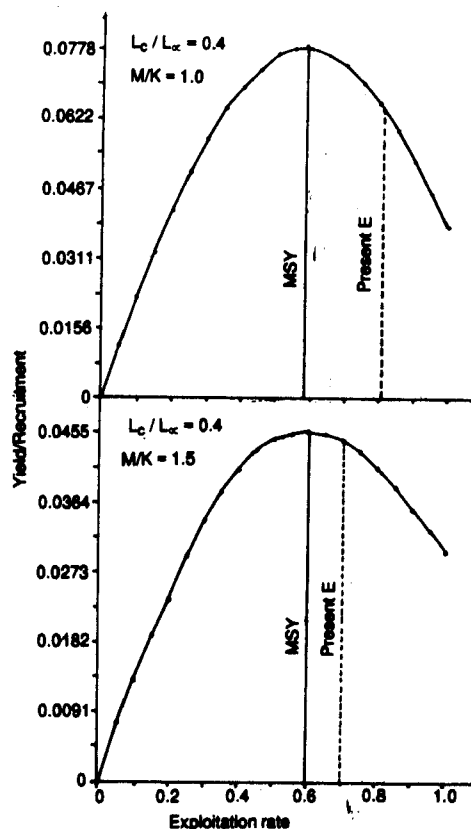


Fig. 4. Yield per recruit in Kerala during 1984-88 for M/K values of 1 and 1.5.

reduced with a reduced MSY of 5 030 tonnes.

Similar situation prevailed in Tamil Nadu with E standing beyond the E_{max} and the difference reducing with increased M/K (Table 3 and Fig. 5).

Stock estimates of east coast, west coast and all-India for M/K values of 1.0 and 1.5 are given in Table 4. Total MSY for all-India comes to 19 733 tonnes. Taking M/K value of 1.5 as more appropriate, with the annual average catch of 19 171 tonnes of *S. commerson* from all India (1984-88), the fishery is only

562 tonnes short of MSY. A reduction in exploitation rate by about 16% will bring the fishery back to MSY level while saving a lot of expenditure on effort.

A study was made to know the optimum L_c to get maximum yield when M/K is 1.5. The Y_{max} for different values of L_c were plotted as given in Fig. 6. Optimum L_c for Kerala was 87.6 cm and for Tamil Nadu 80.3 cm, whereas during the period of study the L_c was at 60 cm for Kerala and 45 cm for Tamil Nadu.

Stock estimates: Average annual catch of *S. commerson* in Kerala for the period was 4 909 tonnes. When M/K was taken as 1, the annual fishing mortality (F) was 3.30 and the exploitation ratio (U) was 0.8. These values gave annual stock and average standing stock estimates for the area as 6 136 tonnes and 1 488 tonnes respectively. When M/K was taken as 1.5 the estimates increased a little to 7 013 tonnes and 1 687 tonnes due to a lower value of F as 2.91 and U as 0.70 (Table 3).

As Kerala lands the maximum quantity (38.32%) of this species along the west coast, the situation here was taken as representing the situation along the west coast and these estimates were raised to the annual average

Table 3. Stock estimates of *Scomberomorus commerson* for Kerala and Tamil Nadu ($L_\infty = 146$ cm, $K = 0.78$)

Estimates for	Kerala		Tamil Nadu	
	1.00	1.50	1.00	1.50
$Z = 4.08, L_c = 60$ cm $Z = 3.09, L_c = 45$ cm				
Annual average catch	4 909 tonnes		3 488 tonnes	
F	3.30	2.91	2.31	1.92
U	0.80	0.70	0.72	0.59
Total annual stock (tonnes)	6 136	7 013	4 844	5 912
Average standing stock (tonnes)	1 488	1 687	1 510	1 817
Present E	0.81	0.71	0.75	0.62
E_{max}	0.58	0.60	0.52	0.52
MSY (tonnes)	5 823	5 030	4 417	3 624

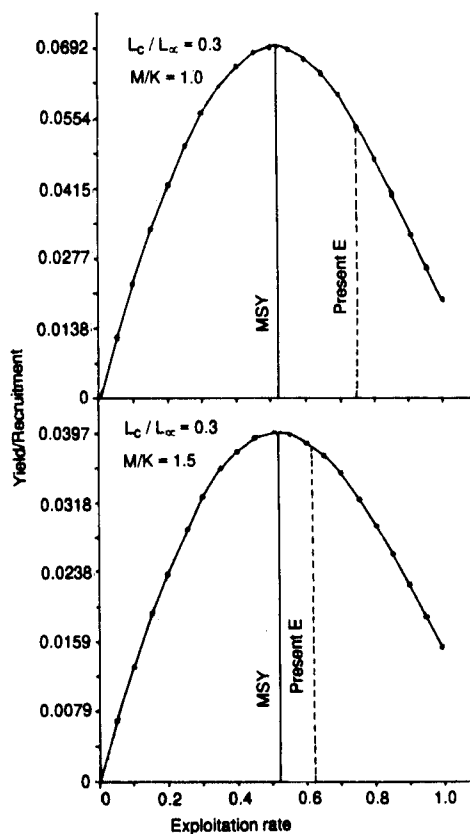


Fig. 5. Yield per recruit in Tamil Nadu during 1984-88 for M/K values of 1 and 1.5.

