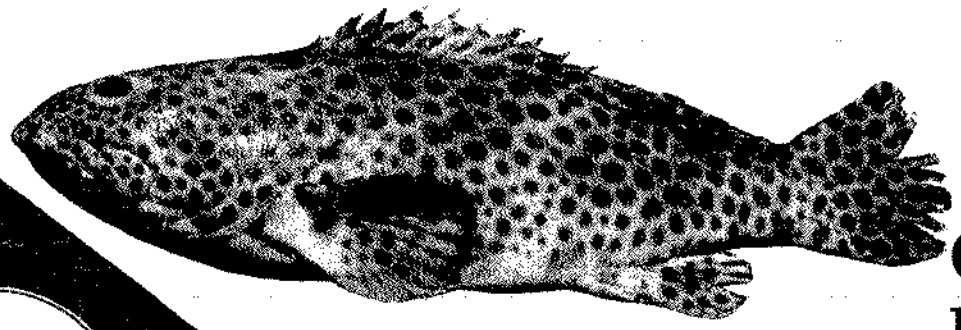

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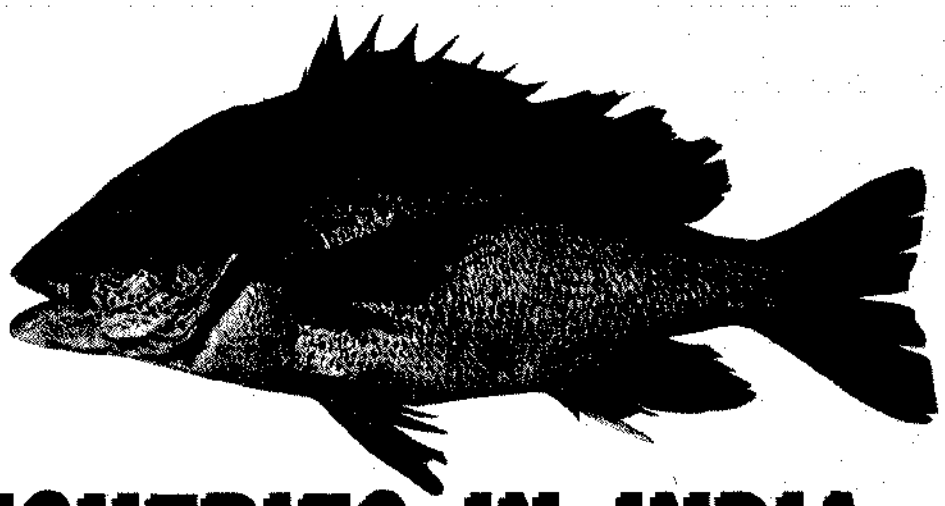

PERCH FISHERIES IN INDIA

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
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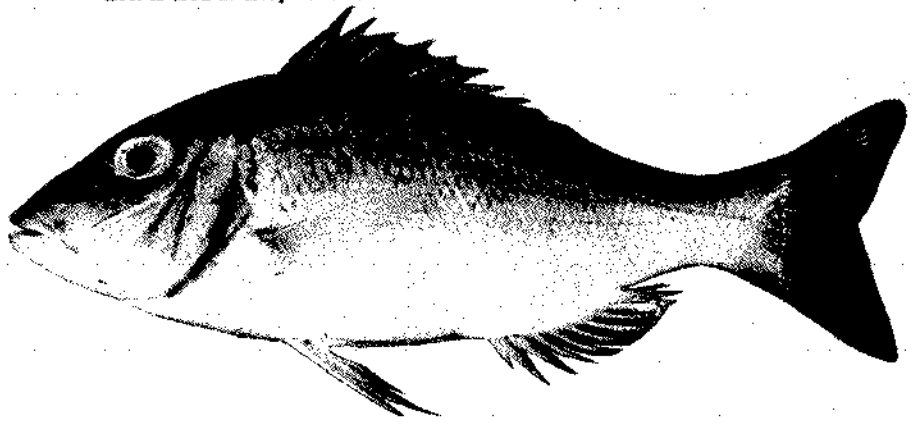

