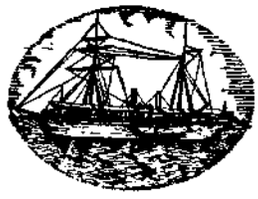
SYMPOSIUM ON CRUSTACEA

PART IV



MARINE BIOLOGICAL ASSOCIATION OF INDIA

MARINE FISHERIES P.O., MANDAPAM CAMP

INDIA

PROCEEDINGS

OF THE

SYMPOSIUM ON CRUSTACEA

HELD AT

ERNAKULAM

FROM JANUARY 12 TO 15, 1965

PART IV

SYMPOSIUM SERIES 2

MARINE BIOLOGICAL ASSOCIATION OF INDIA

MARINE FISHERIES P.O., MANDAPAM CAMP

INDIA

PRAWN CATCHES BY MECHANISED VESSELS IN THE TRAWLING GROUNDS OF BOMBAY AND SAURASHTRA*

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ABSTRACT

The relative abundance in the regional, seasonal and depthwise distributions of prawns between latitudes 16° N, south of Bombay, and 24° N, of Kutch, based on the landings of two sets of bull-trawlers, '*Arnalla-Paj*' and '*Satpati-Pilotan*' of the New India Fisheries Company, and of the otter trawlers M.F.V. *Jheenga*, M.F.V. '*Bumlli*', M.L. '*Meera*' and M.L. '*Sagarkanti*' of the Government of India Deep Sea Fishing Station, Bombay, has been studied.

The average annual yields of 20,690 kg. of prawns forming 0·63% and 8,367 kg. forming 2·04% of the total catches of all fish were obtained by the bull-trawlers for the period 1956–63 and the Government of India vessels for 1961–64 respectively. The highest catch of 38,070 kg. of prawns was obtained in 1962 for the bull trawlers with 9·78 kg. per hour of trawling and 10,540 kg. for Government of India vessels in 1961 with a catch rate of 6·04 kg. per trawling hour.

Taking Bombay and Saurashtra together it has been observed that the prawn catches begin to increase from April–May and peak catches are obtained in some of the months from July–September and occasionally even October as in 1961. The fishing operations were generally in the 8 m. to 70 m. depth ranges which have been considered in detail regionwise. The prawn resources in trawling grounds appear to increase from north to southwards along the west coast. While in Kutch to Veraval region, the catches have been either poor or only moderate, in Cambay and Bombay regions they have been fairly good. The annual average in percentage of prawns in Kutch to Bombay region ranged between 0·16–1·29.

Metapenaeus affinis, M. monoceros, M. dobsoni, Penaeus indicus and *Parapenaeopsis stylifera* are the common species of the Bombay and Saurashtra waters.

INTRODUCTION

THE importance of the prawn fishery of India has been well emphasised by Panikkar and Menon (1955) who observed that it ranks second only to that of U.S.A. Their observation was based mostly on the catches from the inshore regions and backwaters which have been exploited fairly efficiently and extensively by fishermen from ages past employing indigenous craft and gear. The effective use of trawlers and other mechanised vessels in fishing for 'shrimps' exclusively or along with commercially important fishes has come into vogue in recent years, *i.e.*, in the last two decades only. From published accounts, unfortunately no information is available on the prawn catches by commercial or exploratory fishing trawlers operating in deeper waters off the Indian coasts beyond the zones which the local fishermen reach with their non-mechanised or even mechanised craft and gear. In the accounts given by Jayaraman *et al.* (1959) very valuable information is found in respect of various commercially important species of fish excepting prawns, the latter having been evidently treated along with other miscellaneous catches.

The inshore catches of prawns in Bombay and other parts of the north-western coast of India, although forming a considerable part of the total landings, are mostly unsuitable for export in the frozen or canned state as they are composed mainly of small varieties like *Palaemon tenuipes*.

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Annually several crores of rupees of foreign exchange is earned from the export of prawn by the canning and freezing factories located in the south-western part of the country where the economically important species abound. As the trawlers invariably catch larger varieties like the penaeid prawns, it is felt that a knowledge of their distribution and relative abundance in different regions would provide the basic information which is highly essential for promoting the export trade of 'shrimp'.

The present paper deals with the season wise and region wise distribution of the prawns based on catches landed by the bull-trawlers of the New India Fisheries Co., Ltd. and otter-trawlers of the Government of India Deep Sea Fishing Station, Bombay, which operated in Bombay and Saurashtra waters, including the Gulf of Kutch.

Vessels, Areas of Operation and Analysis of Catches

The bull-trawlers, 'Arnalla'-'Paj', and 'Satpati' 'Pilotan' of the New India Fisheries Co., Ltd. which operated in pairs, were each of 92·67 gross tonnage and 250 B.H.P. The trawl nets used by these vessels had 67·06 metre of head rope, 68·58 metre of foot rope with the cod end of 50·8 metres. The length of the hunt rope varied from 180 to 200 metres.