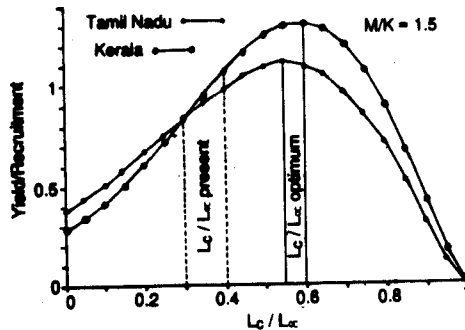
catch of 12 812 tonnes from the west coast to get rough estimates of total stock and average standing stock as given in Table 4.

In Tamil Nadu annual average catch for the period was 3 488 tonnes. With an M/K value of 1, the F was 2.31 and U as 0.72. Total annual stock and average standing stock estimates were 4 844 tonnes and 1 510 tonnes respectively. The estimates increased to 5 912 tonnes and 1 817 tonnes respectively when M/K was taken as 1.5.

Tamil Nadu lands 54.85% of the east coast catch of the species. Hence, these estimates were considered as representing the

Table 4. Stock estimates of *Scomberomorus commerson* for west coast, east coast and all-India

Estimates (tonnes) for	West coast		East coast		All-India	
	1.00	1.50	1.00	1.50	1.00	1.50
M/K						
Average annual catch	12 812	12 812	6 358	6 358	19 171	19 171
Total annual stock	16 014	18 303	8 830	10 776	24 844	29 079
Average standing stock	3 883	4 403	2 752	3 312	6 635	7 715
MSY	15 197	13 127	8 051	6 606	23 248	19 733

Fig. 6. Yield per recruit (Y/R) in Kerala and Tamil Nadu for different values of L_c/L_∞ for M/K value of 1.5.

east coast and were raised to the annual average catch of 6 358 tonnes to get rough estimates for east coast as given in Table 4.

Summing the west coast and east coast figures the estimate of total annual stock of *S. commerson* in all-India ranged from 24 844 tonnes to 29 079 tonnes and annual average standing stock from 6 635 to 7 715 tonnes for M/K values of 1 to 1.5.

DISCUSSION

S. commerson is a migratory species. Fig. 3 indicates its abundance along the east coast in younger stages. Young ones are caught more abundantly in Tamil Nadu where the length at capture is only 45 cm. Peak landings are in June and September. Along the Kerala coast they are abundant in October where the length at capture is 60 cm. Perhaps, they move to west coast from east coast during this

period. Fig. 6 indicates that the best size at capture in Tamil Nadu is 80.3 cm, which may not be practical considering the migratory nature of the fish. Still, exploitation of the young ones along this coast using trawl nets, shore seines and small meshed gill nets should be discouraged for better yields. This may, perhaps, will improve the catch along the west coast also. Avoiding the capture of these young ones may even take care of the 16% reduction in the exploitation rate indicated in the yield per recruit studies.

The K value estimated here is very high when compared to those given by Devaraj (1981), Kasim and Hamsa (1989) and Thiagarajan (1989). However, Devaraj (1981) has given the growth lines of *S. commerson* in his Fig. 2 where he has given a peculiar bend below 40 cm in the lines of extrapolation to length 0. His 1966 broods can be 1967 broods if the values of modes of these broods are extrapolated as a VBG curve resulting in a K value similar to the present study.

Kasim and Hamsa (1989) studied the population dynamics of *S. commerson* based on the data collected from Tuticorin. They found the fishing to be at higher level than the optimum. The present study also confirms their observation, though the population parameters given by them are not comparable with the present estimates as their L_∞ was higher and K lower.

Devaraj (1983) observed the length at first maturity of *S. commerson* as 75 cm. Presently

these are heavily fished before this size. In Tamil Nadu 91% of the catch in numbers is below this size, though in Kerala it is only 64%. Exploitation at the present high rates before the age at first maturity can affect the spawning stock and recruitment. Fishing of this species by shore seines, trawl nets and small meshed gill nets as well as the drift nets with mesh sizes below 12 cm should be discouraged.

Collection of more extensive data on the fishery and biology of the species is warranted to improve our knowledge on the condition of the stocks of this species in Indian waters.

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