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EXPLOITATION OF PERCH FISHERY RESOURCE OFF TUTICORIN BY SMALL MECHANISED TRAWLERS WITH AN ACCOUNT ON THE BIOLOGY OF *SCOLOPSIS BIMACULATUS* RÜPPELL

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ABSTRACT

Annual average perch production was 2541.2 tonnes at the catch rate of 88.8 kg/unit by average effort of 28612 units of small mechanised trawlers measuring 14 m and below. Peak periods of perch fishery were during June-September and a minor peak during December-February. Inspite of the comparative decline in the catch rate of perch, there is a scope for further increase in perch production provided the effort is increased. The age and growth of *Scolopsis bimaculatus* is described by the von Bertalanffy growth equation *i.e.* $1_t = 322\ (1\text{-}e^{-1.4146\ (t+0.0018)})$. This species attains a size of 163.6, 243.9, 283.5 and 303.0 mm in 0.5, 1.0, 1.5 and 2.0 years. Length - weight relationship of this species is defined by the equation Log W = -5.6848 + 3.3699 Log L and the W_∞ is 584 g. The natural mortality coefficient (M) is estimated to be 2.2, the total mortality coefficient (Z) is 3.2 and the fishing mortality rate (F) is 1.0. Yield per recruit of this species indicates that for the prevailing M/K ratio 1.56 and age at first capture 0.4353 the F_{max} which can produce the Y_{max} of 52.3 g is 4.5 and suggests that the fishing effort may be increased further from the present level to enhance the yield of this species as in the case of *L. nebulosus* and *N. delagoae*. The fish is a carnivore feeding on fishes, amphipods, *Squilla* spp., brittle stars, prawns, cuttlefish, polychaetes and molluscs.

INTRODUCTION

Systematic and planned intensive surveys carried out in areas beyond the traditional coastal fishing grounds have indicated the existence of a few potential fishery resources. Among them perches and perch-like fishes have gained enviable importance in view of the dominant emergence of a few species specially belonging to the genera *Priacanthus, Psenes, Centrolophus*, etc. This has lead to an increase in perch production from 59215.6 t during 1982-85 (Kasim *et al.*, 1989) to 89,031.8 t during 1985-89. Perches are exploited by different types of gears operated by both mechansied and non-machanised crafts in which the mechanised commercial trawlers alone lands 42% of perch catch.

In view of the intensive and extensive exploitation by mechanised trawlers along both east and west coasts of India, it was felt essential to monitor the trawl net operations from selected centres along east and west coast by the Central Marine Fisheries Research Institute. Accordingly, observations of small mechanised trawlers below 14 m size was carried out at Tuticorin, an age old fishing port situated in the Gulf of Manner in southeast coast of India from 1985 onwards. Exploitation of perches off Tuticorin is presented here with a special account on the biology of *Scolopsis bimaculatus* since information on the biology of this species is very rare from Indian waters.

OBSERVATIONS

Data on the effort of mechanised trawler, qualitative and quantitative catch composition of different fishery resorces landed by trawlers, species composition of perches and length frequency of *Scolopsis bimaculatus* were collected by systematically observing the landing at Tuticorin Fishing Harbour once in a week. The data obtained on the sampling days were initially raised to the sampling days and then to the month by the respective raising factors.

FISHERY

Catch statistics : The strength of small mechanised trawlers continued to increase from 150 in 1984-85 to 210 in 1991-92. The catch statistics obtained during 1989-92 are presented in Table 1. The monthwise effort expended by small mechanised trawlers was observed to be uniformly good during 1989-90 and it moderately declined in general in subsequent two years as the total annual effort declined from 31,757 units in 1989-90 to 26,732 units in 1990-91 and it further declined moderately to 24,280 units in 1991-92. On the other hand the perch production increased from 1970.5 t in 1989-90 to 2889.0 t in 1990-91 and then it declined moderately to 2634.4 t in 1991-92. The decline in the annual perch production is not due to the decline in the