The fishing grounds covered by these vessels are the same that have been charted out and published earlier (Jayaraman *et al., loc. cit.*). On the basis of certain latitudes passing from the coastline across the continental shelf, the regions have been demarcated as follows: Bombay from 18° N. to 19° 40′ N.; Cambay 19° 50′ N. to 20° 40′ N., Veraval 20° 50′ N. to 21° N.; Porbundar 21° 10′ N. to 22° N., Dwarka 22° 10′ N. to 22° 40′ N. and Kutch 22° 50′ N. to 24° N.

These regions are divided into areas, 30 minutes latitude by 20 minute longitude, thus giving 600 square miles each (Fig. 1).

Besides the areas covered in the operations by *M.T.* '*Ashok*', *M.T.* '*Pratap*' and '*Taiyo Maru*' (Jayaraman *et al., loc. cit.*) the following areas also have been exploited by the New India Fisheries vessels, *viz.*, '43 A', '42', '37' and '36' in Bombay region, '23', '16', '13', '12' and '9' in Cambay; '1' in Veraval and 'G' and 'I' in Porbundar and all the areas 'P' to 'Z' in Kutch. In Cambay region areas '26' and '20' covered by *M.T.* '*Ashok*' and *M.T.* '*Pratap*' have not been fished by these vessels.

The catch data of the motor fishing vessels '*Jheenga*' of 153 B.H.P. and '*Bumili*' of 135 B.H.P. as also the motor launches '*Meera*' of 60 B.H.P. and '*Sagarkanti*' of 40 B.H.P. of the Government of India Deep Sea Fishing Station, Bombay, operating between latitudes 16° N. and 23° N. from January 1961 to June 1964 have also been considered in the present study. These vessels differ much in their gross tonnage, 11·77 of '*Sagarkanti*' to 48·61 of '*Jheenga*'. All these vessels were operating Russain and Indian types of otter-trawls of 11–16 metres.

The charting of the fishing grounds by the Government of India vessels is based on latitudes and longitudes chosen at one degree interval so that major areas are obtained having 3,600 nautical square miles each and these are subdivided at intervals of 10 minute longitude by 10 minute latitude, each sub-area thus giving 100 natuical square miles as seen from Fig. 2. In a major area, taking the numbers 1–6 at 10 minute interval on the longitude and A–F at the same interval on the latitude, the sub-areas are designated as 18–72: 1 A, 6 E, etc.

The log sheets of New India Fisheries vessels recorded the haul-wise number of cases of prawns at each area fished with particulars of depths and the time of shooting and hauling. While analysing the log data, each of the cases was allotted the weight of 18 kg. in respect of prawns and also small fish. The weights of larger fish are reckoned according to the standard tables adopted by the Central Marine Fisheries Research Institute based on average weights. The logs of the Government

