J. mar. biol. Ass. India, 1991, 33 (1 & 2) : 107-114

THE FISHERY CHARACTERISTICS AND BIOLOGY OF MACKEREL AT VIZHINJAM *

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ABSTRACT

Annual mackerel landings during 1977-'86 at Vizhinjam averaged 191.5 tonnes. The fishing season for mackerel here extends from October to May with peak in April-May. Drift net yielded 63% of the catch. Another 20% was caught by hooks and line. Mechanisation of traditional craft has increased the catch. The size of fish caught ranged between 50 and 290 mm. Peak spawning was once during April-May and again during September-October. Problems caused by indiscriminate exploitation of spawners during peak breeding periods and young fish in pre-recruitment phase are discussed. Possibilities for augmenting production are suggested. Observations on biology, length-weight relationship and present status of utilization and marketing are also dealt with in this paper.

INTRODUCTION

MACKEREL constituted about 2% of the artisanal fishery at Vizhinjam. Only very little information is available on this fishery from this area. Balakrishnan (1957) reported the occurrence of larvae and young mackerel, Rao (1965) studied the food and maturity condition mackerel taken by drift nets, Bennet (1968) recorded the seasonal abundance of juvenile mackerel and Noble (1979) reviewed the fishery and biological aspects based on data collected during 1978. There has been an increase in the production of mackerel at Vizhinjam from 1983 onwards, mainly due to the exploitation of distant fishing grounds by the motorised indigenous crafts. The trend of fishery based on ten years data alongwith observations on the biology of the species is presented in this account.

The authors wish to express their sincere thanks to Dr. A. Noble for his kind encouragement and guidance, to Dr. P. N. Radhakrishnan Nair for critically going through the manuscript and to Shri K. Ramachandran Nair for the help rendered in the analysis of data.

MATERIAL AND METHODS

The fishery data collected during 1977-'86 from Vizhinjam fish landing centre were analysed for this study. Observations were made twice a week for estimating the catch and effort and a sample of 30 fish on each sampling day was collected and examined for biology. A daily fishing trip was taken as a unit of fishing effort and standard effort was calculated by taking drift net as the standard gear. The biological aspects, other than maturity and spawning, dealt with in this paper are based on the data for 1984-'86. Maturity and spawning studies are based on the data for 1977-'86.

FISHERY

Craft and gear : The main gear for mackerel is draft net and the next important one is hooks

* Presented at the 'Symposium on Tropical Marine Living Resources' held by the Marine Biological Association of India at Cochin from January 12-16, 1988.

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and line. uIt is also caught as a by-catch *Konchu vala*, boat seine, shore seine and *Chala vala*. The gears are operated either from catamaran or dug-out canoe. Details of the craft and gear employed at Vizhinjam and their modes of operation are given by Nayar (1958) and seasonal trend of operation of various gears by Luther *et al.* (1982). By about 1983, traditional crafts fitted with outboard motors became popular in the small-scale fishery at Vizhinjam (Gopakumar *et al.*, 1986). The area of fishing for non-motorised crafts ranges between 5 and 10 kms and that of motorised crafts between 20 and 25 kms.

Annual production : The year-wise catch, standard effort and catch per standard effort is given in Fig. 1. The annual mackerel catch

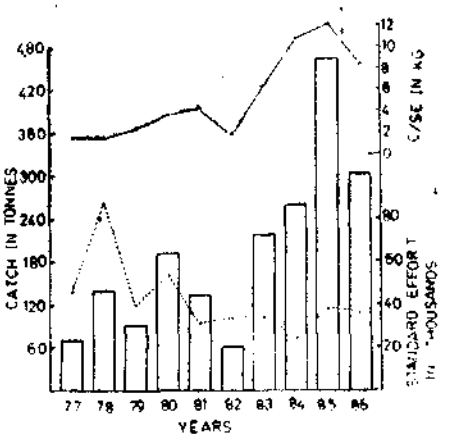

Fig. 1. The year-wise catch, standard effort and catch per standard effort of mackerel during 1977-'86.

at Vizhinjam ranged from 58.7 t in the year 1982 to 462.6 t in the year 1985, with the annual average of 191.5 t. The standard effort varied between 24,047 in 1984 to 87,427 in 1978 and the catch per standard effort ranged between 1.51 kg in 1977 to 12.07 kg in 1985.

Gear-wise production : Drift net operated from non-motorised crafts accounted for the bulk of the catch (33.0 %), followed by that operated from motorised crafts (30.3 %), hooks and line operated from non-motorised crafts (16.0 %), *Konchu vala* (9.6 %), boat seine (5.4 %), hooks and line operated from motorised crafts (4.3 %), shore seine (1.3 %) and *chala vala* (0.3 %). The average monthly trend in the catch per unit effort by various gears is presented in Table 1.