TABLE 1. *Estimated fishing effort, catch and CPUE of perches landed by trawl net at Tuticorin fishing harbour during 1989 - 1992*

Months	1989-90			1990-91			1991-92		
	E (Units)	C (t)	C/E (kg)	E (Units)	C (t)	C/E (kg)	E (Units)	C (t)	C/E (kg)
April	2262	95.5	42.2	858	48.6	56.6	1372	126.3	92.1
May	4165	157.7	37.9	2655	157.7	59.4	1822	179.2	98.4
June	3600	94.9	26.4	3515	291.8	83.0	2600	460.9	177.3
July	4347	285.4	65.7	3800	846.4	222.7	3367	541.8	160.9
August	3796	373.5	98.4	4306	641.4	148.9	3133	208.3	66.5
September	2470	239.5	96.9	3500	281.0	80.3	2714	260.2	95.9
October	1040	120.3	115.7	2641	134.8	51.0	2220	161.1	72.6
November	1536	64.7	42.1	-	-	-	-	-	-
December	1980	164.3	82.9	2200	166.6	75.7	2877	205.0	71.3
January	3017	101.6	33.7	1365	146.7	107.5	1595	158.1	99.1
February	2424	167.6	69.1	980	91.1	92.9	1700	189.8	111.6
March	1100	105.5	95.9	912	82.9	90.9	880	143.7	163.2
Total	3175 7	1970.5	62.1	26732	2889.0	108.1	24280	2634.4	108.5
Mean	2646	164.2	62.1	2228	240.8	108.1	2023	219.5	108.5

TABLE 2. *Estimated monthwise average catch, effort and CPUE of perches landed by trawl net at Tuticorin fishing harbour during 1989 - 1992*

Months	Effort (Units)	Perch catch (t)	CPUE (kg)	Other fishes (t)	Total catch (t)
April	1497	90.1	60.18	282.96	373.06
May	2887	164.9	57.12	509.19	674.09
June	3238	282.5	87.25	1305.90	1588.40
July	3838	557.8	145.34	1667.37	2225.17
August	3745	407.8	108.89	735.53	1143.33
September	2895	260.3	89.91	750.97	1011.27
October	1967	138.8	70.56	528.73	667.53
November	1536	64.7	42.12	339.64	404.34
December	2352	178.7	75.98	922.14	1100.84
January	1992	135.5	68.02	753.06	888.56
February	1701	149.5	87.89	537.39	686.89
March	964	110.6	114.73	378.56	489.16
Total	28612	2541.2	88.82	9485.01	12026.21
Mean	2384	211.8	88.84	790.42	1002.22

abundance of perch resource as the annual catch rate continued to increase from 62.1 kg/unit in 1989-90 to 108.1 kg/unit in 1990-91 and then to 108.5 kg/unit in 1991-92, but due to decline in the effort expended during 1991-92 (Table 1).

bimaculatus (15.37%), *Lutjanus* spp. (6.38%), *Diagramma* spp. (5.31%), *Epinephelus* spp. (4.94%), *L. miniatus* (3.19%), *Serranus* spp. (3.08%), *Siganus* spp. (1.43%) and *N. japonicus* (0.82%).

TABLE 3. *Estimated species catch (t) composition of perches landed by trawl net at Tuticorin fishing harbour during 1989 - 1992*

Year	*Lethrinus nebulosus*	*Lethrinus miniatus*	*Lutjanus* spp.	*Epinephelus* spp.	*Serranus* spp.	*Diagramma* spp.	*Siganus* spp.	*Scolopsis bimaculatus*	*Nemipterus delagoae*	*Nemipterus japonicus*	Total catch of perches
1989-90	668.4	107.1	118.6	108.0	41.1	117.7	38.8	256.9	513.9	-	1970.5
1990-91	923.6	79.5	160.6	93.0	64.4	103.2	49.3	456.4	959.1	-	2889.1
1991-92	818.4	52.7	198.7	169.5	125.2	176.7	19.4	438.8	573.6	61.5	2634.5
Total	2410.4	239.3	477.9	370.5	230.7	397.6	107.5	1152.1	2046.6	61.5	7494.1
Mean	803.5	79.8	159.3	123.5	76.9	132.5	35.8	384.03	682.2	61.5	2498.0
%	32.16	3.19	6.38	4.94	3.08	5.31	1.43	15.37	27.31	0.82	-