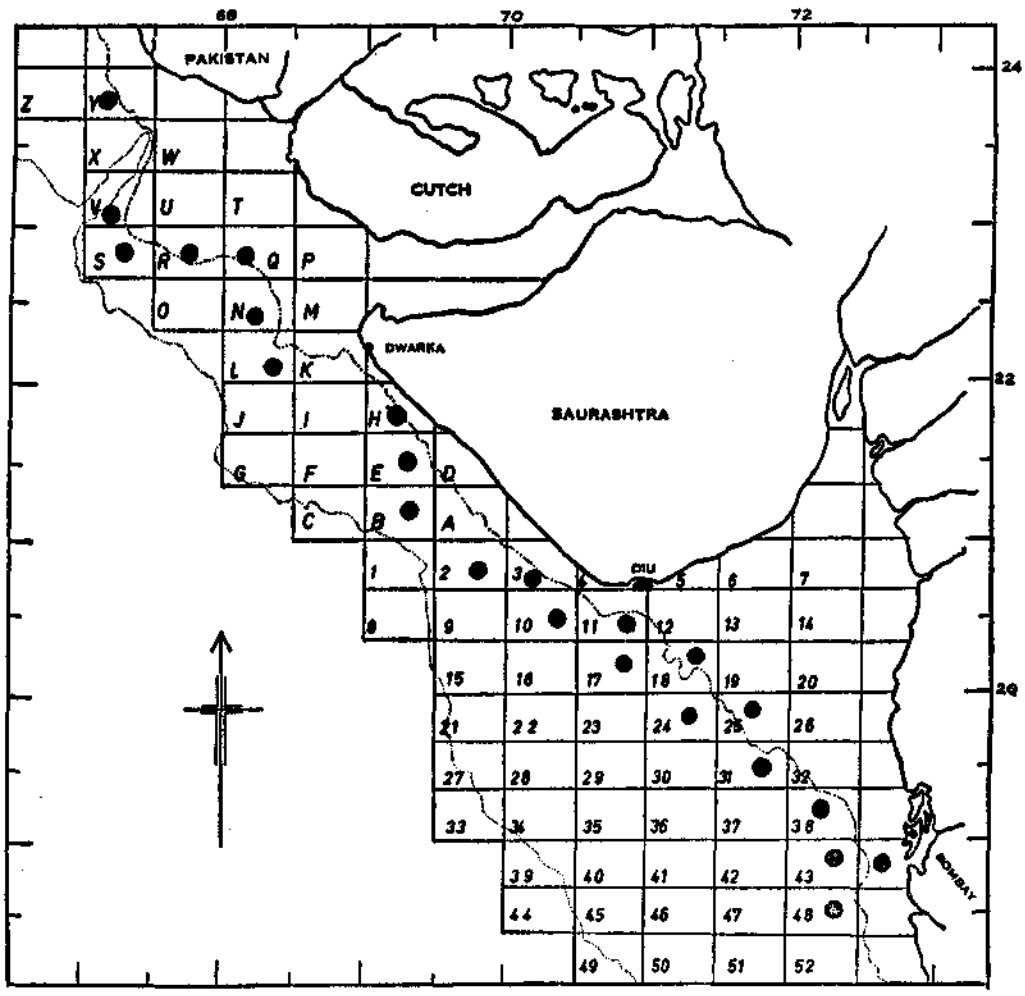

FIG. 1. Trawling grounds of Bombay-Saurashtra waters fished by the bull-trawlers of the New India Fisheries Co. Black circles indicate either rich or fairly rich prawn grounds.

of India vessels show direct entry of the weight of prawns and different categories of fish in kilograms. From the log data the monthly catch and catch rates in each area per hour of trawling, depth-wise distribution of prawns and their seasonal variations in different regions were worked out.

THE ANNUAL PRAWN YIELDS BY TRAWLS DURING 1956-64

The New India Fisheries trawlers showed an average annual yield of 20,624 kg. of prawns forming 0·62% of the total landings at a catch rate of 4·72 kg. per hour. The maximum yield of 38,070 kg. (Table I) was in 1962 forming 1·07% of the total landings with a catch rate of 10·04 kg. and the next high yield of 28,980 kg. was in 1957 forming 0·88% with a catch rate of 5·31 kg. per hour of trawling. The catches in 1956, 1958, 1959 and 1963 were below average ranging between 12,204 kg. and 15,174 kg. There was no fishing in the first three months in 1956 and the last two

