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Assessment of mackerel stock along the Indian coast

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ABSTRACT

Study on the stock of mackerel, *Rastrelliger kanagurta*, along the west coast during 1984-88 revealed that its annual average yield was short of only 891 tonnes to the estimated MSY of 50 732 tonnes. The effort has to be increased by another 61% to reach the MSY level. As it may be uneconomical the present level of fishing can be taken to be at its optimum. Similar studies on the east coast, however, showed that the exploitation has surpassed the MSY level but the yield fell short of MSY by 1 609 tonnes. A 39% reduction in effort is needed to maintain the fishery at the MSY level. At the all-India level the fishery was almost at the MSY level with an average annual catch of 73 571 tonnes against the MSY of 73 521 tonnes. Further increase in effort would only reduce the catch. A reduction in effort by 21% can yield almost the same quantity improving economics of the fishery and can save large-scale exploitation of young mackerel found along Andhra coast.

Indian mackerel, *Rastelliger kanagurta*, is an important pelagic resource of our coasts. Its catches, however, show wide fluctuations ranging between 2 and 20% from year to year, causing much concern to the industry. A study on the stock of the resource during 1984–88 was, hence, undertaken.

MATERIALS AND METHODS

Data for 1984–88 on catch and effort of the mackerel fishery collected from Goa, Karwar, Mangalore, Calicut, Cochin, Vizhinjam, Mandapam and Visakhapatnam and length frequency data from non-selective gears, the main and standard one among them being purse seine, raised to the catch of the centre, states and coasts, were used for this study. Statewise total catch data for east and west coasts were taken from FRAD (Fishery Resources Assessment Division). East coast and west coast data were summed up to get the all-India figures. Growth parameters were taken from a study for a long period of 15 years by Noble (1986) and value of natural mortality(M) was estimated by the method of Rikhter and Efanov (1976). Fishing mortality (F) was estimated by length converted cohort analysis method (Jones 1984) using LFSA package (Sparre 1987). MSY was estimated by Thompson and Bell long-term forecast method (Sparre 1985) using the same package. Annual average standing stock was estimated by the formula Y/F.

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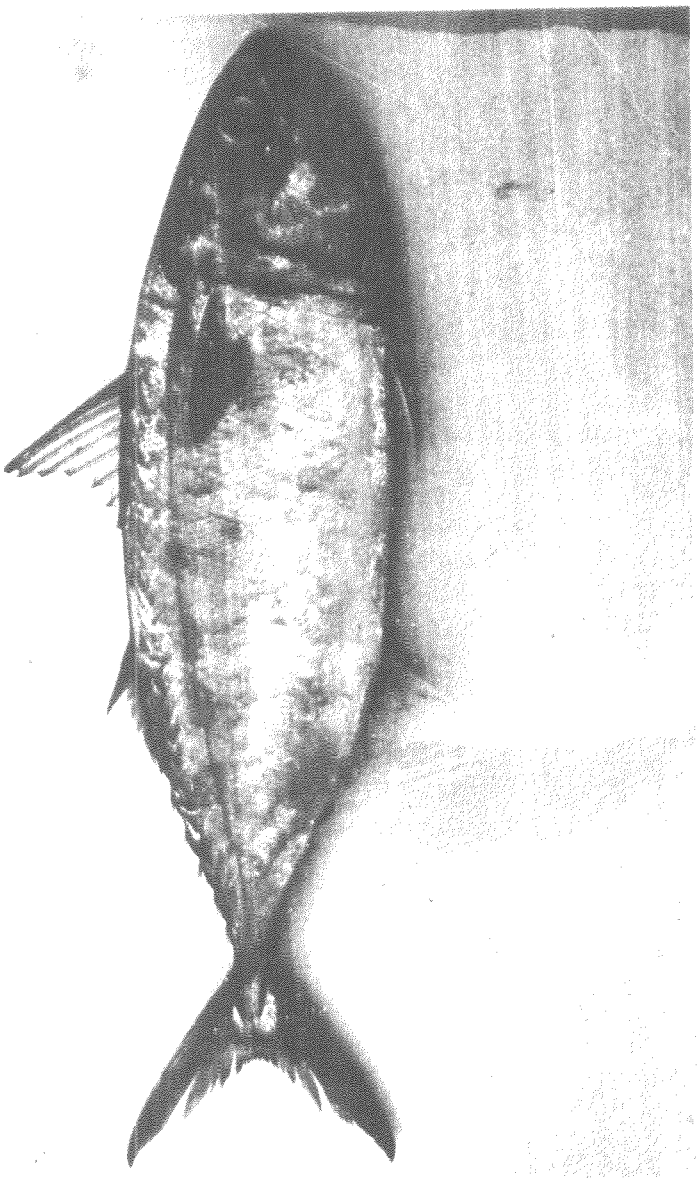
RESULTS