The monthwise average perch production, effort expenditure and catch rate are given along with other fish catch and total fish catch during 1989-92. On an average 12,026.21 t of fish were landed by 28,612 units of small mechanised trawlers in which the perch constituted 2541.2 t which were landed at the catch rate of 88.82 kg/unit. In all fish catch perch constituted on an average 21.1% during 1989-92. In a month, on an average 211.8 t of perches were landed by 2384 units of small mechanised trawlers at the catch rate of 88.84 kg/unit. Monthwise average perch production indicates that the landings varied from 64.7 t in November to 557.8 t in July. The average monthly catch rate increased from 60.18 kg/unit in April to 145.34 kg unit in July, then declined to 42.12 kg/unit in November and then increased to 114.73 kg/unit in March. Inspite of comparatively higher catch rate in March the catch was only 110.6 t due to poor effort input. In general a peak period of perch production is identified during summer *i.e.* June - September and a secondary peak in winter *i.e.* December - February (Table 2).

Species composition : Annual species composition of perches landed during 1989 - 92 is given in Table 3. A variety of species constituted the perch fishery. Among them the pigface bream *Lethrinus nebulosus* was the dominant species forming 32.11% followed by the threadfin-bream *Nemipterus delagoae* (27.31%), *Scoloposis*

In Addition to the two dominant species *L. nebulosus* and *N. delagoae* studied in detail, *Scolopsis bimuculatus* also constitutes a sizable portion of the perch landings and commands considerable commercial importance among perches. Hence, the age and growth, mortality rates, yield per recruit and stock assessment of this species has been studied and reported here under.

BIOLOGY OF *SCOLOPSIS BIMACULATUS*

Sex, maturity and food : A total of 113 specimens of *Scolopsis bimaculatus* in the size range of 106 - 262 mm in total length were collected from the trawl catches at Tuticorin Fishing Harbour and examined for sex, maturity food and feeding habits.

Out of the 113 specimens examined, 58.09% were females followed by indeterminates (33.)%) and males (9.0%). Fishes with maturity stages I -VI were recorded during the period of study. Ripe females (Stages IV - VI) occurred more during July - September.

Of the 113 stomachs examined, empty stomachs constituted 25.0%, stomachs with little food 35.22%, 1/4 full 18.20%, 3/4 full 10.22%, full 7.94% and 1/2 full 3.42%. A qualitative analysis of the stomach contents of *S. bimaculatus* revealed that fishes (small perches, red-bait

Dipterygonotus leucogrammicus, 49-72 mm), amphipods, *Squilla* spp., brittle stars (Amphiurid ophiuroid), small prawns (*Metapenaeus* spp.), cuttlefish (*Sepia* spp.), polychaetes and molluscs were found to be the food of this species. The volume of the stomach contents varied from 0.05 ml to 6.25 ml.

Age and growth : Length frequency data of *S. bimaculatus* collected from the trawl net landings at Tuticorin indicate the presence of multimodes in each month showing the recruitment of different broods into the fishery. The progression of these modes in subsequent months due to growth of the broods were traced (Fig. 1) by plotting these modes against the respective month in the form of a scatter diagram as per Pauly (1980). These growth curves were transformed into a tabular form and the average size attained by this species in subsequent months was obtained as per George and Banerji (1968). These average sizes were plotted on an arithmatic graph and an empirical growth curve was fitted through these plots (Fig. 2). A new set of average sizes were obtained from this empirical growth curve and used for the estimation of the growth parameters for this species to define the age and growth of this species. Accordingly the asymptotic growth *i.e.* L_∞ of this species is estimated to be 322 mm, growth constant K is 1.4146 year and the age at 0 length t_0 is - 0.0018 year as per Begenal (1955) method. The growth of this species may be defined as per von Bertalanffy growth equation as shown below.