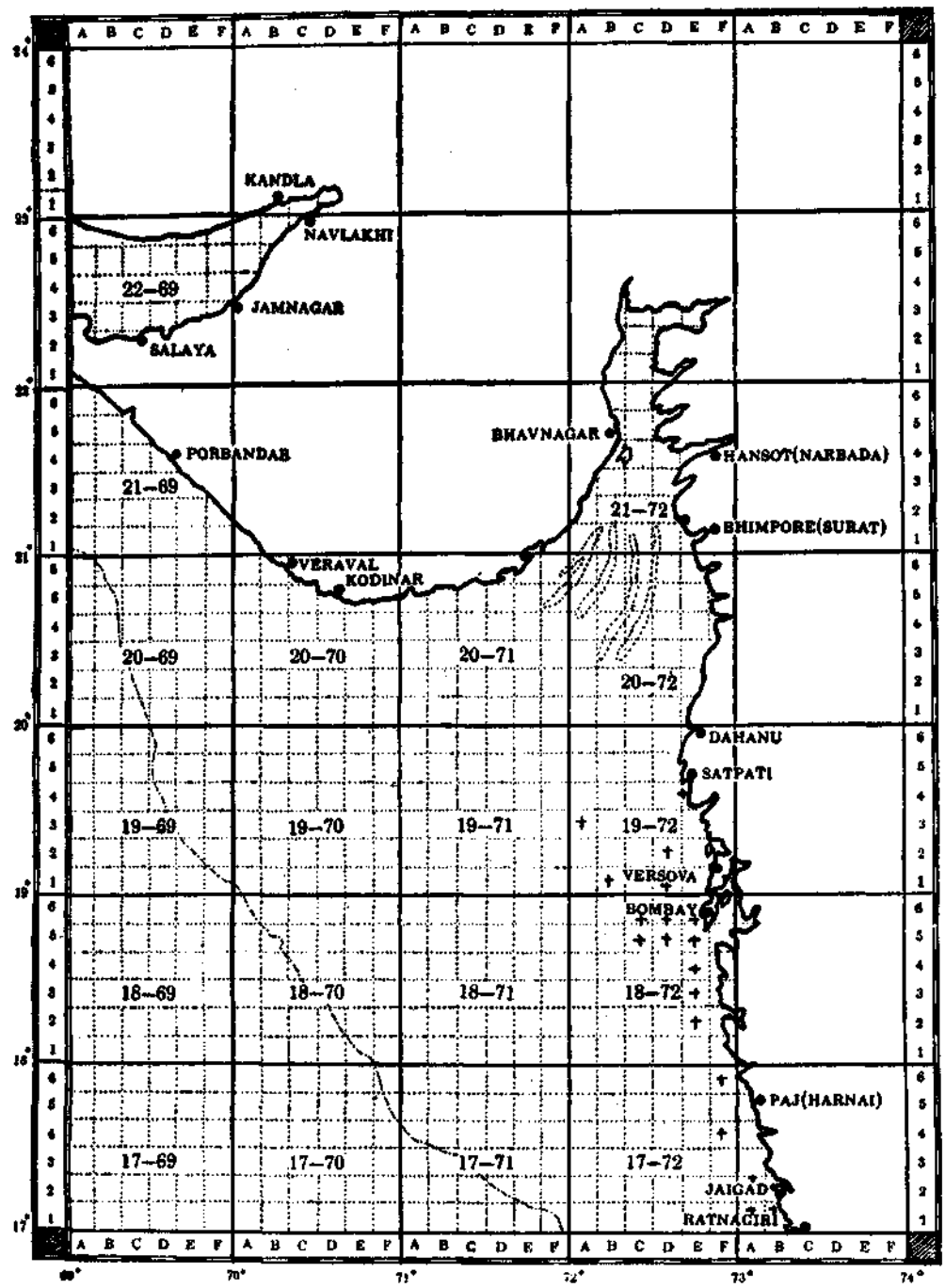

FIG. 2. Trawling grounds of Bombay-Saurashtra waters. Sub-areas indicated by + denote rich or fairly rich prawn grounds covered by Government of India vessels in exploratory fishing operations.

months in 1963; even if there was fishing in the said months the annual prawn landings for those years might not have been appreciably high as those months form the off-seasons for this fishery.

TABLE I

Annual regionwise distribution of prawn catch by bull-trawlers of New India Fisheries Co.

Region / Year	Kutch catch in kg. (catch rate) %	Dwarka catch in kg. (catch rate) %	Porbundar catch in kg. (catch rate) %	Veraval catch in kg. (catch rate) %	Cambay catch in kg. (catch rate) %	Bombay catch in kg. (catch rate) %	All regions catch in kg. (catch rate) %
1956	..	504	36	234	6,390	4,968	12,204
		(0·66)	(0·80)	(2·77)	(5·09)	(7·05)	(4·28)
		0·08	0·20	0·38	0·58	0·99	0·52
1957	..	2,304	612	1,620	23,526	918	28,980
		(1·64)	(0·42)	(3·08)	(11·70)	(12·11)	(5·31)
		0·31	0·06	0·52	1·82	3·73	0·88
1958	18	2,700	1,242	1,044	9,990	144	15,174
	(0·48)	(0·03)	(0·77)	(1·50)	(5·70)	(1·80)	(3·00)
	0·10	0·42	0·13	0·23	0·76	0·53	0·42
1959	477	693	945	2,196	9,939	504	14,760
	(0·69)	(0·83)	(1·03)	(4·33)	(7·76)	(5·49)	(3·43)
	0·06	0·14	0·55	0·77	1·44	1·36	0·54
1960	10,386	720	7,740	2,664	774	54	22,338
	(3·14)	(8·52)	(20·98)	(6·90)	(5·38)	(4·80)	(4·28)
	0·34	0·25	1·39	1·15	2·61	1·96	0·52
1961	6,498	486	1,836	3,420	8,730	18	20,988
	(2·44)	(2·03)	(2·83)	(8·30)	(13·32)	(10·28)	(4·54)
	0·25	0·24	0·36	1·18	2·31	4·08	0·53
1962	4,860	1,026	13,752	5,130	12,954	378	38,070
	(2·57)	(7·30)	(14·87)	(19·44)	(18·06)	(66·43)	(10·04)
	0·26	0·87	1·73	3·11	2·22	12·58	1·07
1963	3,979	486	3,528	1,062	3,222	18	12,475
	(2·98)	(4·09)	(3·58)	(3·01)	(4·27)	(3·42)	(3·50)
	0·34	0·47	0·50	0·46	0·65	0·79	0·46
Average	3,745	1,115	3,711	2,171	9,441	875	20,624
	(2·60)	(1·88)	(3·97)	(5·39)	(8·81)	(7·18)	(4·72)
	0·27	0·28	0·60	0·16	1·28	1·18	0·62

The Government of India vessels had an average annual yield of 8,367 kg. of prawns forming 2·04% of the total landings with the catch rate of 5·01 kg. per hour of trawling as shown in Table II. The highest catch of 10,540 kg. was obtained in 1961 with the maximum catch rate of 6·04 kg. per hour, but at the same time its percentage was the lowest being 1·74 only in the total landings. The highest per cent of 2·30 was in 1962 when the catch was 10,372 kg. In 1963 the catch was comparatively low being 7,466 kg. but in 1964 the catch of 5,091 kg. should be considered fairly good as it was obtained in the first half of the year only.