Fishery

Yearwise mackerel catch along the west



Indian mackerel *Rastrelliger kanagurta*.

Table 1. Annual landings of mackerel in east coast, west coast and all-India during 1984-88

Year	Landings (tonnes) in		
	West coast	East coast	All-India
1984	27 804	14 348	42 152
1985	49 679	12 565	62 244
1986	44 839	36 626	81 465
1987	46 507	31 867	78 374
1988	80 375	23 245	103 620
Average	49 840.8	23 730.2	73 571
%	(67.75)	(32.25)	(100.00)

Table 2. Statewise average annual catch of mackerel during 1984–88 and its percentage in total catch

State	Annual catch (tonnes)	Percentage in total mackerel catch
Gujarat	47.0	0.06
Maharashtra	1 740.8	2.37
Goa	5 419.6	7.37
Karnataka	21 488.6	29.21
Kerala	21 144.8	28.74
Tamil Nadu and Pondicherry	10 323.2	14.03
Andhra Pradesh	12 530.2	17.03
Orissa	868.8	1.18
West Bengal	8.0	0.01
Total	73 571.0	100.00

coast, east coast and all-India are given in Table 1. It can be seen that during 1984–88 west coast contributed 67.7% of the total all-India mackerel catch. The remaining 32.3% was contributed by the east coast. Table 2 gives the mackerel catch in different states. Karnataka and Kerala contributed 29.2% and 28.7% respectively to the total catch followed by Andhra Pradesh.

Seasonal variations: Fig. 1 shows the average monthly catch of mackerel from different centres. At Cochin, Calicut and Mangalore, peak catches were obtained in September and at Karwar and Goa in October. At Vizhinjam, peak landings were in April and also in October. At Visakhapatnam and

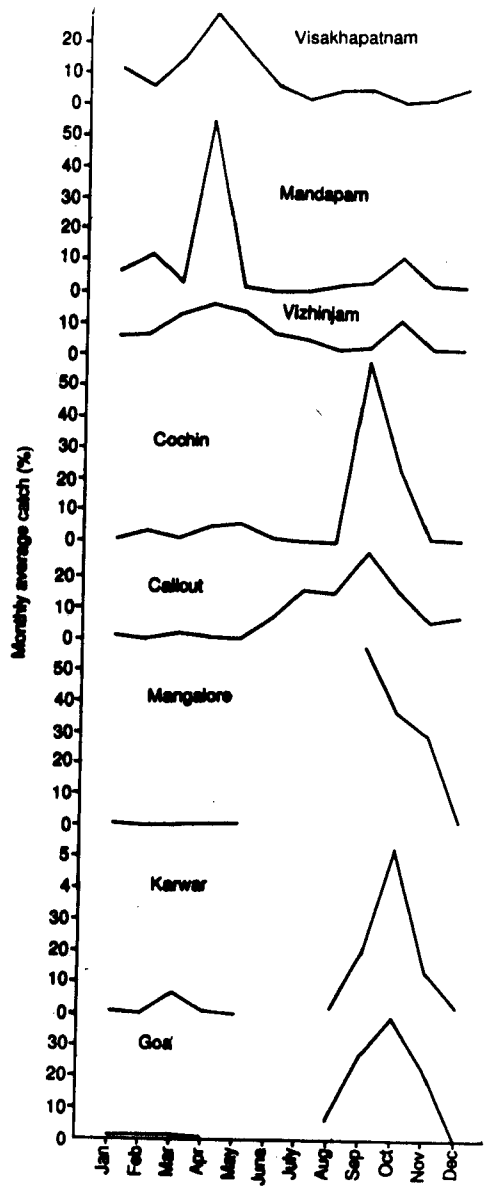


Fig. 1. Monthly catch of mackerel at different centres during 1984-88 (pooled).