Drift net: The gear was operated from motorised as well as non-motorised crafts. Drift net from non-motorised crafts was operated in all the years. The annual fishing effort ranged from 5,412 in 1986 to 22,214 in 1978 with an average of 15,301. Minimum catch (27.4 t) and catch per unit (1.5 kg) were noted in 1977 and the maximum catch (105.3 t) in 1984 and catch per unit effort (10.9 kg) in 1986. The annual average catch and catch per unit effort were 63.3 kg and 4.1 kg respectively. The gear was operated in all the months except July-August and it was intense during March to May and October-December, when about 38 % and 34 % respectively of the annual effort was expended accounting for 45 % and 33 % respectively of the annual mackerel catch. The monthly CPUE ranged from 4.15 to 6.2 and 2.8 to 6.7 kg respectively during the two seasons. April and December were the best months for the non-mechanised drift net mackerel fishery.

Eventhough drift net operation from motorised crafts was started from 1981, it became regular only from 1984. The effort ranged between 177 units in 1981 to 23,057 units in 1985 with the average of 8,789 units. The total catch varied between 0.1 t in 1981 to 298.9 t in 1985 with the annual average of 95.8 tonnes. The annual CPUE ranged from 0.1 kg in 1981 to 12.9 kg in 1985 with the average of 10.9 kg. It could be seen that the CPUE of drift nets operated from motorised crafts was more than double of that operated from non-motorised crafts (Table 1). Drift net fishing by motorised crafts was also done in all the months

except July-August and it was intense during March to May and October-December when about 32.8 % and 39.6 % respectively of the annual effort was expended accounting for 57 % and 26 % respectively of the annual catch with the monthly CPUE ranging from 16.7 to 20.2 kg and 3.8 to 13.9 kg respectively during the two seasons, March-May was the best season for the mechanised drift net fishery. April-May was the best season for hooks and line mackerel fishery at Vizhinjam which yielded 35 % of the annual mackerel catch with a CPUE of 1.2 kg.

Hooks and line fishing from motorised crafts became regular from 1983 onwards. The effort ranged between 5,195 in 1983 to 35,565 in 1986 with the annual average of 21,138 units. The total catch varied between 5.8 t in 1983 to 30.2 t in 1986 with an average of 20.4 tonnes. The annual CPUE ranged from 1.1 kg in 1983 to 1.9 kg in 1984 with the average of 0.9 kg. An increase in the catch rate of hooks and lines from motorised crafts was observed when compared to that operated from non-motorised crafts (Table 1). Fishing was done all through the year and it was intense during July-December when 69 % of the annual effort was expended. 93 % of the catch was obtained during March-August and November-December with a catch rate of 1.4 kg with the best catch during July and December.

TABLE 1. *Catch per unit effort (kg) of mackerel in different gears (Pooled data from 1977-'86)*

Months	Drift Net		Hooks & Line		Konchu vala	Shore seine	Boat seine
	(Non-mechanised)	(Mechanised)	(Non-mechanised)	(Mechanised)			
Jan. ..	3.98	6.62	0.19	0.09	7.10	13.36	—
Feb. ..	3.04	13.52	0.37	0.76	11.36	0.25	—
Mar. ..	4.36	20.19	0.56	1.71	2.34	0.48	—
Apr. ..	6.23	21.22	1.05	2.50	3.71	0.18	—
May ..	4.15	16.66	1.38	1.77	2.45	0.35	0.23
June ..	2.21	2.72	0.55	1.42	0.37	0.31	0.30
July ..	—	—	0.36	1.84	—	—	0.61
Aug. ..	—	—	0.46	0.87	—	0.81	0.17
Sep. ..	3.41	2.31	0.41	0.14	2.11	—	0.18
Oct. ..	2.85	3.81	0.20	0.09	6.36	4.86	0.39
Nov. ..	3.12	7.81	0.32	0.60	2.40	1.25	—
Dec. ..	6.72	13.90	0.61	1.54	5.57	0.68	—
Annual ..	4.14	10.89	0.52	0.96	2.39	2.40	0.35

Hooks and line : Hooks and line from non-motorised crafts was operated in all the years. The annual effort ranged between 12,099 in 1986 to 84,161 units in 1983 with an average of 59,335 units. The mackerel catch ranged from 9.5 t in 1977 to 86.6 t in 1983 with an annual average of 30.6 t. The annual CPUE varied from 0.2 kg in 1977 to 1.0 kg in 1983 with an annual average of 0.5 kg. The gear from non-motorised crafts was operated throughout the year and it was intense during January-April and August-October when 37 % and 30 % respectively of the annual effort was