$$l_t = 322\ (1\text{-}e^{-1.4146\ (t\ +\ 0.0018)})$$

The data used for the estimation of above said growth factors and the estimated age and growth of this species are given in Table 4. This species is estimated to grow to a size of 163.6, 243.9, 283.5 and 303.0 mm at the end of 0.5, 1.0, 1.5 and 2.0 years respectively.

Length - weight relationship : Total length in mm and wet weight in g of 113 specimens of both the sexes of this species were examined to study the langth-weight relationship of this species. The length-weight relationship of this species may be described by the following formula.

Log W = -5.6848 + 3.3699 log L (r = 0.9340).

Based on this equation the asymptotic weight *i. e.* W_∞ of this species is estimated to be 584 g.

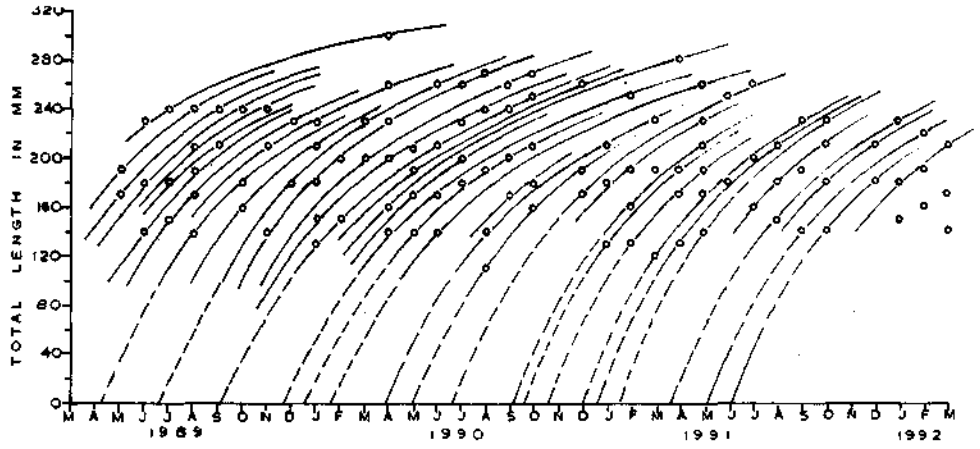

Fig. 1. Modal progression of *S. bimaculatuas* in subsequent month obtained from length frequency data collected from trawl landings at Tuticorin during 1989-'92.

Size and age at first capture : The size at first capture (l_c) of this species during 1989 - 92 has been estimated from the length frequency to be 143.0 mm, 152.6 mm and 15.0 mm respectively in 1989-90, 1990-91 and 1991-92 with an average l_c of 148.5 mm as per the catch curve method of Pauly (1984). Corresponding average age at first capture (t_c) is 0.4353 yr.

Average size : The average size ($\bar{l}$) obtained from the length frequency above the size at first capture are 200.2, 205.9 and 199.8 mm in 1989 - 90, 1990 - 91 and 1991 - 92 respectively.

Size and age at recruitment : The smallest size which suffered mortality by the trawlnet is 110 mm which is taken as the size at recruitment (l_r) into the fishery and the corresponding age at recruitment (t_r) is 0.2937 yr.