Mandapam peak catches were obtained in April. At Mandapam, there was a minor peak in October. Thus, in general, the west coast

received good catches during September–November and the east coast during February–May.

Length composition: Fig. 2 gives the length frequency distribution in the mackerel catches in numbers along the west and east coasts. In the west coast the bulk of the catch was contributed by larger size groups beginning from 160 mm with the peak at 200 mm. But in the east coast the maximum catch was contributed by sizes below 160 mm with the primary peak at 90 mm and secondary peak at 210 mm. But the number of small fish caught along the east coast is so high that it influences the all-India figures (Fig. 2), pushing down the bigger fishes to the secondary position. The large-scale exploitation of non-commercial sizes in the east coast is concentrated in the northern area especially in the month of April. Their fishery was so high in April 1987 at Visakhapatnam that the total number caught was 31 million. Out of this, 30 million were netted in shrimp trawl (Table 3) alone. Likewise in April 1988 also 92% of the small fish caught occurred in shrimp trawl.

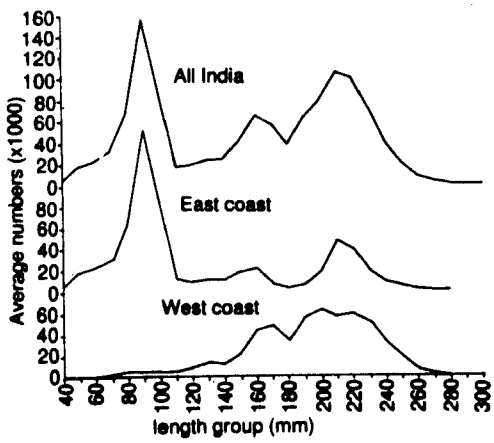


Fig. 2. Length frequency distribution in the mackerel catches along the west coast, east coast and all-India during 1984-88 (pooled).

Table 3. Size distribution of mackerel in shrimp trawl landings at Visakhapatnam in April 1987 and 1988

Length group (mm)	April 1987 (No.)	April 1988 (No.)
40	—	166 956
50	—	666 329
60	107 568	748 305
70	517 889	882 637
80	4 905 782	351 708
90	14 873 575	107 984
100	8 658 752	1 311
110	1 036 743	—
120	144 213	—
130	26 962	—
140	14 552	—
Total	30 286 036	2 925 230
Catch in kg	192 463	8 725
Total caught in Nos by all gears including shrimp trawl	31 077 046	3 152 071

Biology

The growth parameters given by Noble (1986) such as L_∞ (315 mm) and K (0.6) were used in further analysis.

Length-weight relationship was estimated separately using data collected from Goa in the west coast and Visakhapatnam in the east coast. Since they did not show any marked variation, a common equation was obtained:

$$W = 0.000000795\ L^{3.475}$$

Stock assessment

Mortality: Taking age at first maturity as 2 years the M was estimated to be 1 by Rikhter and Efanov (1976) method. The pooled and raised data on length frequency distribution on mackerel from west coast were subjected to length cohort analysis using LFSA package which gave a mean F for the west coast as 1.924. Similar analysis with east coast data gave the F as 2.506. The west coast and the east coast data were pooled and summed to get the all-India figures which when subjected to

length cohort analysis gave a mean value of F as 1.841.

Effort and yield : MSY was estimated separately for west coast, east coast and all-India by Thompson and Bell long-term forecast method using LFSA package. The results are given in Tables 4, 5 and 6. For west coast the MSY estimate was 50 732 tonnes against the average yield of 49 841 tonnes from the area during 1984–88 (Table 4), suggesting an increase in effort by 61% to cover up the shortfall of 891 tonnes to reach MSY level. However, in the present yield 61% of the existing effort fetches around 47 000 tonnes. The mean biomass during the period of study was 62 634 tonnes.

For east coast the average yield was 23 730 tonnes and the estimated MSY was 25 339 tonnes. A reduction in the effort by 39% is necessary to reach this level when the mean biomass will increase from 25 419 tonnes to 34 368 tonnes (Table 5).

The estimates for all-India are given in Table 6. The MSY according to this is 73 521 tonnes and it is almost equal to the annual average catch of 73 571 tonnes during 1984–88.