TABLE II

Annual prawn catch in the otter-trawls by the Government of India vessels at Bombay

Year	All fish	Prawns	%	Kg./hour
1961	602,335	10,540	1·74	6·04
1962	449,535	10,372	2·30	4·80
1963	354,335	7,466	2·10	5·27
1964	233,447	5,091	2·18	3·76
Average ..	409,913	8,367	2·04	5·01

REGIONAL ABUNDANCE AND RICHNESS OF THE AREAS IN RESPECT OF PRAWN CATCHES BY THE NEW INDIA FISHERIES VESSELS

Based on the average annual percentage of prawns in the total catches, the regions Cambay and Bombay are far better than those of Kutch and Dwarka, Veraval ranking last. From the point of view of quantitative abundance of the prawn catch, irrespective of the effort expended, Cambay region ranked first followed by Kutch, Porbundar, Veraval, Dwarka and Bombay. According to catch rates, Cambay, Bombay, Veraval, Porbundar, Kutch and Dwarka were in the order of abundance of the prawn resources.

Kutch Region

It may be seen from Table I that the average annual percentage of 0·27 was almost the same in this region as for Dwarka but, the catch rate was slightly better than in the latter, giving 2·60 kg. per hour. There was no fishing in this region during 1956. In 1957 the trawlers had just touched this region and the catch was nil. In the remaining four years the catch rates ranged from 0·48 kg. in 1958 to 3·14 kg. per hour in 1960 with the catch of 18 kg. and 10,386 kg. respectively.

The most extensively fished areas were 'R' and 'Q'; 'S', 'Y', 'V' and 'U' were moderately fished and the least fished areas were 'P', 'T', 'W', 'X' and 'Z'. The effort put in this region in 1957 was too small to record prawn catch.

In 'R' and 'Q' (Table III), the average annual effort put in was 807·10 hours and 343·79 hours respectively; but the catch rates were almost the same being 2·90 kg. and 2·64 kg. per hour respectively. The annual catch rates in the area 'R' ranged from 1 kg. with the lowest catch of 351 kg. in 1959 to 3·69 kg. per hour with the catch of 4,428 kg. in 1961; the highest catch of 5,184 kg. with the catch rate of 2·85 kg. per hour being observed in 1960.

In 'Q' area the lowest catch of 36 kg. with the catch rate of 0·14 kg. per hour was recorded in 1959. The highest catch of 2,376 kg. with the catch rate of 2·77 kg. per hour was in 1960, but the highest catch rate of 4 kg. per hour was noticed in 1962 when the catch was only 1,494 kg.

Amongst the moderately fished areas, 'U' recorded the lowest average annual catch rate of 0·77 kg. per hour and 'S', the highest of 8·53 kg. per hour. Area 'Y' followed 'S' with the average annual catch rate of 5·76 kg. per hour. In area 'S' the catch rates ranged between 0·97 kg. and 10·55 kg. per hour when the catches were 18 kg. in 1959 and 36 kg. in 1962 respectively. The highest catch of 1,278 kg. with the catch rate of 10·40 kg. per hour was in 1960.

The catch rates in the area 'Y' ranged from 5·17 kg. per hour with the catch of 270 kg. in 1961 to 6·64 kg. per hour with the catch of 162 kg. in 1960, the highest catch of 306 kg. with the catch rate of 6·54 kg. per hour being in 1962.

In the area 'V', the catch rates fluctuated between 2·24 kg. per hour with the catch of 324 kg. in 1961 and 5·89 kg. per hour with the catch of 882 kg. in 1963; however, the catches fluctuated between 198 kg. with the catch rates of 2·60 kg. per hour in 1962 and 1,008 kg. with the catch rate of 2·99 kg. per hour in 1960.

TABLE III

Areawise distribution of prawn catch (catch-per-hour) in kg. by bull-trawlers of the New India Fisheries Co. in Kutch region

Area / Year	Q	R	Sj	T	U	V	X	Y
1957	0	..	..	..	..	..	..	..
1958	0	0	0	..	0	0	18 (7·20)	.. ..
1959	36 (0·14)	351 (1·00)	18 (0·97)	.. ..	72 (1·30)	0 ..	.. ..	.. ..
1960	2,376 (2·77)	5,184 (2·85)	1,278 (10·40)	90 (4·88)	288 (2·44)	1,008 (2·99)	0	162 (6·64)
1961	1,296 (2·15)	4,428 (3·69)	72 (3·20)	0	108 (0·49)	324 (2·24)	0	270 (5·17)
1962	1,494 (4·00)	2,592 (3·15)	36 (10·55)	..	126 (0·35)	198 (2·60)	108 (2·47)	306 (6·54)
1963	1,170 (3·67)	1,531 (2·35)	288 (9·64)	..	108 (0·65)	882 (5·89)	..	..
Average	910 (2·64)	2,348 (2·90)	282 (8·53)	45 (3·78)	117 (0·77)	402 (3·28)	31 (1·83)	246 (5·76)

The area 'U' had the catch rates ranging from 0·35 kg. per hour with the catch of 126 kg. in 1962 to 2·44 kg. per hour when the catch of 288 kg. was the highest in 1960. The lowest catch of 72 kg. with the catch rate of 1·30 kg. per hour was registered in 1959.

In the remaining areas, the average annual catch rates varied between zero (in 'P', 'W' and 'Z') and 3·78 kg. per hour (in 'T').

From the above it can be inferred that the areas 'S' and 'Y' are rich, 'V' fairly good and 'Q' and 'R' moderately rich in their prawn resources. Area 'T' if sufficiently exploited may also yield fair catches.