TABLE 4. *Average size obtained from the empirical growth curve shown in Fig. 2 used for the estimation of growth parameters and the estimated size at ages based on the growth parameters as per von Bertalanffy growth equation*

Age in months	Average size (mm)	Estimated size (mm)
1	45.0	36.5
2	80.0	68.3
3	109.0	96.5
4	131.0	121.5
5	150.0	143.8
6	166.0	163.6
7	182.0	181.2
8	197.0	196.9
9	210.0	210.8
10	222.0	223.2
11	233.0	234.1
12	242.0	243.9
13	251.0	252.6
14	259.0	260.3
15	266.0	267.2
16	273.0	273.3
17	278.5	278.7
18	284.0	283.5
19	289.0	287.8
20	293.5	291.6
21	297.5	295.0
22	301.0	298.0
23	-	300.6
24	-	303.0
25	-	305.1
26	-	307.0
27	-	308.7

Mortality rates : The natural mortality coefficient (M) is estimated to be 2.2 as per Sekharan (1974) method. The total mortality coefficient (Z) is estimated to be 3.01, 3.08 and 3.47 in 1989-90, 1990-91 and 1991-92 respectively as per Beverton and Holt (1956) method. The fishing mortality coefficient (F) is derived from the relation F = Z - M and the estimates are 0.81, 0.88 and 1.27 during these 3 years respectively. The average total and fishing mortality rates are 3.2 and 1.0 respectively.

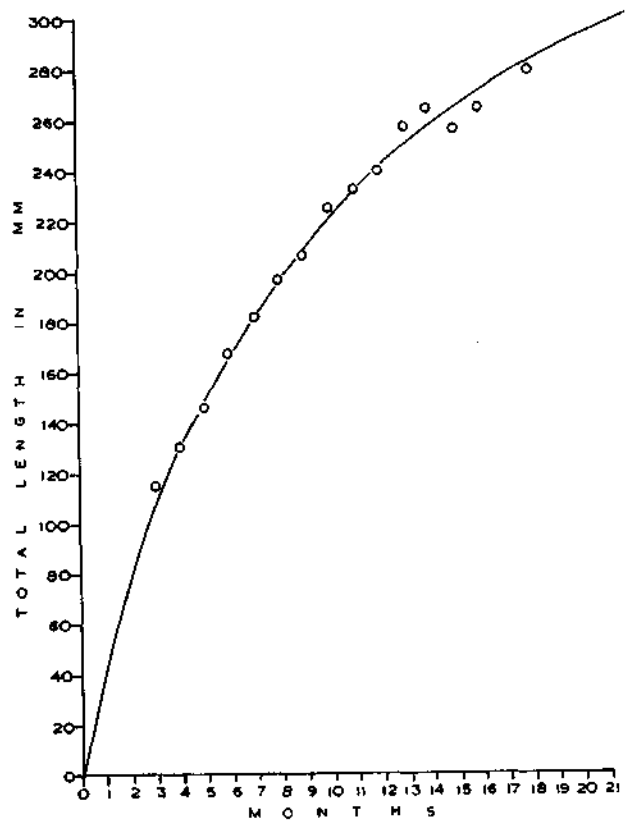

Fig. 2. Empirical growth curve of *S. bimaculatus* estimated from the modal progression analysis as shown in Fig. 1.

Exploitation rate : The exploitation rate (U) is estimated from the relation $K = F/Z (1 - e^{-Z})$ and the estimates are 0.26, 0.27, and 0.36 in 1989 - 90, 1990 - 91 and 1991 - 92 respectively. The average exploitation rate is 0.30.

Yield per recruit : Keeping the age at first capture (t_c) as constant at the prevailing level of 0.4353, the yield per recruit of *S. bimaculatus* has been estimated at different varying fishing mortality rates for 3 M/K ratios and the yield per recruit curves are given in Fig. 3. As seen from these curves the yield increases with an increase in F to attain a maximum and then tends to decline at higher F. The fishing mortality rate which produces the highest yield is known as the F_{max} corresponding yield as Y_{max}. The F_{max} and Y_{max} are 2.5 and 75 g at M/K ratio 1.0, at M/K ratio 1.56 they are 4.5 and 52.3 g

and at M/K ratio 2.0 they are 10.5 and 46.8 g. For the prevailing M/K ratio, present F expended by the trawl net units at Tuticorin is lower by 1.5 than the F_{max} suggesting a scope for further increase in the trawlnet effort input.