Table 4. Thompson and Bell long-term forecast analysis of west coast data on mackerel

X	Yield (tonnes)	Mean biomass (tonnes)
0.0	0.0	159 322.98
0.2	29 436.85	113 355.41
0.4	40 888.33	90 821.56
0.6	46 045.66	77 627.25
0.8	48 568.76	68 908.03
1.0	49 840.41	62 634.11
1.2	50 458.03	57 837.40
1.4	50 707.77	54 005.54
1.6	50 738.84	50 843.61
1.8	50 634.52	48 169.89
2.0	50 443.92	45 865.73

MSY = 50 731.96 tonnes, X = 1.6125
Biomass MSY = 50 344.46 tonnes
Present annual average yield = 49 840.8 tonnes
F = 1.924, M = 1.0, L_∞ = 315 mm, K = 0.6
Average annual standing stock = 25 905 tonnes

Table 5. Results of Thompson and Bell long-term forecast analysis of east coast data on mackerel

X	Yield (tonnes)	Mean biomass (tonnes)
0.0	0.0	94 774.43
0.2	20 469.18	59 166.45
0.4	24 821.66	44 162.17
0.6	25 376.45	35 537.46
0.8	24 756.33	29 718.11
1.0	23 730.18	25 419.20
1.2	22 573.00	22 063.39
1.4	21 397.38	19 347.96
1.6	20 253.30	17 095.68
1.8	19 163.44	15 194.01
2.0	18 137.39	13 566.99

MSY = 25 339.01 tonnes, X = 0.6125
Biomass MSY = 34 367.94 tonnes
Present annual average yield = 23 730.2 tonnes
F = 2.5057, M = 1.0, L_∞ = 315 mm, K = 0.6
Average annual standing stock = 9 469 tonnes

Table 6. Results of Thompson and Bell long-term forecast analysis of all-India mackerel data

X	Yield	Mean biomass
0.0	0.0	257 171.09
0.2	48 381.75	175 874.36
0.4	65 086.55	136 873.46
0.6	71 297.75	114 153.00
0.8	73 361.04	99 045.11
1.0	73 570.61	88 045.77
1.2	72 877.47	79 522.74
1.4	71 720.78	72 625.08
1.6	70 321.76	66 866.51
1.8	68 799.75	61 947.59
2.0	67 222.64	57 672.33

MSY = 73 521.15 tonnes, X = 1.0125
Biomass MSY = 86 406.29 tonnes
Present annual average yield = 73571.0 tonnes
F = 1.8414, M = 1.0, L_∞ = 315 mm, K = 0.6
Average annual standing stock = 39984 tonnes

DISCUSSION

Along the west coast the yield as seen above is short of 891 tonnes of MSY (Table 4)

and to exploit this an additional 61% of effort is required. The returns from this 61% increase in effort to reach the MSY being only 891 tonnes, it will slash the overall production rate in the existing fishery. The present state of the fishery along the west coast may, therefore, be taken as at its optimum level.

The situation along the east coast as evident by Table 5 is different. The present yield here has surpassed the MSY level due to the increased level of exploitation. The yield can be maintained at MSY level only by reducing 39% of the present effort.

The exploitation of mackerel is at MSY level. Any further increase in effort can only reduce the catches. On the other hand, with a reduction of the effort by 21% a quantity of 73 000 tonnes can still be caught thus saving expenditure on fuel and labour. In other words, 99.72% of the MSY can be obtained by employing 80% of the efforts (Table 6). Remaining 20% of the efforts is a wasteful expenditure for an insignificant yield.

Another phenomenon noticed in the east coast is the large-scale exploitation of mackerel belonging to the sizes from 40 to 159 mm forming 71% of the total number caught with the peak at 90 mm group (Fig. 2). Nevertheless, they weighed only 3 716 tonnes forming 16% of the total catch. Probably the large-scale exploitation of the undersized uneconomical fishes has caused reduction in the commercial size groups here.

The exploitation of the young ones at such staggering numbers can affect the recruitment of commercial sizes not only along the northeast coast but also in the southeast coast and may be in the west coast. This may hence be avoided.

The young mackerel in such large quantities are not observed anywhere else in the country. Probably the spawning ground for mackerel may be somewhere in northeast area of the Bay of Bengal. Vessel bound programmes are necessary to throw more light on this.

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