Dwarka Region

This region (Table I) recorded the lowest average annual catch rate of 1·88 kg. per hour, but the average annual percentage of prawn yield was 0·28 which is as good as that of Kutch and better than that of Veraval. The highest catch of 2,700 kg. was in 1958 with the lowest catch rate of 0·03 kg. per hour. The lowest catch of 486 kg. was in 1961 and 1963 when the catch rates were 2·03 kg. and 4·09 kg. per hour respectively.

In spite of the fairly high amount of fishing effort put in this region during 1956 the prawn yield for that year was poor because fishing was done during November and December, the lean months for this fishery. The average annual catch rates ranged between 0·88 kg. per hour in 'K' and

2·81 kg. per hour in 'L' (Table IV) the catch rates at 'M' and 'N' being 1·89 kg. and 2·58 kg. per hour respectively. The highly exploited areas were 'N', 'M', and 'K'. Though the area 'L' showed the best catch rate, the effort put during different years was extremely poor, at times almost insignificant, leading to nil catch as noticed during the period 1960–62. The catch rates ranged from 1·91 kg. per hour with the highest catch of 108 kg. in 1957 and 16·7 kg. per hour with the lowest catch of only 18 kg. in 1·08 hours in 1963.

TABLE IV

Areawise distribution of prawn catch (catch-per-hour) in kg. by bull-trawlers of New India Fisheries Co. in Dwaraka region

Year \ Area	K	L	M	N
1956	0	..	504 (1·10)	0
1957	216 (0·41)	108 (1·91)	1,188 (2·62)	792 (2·17)
1958	378 (2·42)	108 (3·81)	954 (2·17)	1,260 (4·20)
1959	180 (0·42)	36 (7·57)	144 (1·22)	333 (1·15)
1960	270 (5·25)	0	0	324 (1·03)
1961	36 (1·73)	0	0	450 (3·15)
1962	54 (4·32)	0	18 (4·60)	954 (7·75)
1963	18 (1·85)	18 (16·70)	0 ..	450 (4·29)
Average	144 (0·88)	39 (2·81)	351 (1·89)	570 (2·58)

The catch rates in the area 'N' varied between 1·03 kg. per hour in 1960 with the catch of 324 kg. and 7·75 kg. per hour with the catch of 954 kg. in 1962. The highest catch of 1,260 kg. was in 1958 with the catch rate of 4·20 kg. per hour.

The effort put in the area 'M' was quite good only from 1957 to 59 and not in rest of the years. The catch rates fluctuated between 1·10 kg. per hour with the catch of 504 kg. in 1956 and 4·60 kg. per hour with the catch of 18 kg. in 1962. The highest catch of 1,188 kg. was in 1957 with the catch rate of 2·62 kg. per hour.

In 'K' the catch rates ranged from 0·41 kg. per hour with the catch of 216 kg. in 1957 to 5·25 kg. per hour with the catch of 270 kg. in 1960. The maximum catch of 378 kg. with the catch rate of 2·42 kg. per hour was in 1958 while the minimum of 18 kg. with the catch rate of 1·85 kg. per hour was in 1963. It may thus be seen that the areas 'L' and 'N' have good prawn grounds.

Porbundar Region

The average annual percentage of 0·60 (Table I) in this region came next to that of Cambay and Bombay; but, the catch rate was only 3·97 kg. per hour. The prawn yield in this area was very good in 1962 giving 13,752 kg. at a rate of 14·87 kg. per hour. The highest catch rate of

20·98 kg. per hour was in 1960 when the catch obtained was 7,740 kg. ; the lowest catch of 36 kg. was in 1956 with the catch rate of 0·80 kg. and the lowest catch rate of 0·42 kg. per hour was in 1957 when the catch was 612 kg.

TABLE V

Areawise distribution of prawn catch (catch-per-hour) in kg. by bull-trawlers of New India Fisheries Co. in Porbunder region

Area / Year	A	B	D	E	H	I
1956	0	36 (2·76)	–	0	–	–
1957	486 (0·42)	18 (3·57)	36 (0·26)	72 (0·49)	..	..
1958	702 (0·78)	108 (1·83)	180 (0·76)	252 (1·12)	..	..
1959	675 (0·96)	108 (2·73)	36 (0·70)	126 (1·05)	..	..
1960	810 (5·43)	198 (5·17)	54 (3·34)	1,242 (6·67)	5,382 (10·69)	54 (13·67)
1961	270 (3·13)	90 (5·76)	0	504 (2·80)	972 (2·73)	..
1962	2,772 (22·40)	162 (10·18)	54 (1·61)	5,094 (13·46)	5,670 (15·18)	..
1963	2,160 (6·17)	324 (5·86)	54 (3·27)	846 (2·88)	144 (0·52)	..
Average	984 (2·28)	130 (4·32)	57 (0·82)	1,017 (5·22)	3,042 (8·04)	54 (13·67)

The fishing effort put was very good in the areas 'A' and 'E' throughout and moderate in 'D' and 'B'. The areas 'G' and 'I' were the least exploited, with no prawn catch in the former. The area 'H' was exploited from 1960 onwards and fairly good amount of effort was spent here. The average annual catch rate ranged from 0·82 kg. in 'D' to 8·04 kg. per hour in 'H'. The area 'H' registered the lowest catch of 144 kg. (Table V) in 1963 with the catch rate of 0·52 kg. per hour and the highest of 5,670 kg. with the catch rate of 15·18 kg. per hour in 1962.