Konchu vala : The gear was operated in all the years. The effort ranged from 1,292 units in 1977 to 18,072 in 1978 with the average annual effort of 7,726 units. The catch varied between 1.9 t in 1977 to 59.2 t in 1980 with the average of 18.5 t. The minimum catch rate (0.9 kg) was observed in 1978 and the maximum (4.6 kg) in 1980 with the average of 2.4 kg. The gear was operated during January-June and September-December and it was intense during April-June when 86 % of the annual effort was expended. 68 % of the catch by this gear was obtained during April-May with a catch rate of 2.8 kg.

Boat seine : The gear was operated in all the years. The effort varied from 280 units in 1982 to 51,324 in 1978 with the annual average of 29,533 units. Mackerel formed only a minor component of boat seine fishery and in 1981, 1982 and 1985 there was no mackerel catch in boat seine. During the other years the catch ranged from 0.9 t in 1979 to 56.2 t in 1978 with the annual average of 10.4 t. The minimum catch rate (0.02 kg) was recorded in 1979 and the maximum (1.10 kg) in 1978 with the average of 0.35 kg (Table 1). Eventhough the gear was operated all through the year, the season for this gear was June-October when 95 % of the annual effort was expended. 75 % of the mackerel catch by this gear was landed during June-July with a catch rate of 0.5 kg.

Shore seine : The gear was also operated in all the years. The effort ranged from 388 units in 1985 to 2,448 in 1978 with the annual average of 1,054 units. The catch ranged from 0.1 t in 1982 to an annual catch of 15.1 t in 1985 with the annual average of 2.5 t. The annual catch rate ranged from 0.2 kg in 1982 to 38.8 kg in 1985 with the unusual average of 2.4 kg. The gear was operated throughout the year and the main seasons were January-May and October-December when 90 % of the annual effort was expended. October-December was the season for the fishery which brought 80 % of the catch with a catch rate of 1.8 kg (Table 1).

Chala vala : Mackerel catch from *Chala vala* which was operated mainly for sardines, was not quantitatively significant. Stray catches of young mackerel were recorded during certain years in May, June, November and December in this gear.

Fishery season : The month-wise mackerel catch, standard effort and catch per standard effort based on pooled data for 1977-'86 (Fig. 2)

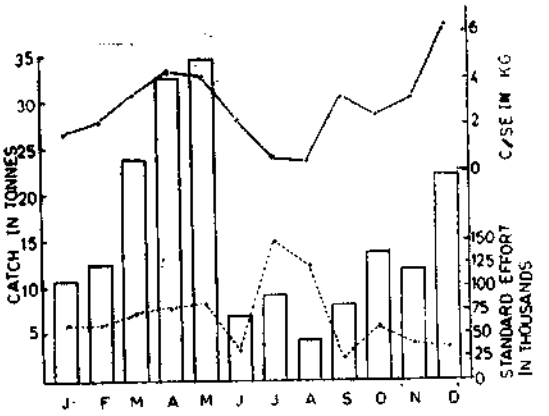

Fig. 2. Month-wise mackerel catch, standard effort and catch per standard effort for the period 1977-'86.

showed that mackerel was landed throughout the year. The average monthly landings ranged between 4.4 t in August and 34.8 t in May with the overall monthly average of 16.0 t. The standard effort varied between 1,49,597 units in July and 25,486 units in September and the catch per standard effort ranged between 0.36 kg in August to 6.35 kg in December. The fishery season extends from October to May with the peak landings in April-May.

Exploitation of spawners and young fish : The month-wise percentage (average) of exploited juveniles and spawners in the total number of fish caught from 1977-'86 is given in Table 2. The non-selective gears *viz.* shore seine and boat seine and the operation of small sized hooks brought considerable quantity of juveniles during certain months. It could be seen from

Table 2 that during May-December indiscriminate exploitation of this group occur at Vizhinjam area with the peak during June-July. In April and May, 60 % and 74 % respectively of the fish caught were spawners. It is of significance to note that the peak landings of mackerel coincide with the major spawning season of the fish in the area.

TABLE 2. *Month-wise average percentage of exploited juveniles and spawners in the total number of fish caught for the period* 1977-'86

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Juveniles ..	—	—	—	—	11.6	48.1	46.0	34.4	11.3	1.0	27.9	11.2
Spawners ..	9.9	21.5	22.2	60.3	73.9	22.6	10.4	7.0	15.9	23.1	5.0	7.4

BIOLOGICAL OBSERVATIONS

Length-weight relationship : Data of 400 fishes were used for determining the length-weight relationship. These included 150 males, 150 females and 100 indeterminates.