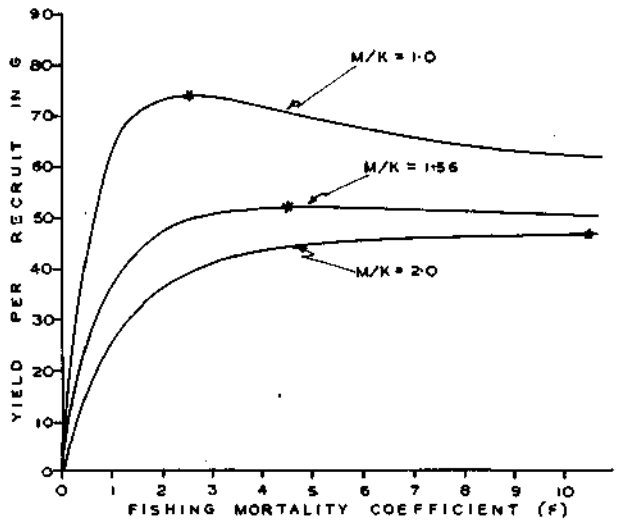

Fig. 3. Yield per recruit in g of *S. bimaculatus* at prevailing age at first capture, three different M/K ratios and at different fishing mortality rates. The asterisk indicates the F_{max} and Y_{max} for the respective M/K ratios.

Stock assessment : The annual standing stock of *S. bimaculatus* is estimated to be 316.7, 518.6 and 345.5 t in 1989 - 90, 1990 - 91 and 1991 - 92 respectively. The annual total stock is estimated to be 988.1, 1690.4 and 1218.9 t during the above said three years respectively. The annual average standing stock of this species off Tuticorin is 393.6 t and the annual average total stock is 1299.1 t.

DISCUSSION

Three fold increase in all India perch production from 1969 to 1982 - 85 has been adequately explained by Kasim *et al.* (1989) and they have suggested a further increase in perch landings which has come true that in subsequent years ending 1986 - 90 all India perch production has increased from 59,215.6 t to 89031.8 t. This has been possible due to continued mechanisation, introduction of efficient gears and modernization of fishing fleet through various development programmes such as Bay of Bengal programme funded by Sweedish International Development Authority and other FAO sponsored programmes for developing countries.

Kasim *et al.* (1989) have reported an increase in annual perch production in Tuticorin from 1369.1 t in 1984-85 to 5588.4 t in 1986-87. However, during 1989-92 the perch landing in Tuticorin is estimated to be on an average 2541.2 t which is less than half of the perch production reported during 1986-87. The decline in the landing is not only due to poor abundance of perch as the annual average catch rate during 1989-92 was lower (88.8 kg/unit) than the catch rate reported in1986-87 (114.9 kg/unit), but also due to apparent reduction in the effort expenditure also as the effort in 1986-87 was nearly 100% higher (48,631 units). Further, the effort obtained in 1986-87 include the effort of pair trawlers also, whereas the present effort reported for the period 1989-92 does not include the pair trawlers effort as the aim of the project was to monitor the commercial small mechanised trawlers measuring 14 m in length and below. Therefore present study indicates that **there is scope for the increase in perch production provided the effort is increased further from present level inspite of the decline in the catch rate.**

The yield per recruit of *S. bimaculatus* also indicated that there is scope for further increase in the effort of trawlnet as the F_{max} which can generate the highest yield of 52.3 g for the prevailing age at first capture 0.4353 yr and M/K ratio 1.56 is 4.5 which is higher than the prevailing F (0.99). Similar observation has been made by Kasim *et al.* (1989) for *L. nebulosus* during 1985-86 as the F was 0.64 which was lower than the F_{max} 0.75 suggesting an increase in the effort of trawl net. Hamsa *et al.* (MS) have also reported a similar observation for the threadfin-bream *N. delagoae* which also suggest an increase in the trawlers effort. All these three studies on the three dominant species of perch resource indicate a further increase in perch production by increasing the effort of trawlnet from present level.

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