In area 'D' the minimum catch of 36 kg. with the catch rate of 0·26 kg. per hour in 1957 and the maximum of 180 kg. with a catch rate of 0·76 kg. per hour in 1958 were observed. The highest catch rate of 3·34 kg. per hour was in 1960 when the catch was only 54 kg.

The catches in 'A' ranged between 270 kg. with the catch rate of 3·13 kg. per hour in 1961 and 2,772 kg. with the catch rate of 22·40 kg. per hour in 1962. The lowest catch rate of 0·42 kg. per hour with the catch of 486 kg. was in 1957.

The catch rates in the area 'B' fluctuated between 1·83 kg. per hour with the catch of 108 kg. in 1958 and 10·18 kg. per hour with the catch of 162 kg. in 1962. But the maximum yield of 324 kg. with the catch rate of 5·86 kg. per hour was in 1963 and the minimum of 18 kg. with the catch rate of 3·57 kg. per hour in 1957.

Area 'E' recorded the minimum catch of 72 kg. with the catch rate of 0·49 kg. per hour and the maximum of 5,094 kg. with the catch rate of 13·46 kg. per hour in 1957 and 1962 respectively.

TABLE VI

Areawise distribution of prawn catch (catch-per-hour) in kg. by bull-trawlers of New India Fisheries Co. in Veraval region

Year \ Area	2	3	4
1956	36 (1·03)	198 (4·11)	..
1957	1,242 (3·74)	378 (1·96)	...
1958	648 (1·80)	396 (1·19)	—
1959	1,224 (6·68)	972 (3·59)	—
1960	1,242 (7·75)	1,422 (6·27)	...
1961	612 (6·51)	2,754 (8·84)	54 (46·15)
1962	954 (8·95)	2,124 (13·49)	—
1963	540 (3·31)	522 (2·75)	...
Average	812 (4·53)	1,096 (5·07)	54 (46·15)

A catch of 54 kg. with the catch rate of 13·67 kg. per hour was noted in the area 'I' in 1960, indicating high prawn resources although not well exploited.

The areas 'H', 'E' and 'B' prove to have good prawn grounds.

Veraval Region

This region recorded the lowest annual average per cent of 0·16 of prawns (Table I), but the average catch rate was fairly good being 5·39 and it is higher than those obtained in Porbundar, Dwarka and Kutch. The highest catch of 5,130 kg. with the catch rate of 19·44 kg. per hour was in 1962 and the lowest catch of 234 kg. with the catch rate of 2·77 kg. in 1956. The lowest catch rate was 1·50 kg. per hour when the catch was 1,044 kg. in 1958.

Of the four areas fished in this region, '1' and '4' were the least exploited. There was no record of prawn in the area '1' and only a small catch of 54 kg. in the area '4' (Table VI) at a catch rate of 46·15 kg. per hour in 1·17 hours in 1961.

The average annual catch rate was 5·07 kg. for '3' and 4·53 kg. per hour for '2'. The catch rates in the area '3' ranged from 1·19 kg. per hour with the catch of 396 kg. in 1958 to 13·49 kg. per hour with the catch of 2,124 kg. in 1962. The minimum catch of 198 kg. with the catch rate of 4·11 kg. per hour was in 1956 and the maximum of 2,754 kg. with the catch rate of 8·84 kg. per hour was in 1961.

Coming to the area '2' the catch rates ranged between 1·03 kg. per hour when the minimum catch was 36 kg. in 1956 and 8·95 kg. per hour in 1962 when the catch was 954 kg. However, the highest catch of 1,242 kg. with the catch rate of 7·75 kg. per hour was obtained in 1960.

The areas '2' and '3' appear almost equally rich for prawns; area '4', if exploited intensively may throw some more light on the prawn grounds in this region.

Cambay Region

From the point of view of the highest catches obtained giving an annual average yield of 9,441 kg. (Table I) forming 1·28% of the total catches and with the highest catch rate of 8·81 kg. per hour, this is the best of the five regions covered by the New India Fisheries vessels. The catch rates varied between 4·27 kg. with a catch of 3,222 kg. in 1963 and 18·06 kg. with a catch of 12,954 kg. in 1962. Catch was the highest in 1957 forming 23,526 kg. with a high catch rate of 11·70 kg. per hour and lowest in 1960 forming 774 kg. yet with fairly good catch rate of 5·38 kg. per hour.

Areas '11' and '10' were highly exploited and '12', '17' and '18' moderately fished. The effort put in the areas '25', '24' and '19' was far below average and that put in the areas '23', '16' '13' and '9' was so poor that there was no prawn catch.