The length-weight relationships of males, females and juveniles were as follows :

Males $W = 0.0000051098\ L^{3.1108}$

Females $W = 0.0000026953\ L^{3.2557}$

Juveniles $W = 0.0000003419\ L^{3.6777}$

Analysis of covariance between males, females and juveniles did not indicate significant variation. Hence a common formula for the species was derived as follows :

$W = 0.0000013848\ L^{3.3805}$

The length-weight relationship of the fish is presented in Fig. 3.

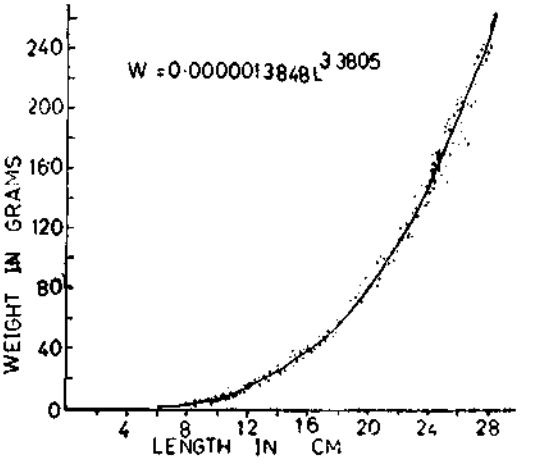

Fig. 3. Length-weight relationship of mackerel.

Size composition : The pooled length frequency distribution of mackerel for the period 1984-86 is given in Fig. 4. It could be seen that mackerel fishery of Vizhinjam was constituted by a wide size range from 50 to 290 mm. Two size groups were predominant in the catch, one in the length range of 110-159 mm (indeterminates) constituting 29.6 % of the total catch (by number) and the other in the

length range of 220-269 mm forming 57.6 %. The recruitment size was around 110 mm.

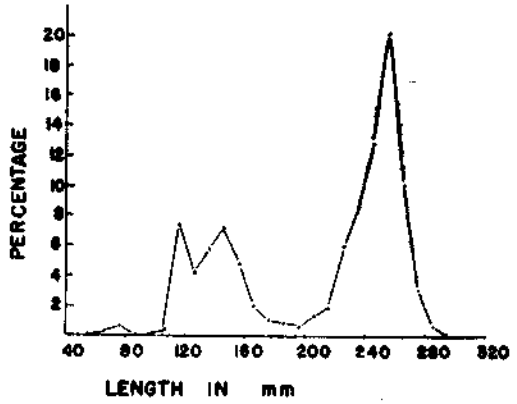

Fig. 4. Size composition of mackerel for the period 1984-'86.

Size at first maturity : To determine the size at first maturity 497 fishes were examined and the percentage of mature and immature specimens at 5 mm interval were calculated. Maturity stages I to III were treated as immature and IV to VII as mature. The smallest specimen met with in stage IV was at 214 mm. The size at first maturity at 50% level was found to be 223 mm (Fig. 5).

Maturity and spawning : Mackerel in advanced stages of maturity occurred almost throughout the year which shows that it has a prolonged spawning season (Table 3). During March-July and September-October the percentage of spawners was high. Spent fishes were generally abundant in February to April and October-December. It is probable that March-April is the primary peak breeding period of mackerel in the area followed by a secondary one in September-October.

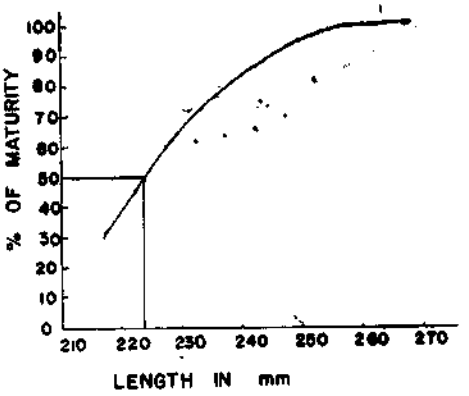

Fig. 5. Size at first maturity of mackerel.

TABLE 3. *Maturity stages of mackerel in different months (Percentages from the pooled data for* 1977-'86)

Months	I	II	III	IV	V	VI	VIIa	VIIb	IIR
Jan. ..	5.1	27.8	35.5	2.0	—	—	—	7.9	21.7
Feb. ..	0.6	20.9	42.6	5.2	1.0	0.1	1.1	14.0	14.5
Mar. ..	2.4	34.9	34.4	6.8	5.3	0.2	3.7	6.2	6.1
Apr. ..	0.1	6.9	29.8	30.6	17.7	2.0	4.5	5.4	3.0
May ..	4.1	1.7	10.5	43.7	34.2	1.1	2.0	2.6	0.1
June ..	48.5	5.1	2.9	7.6	25.9	0.2	7.3	2.5	—
July ..	42.4	31.0	7.3	3.5	15.2	0.6	—	—	—
Aug. ..	73.8	11.3	4.3	2.1	6.1	1.2	1.2	—	—
Sep. ..	53.4	22.6	5.8	10.8	5.7	0.3	0.9	0.3	0.2
Oct. ..	28.7	27.5	17.3	9.3	3.6	0.1	2.3	8.0	3.2
Nov. ..	24.5	32.5	21.3	2.9	0.6	—	0.2	3.2	14.8
Dec. ..	15.2	29.8	25.6	4.1	0.4	—	0.4	3.4	21.1

Sex ratio : A total of 11,804 adult fishes were examined for the period 1977-'86 for calculating the sex ratio. The sex ratio of males to females for the whole period was 1 : 1.01 showing almost an equal distribution.

Fecundity : Mature ovaries of 17 fishes in stage IV to VI were utilised for estimating fecundity. Only yolked eggs were enumerated following the method described by Rao (1971). It could be seen that ova per gram body weight of mature fish ranged from 198 to 515 (Table 4).

TABLE 4. *Details of fecundity studies*

Length of fish (mm)	Weight of fish (gms)	Weight of ovary (gms)	Total No. of mature ova	Ova per gm weight of fish	Maturity stage
263	196	7.07	81,556	416	IV
231	149	10.15	73,370	492	V
269	215	6.83	40,202	187	V
231	143	8.42	48,302	338	V
267	228	14.06	48,148	211	V
244	179	8.68	29,520	165	V
260	216	11.17	49,460	229	V
268	229	13.60	60,343	263	V
266	236	10.00	67,824	287	V
258	217	13.45	92,751	428	V
259	225	15.11	70,715	314	V
250	171	8.43	1,00,919	590	V
243	164	13.70	48,160	198	VI
258	192	10.72	98,961	515	V
230	136	6.32	74,690	549	V
267	183	10.81	72,053	394	V
240	150	8.90	73,383	489	V

UTILIZATION AND MARKETING

The mackerel catch in all the months except in the peak months *viz.* March to May and December, is disposed in fresh state for local consumption. About 50% of the catch in the peak months is salt dried and marketed during the lean months. Salt dried mackerel is reported to keep well for about one year. Price of fresh mackerel ranged from Rs. 7,500 to Rs. 10,000 per tonne during 1985-'86. Good marketing outlets are available at Trivandrum, Balaramapuram and interior villages.

DISCUSSION

Over 90 % of the mackerel caught from the Indian waters is from the west coast off Quilon-Ratnagiri region. Noble (1979) based on his studies during 1977-'78, stated that eventhough the Kerala Coast accounts for about 31-32 % of the country's total mackerel catch, its contribution along the coast of Trivandrum district was only 4 %.

The fishery at Vizhinjam, eventhough a minor one, is of importance due to the abundant occurrence of juveniles and spawners in the

fishery. The mackerel fishery in the area starts from March and intensifies during April-May. Eventhough the fishery is a multigear one in the area, no gear is specifically employed for this resources. Hence, as observed by Yohannan (1977), the fluctuation in the mackerel landings do not seem to have any discernible relation to the fishing effort. However, the new trend towards mechanisation of traditional crafts appears to enhance the catch rate of mackerel. The expansion of the area of fishing by the traditional gear into distant grounds seems to be the reason for the better catch rates and it appears to be a positive step for augmenting the mackerel catch in the area.

The fishery is dominated by 110-159 mm and 220-269 mm size fishes. Yohannan (1979) noted that mackerel grows to a size of about 22 cm at the completion of first year. The appearance of large number of juveniles during June-August indicates that these months are the peak recruitment period for mackerel in the area. The indiscriminate fishing of juveniles during these months by boat seine and small sized hooks may probably adversely affect the commercial fishery.

As opined by Rao (1971) the Indian mackerel might be spawning throughout the year, though there might be peaks in its spawning activity. The observations at Vizhinjam area also point to the same. Balakrishnan (1957) reported that larvae and young mackerel occur at Vizhinjam during March-August with the smallest groups occurring in April, May and June. Bennet (1968) stated that very young mackerel occur several times in the commercial catches and there exists a mackerel spawning ground not far off from Vizhinjam Coast. The present study also confirms that Vizhinjam area is one of the important spawning and nursery grounds for mackerel in the west coast of India.

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