TABLE VII

Areawise distribution of prawn catch (catch-per hour) in kg. by bull-trawlers of New India Fisheries Co. in Cambay region

Area / Year	25	24	19	18	17	12	11	10
1956	0	54 (2·00)	0	990 (6·00)	270 (2·31)	540 (6·53)	2,142 (6·90)	2,394 (4·37)
1957	522 (9·70)	1,674 (12·59)	0	2,574 (13·64)	792 (8·33)	1,782 (15·99)	7,326 (13·21)	8,856 (10·18)
1958	36 (6·00)	72 (3·54)	72 (7·11)	1,008 (7·72)	756 (5·89)	756 (7·11)	6,480 (5·88)	810 (3·27)
1959	..	72 (4·84)	..	315 (7·85)	381 (1·93)	666 (12·67)	593 (8·29)	2,574 (8·37)
1960	..	...	..	..	0	0	216 (4·25)	558 (7·16)
1961	..	..	...	36 (2·88)	288 (4·65)	..	5,292 (17·26)	3,114 (11·35)
1962	..	0	...	198 (12·70)	1,620 (31·2)	756 (13·30)	6,498 (15·45)	3,882 (24·09)
1963	0	0	...	0	72 (2·25)	0	1,746 (4·51)	1,404 (4·47)
Average	140 (8·33)	312 (9·24)	24 (3·29)	732 (9·12)	491 (5·57)	643 (4·02)	3,787 (7·87)	2,949 (8·43)

The average annual catch rates ranged from 3·29 kg. per hour (Table VII) for the area '19' to 9·24 kg. per hour for area '24'. The catch rates in the area '11' varied from 4·25 kg. per hour with the minimum catch of 216 kg. in 1960 to 17·26 kg. per hour with the catch of 5,292 kg. in 1961. The maximum catch of 7,326 kg. with the catch rate of 13·21 kg. per hour was in 1957.

The lowest catch rate in area '10' was 3·27 kg. per hour with the catch of 810 kg. in 1958 and the highest of 24·09 kg. per hour with the catch of 3,882 kg. in 1962. The lowest catch of 558 kg.

with the catch rate of 7·16 kg. per hour and the highest of 8,856 kg. with the catch rate of 10·18 kg. per hour was in 1960 and 1957 respectively.

The catch rates in area '12' ranged from 6·53 kg. with the minimum catch of 540 kg. in 1956 and 15·99 kg. with the maximum catch of 1,782 kg. in 1957.

Area '17' showed the catch rates fluctuating between 1·93 kg. per hour with the catch of 381 kg. in 1959 and 31·2 kg. per hour with the maximum catch of 1,620 kg. in 1962. The minimum catch of 72 kg. with the catch rate of 2·25 kg. per hour was in 1963.

Area '18' recorded the lowest catch of 36 kg. per hour with the catch rate of 2·88 kg. per hour in 1961 and the highest of 2,574 kg. with the catch rate of 13·64 kg. per hour in 1957.

The minimum catch of 36 kg. with the catch rate of 6·00 kg. per hour in 1958 and the maximum of 522 kg. with the catch rate of 9·70 kg. per hour in 1957 were recorded by the area '25'.

In area '24' the lowest catch rate of 2 kg. per hour with the catch of 54 kg. was noticed in 1956. the highest catch rate of 12·59 kg. per hour here was in 1957 when the yield was 1674 kg.

Out of three years of fishing from 1956 to 58 in the area '19' the last one recorded 72 kg. with the catch rate of 7·11 kg. per hour.

The areas '25', '24', '18', '17', '11' and '10' prove to have rich prawn grounds in Cambay region.

Bombay Region

The percentage of prawns in the annual average of total landings being 1·18 (Table I) and the average annual catch rate being as high as 7·18, this region is next to Cambay which ranks first.

The extensively fished areas were '43' and '38', the areas '48', '43 A', '31' and '30' having been fished only occasionally. The rarely fished areas '42', '37', '36' and '32' recorded no prawns.

The average annual catch rates ranged (Table VIII) between 1·50 kg. per hour in the area '30' and 12·25 kg. per hour in '43 A'. Of the two extensively fished areas, area '38' recorded an average annual yield of 7·76 kg. per hour. The catch rates in this area ranged between 3·93 kg. with the catch of 18 kg. in 1958 and 83·62 kg. per hour with the catch of 378 kg. in 1962. The high catch rate in the latter was on account of three rich hauls for an effort of only 3·35 hours as mentioned earlier. The maximum catch of 1,152 kg. with the catch rate of 7·77 kg. per hour was obtained in 1956.

The catch rates in the area '43' ranged from 3·63 kg. per hour with the catch of 108 kg. in 1958 and 7·05 kg. per hour with the catch of 3,528 kg. in 1956.

The area '48' showed a catch of 195 kg. with the catch rate of 11·76 kg. per hour in 1956; area '43 A' catch rate of 13·04 kg. per hour with a catch of 234 kg. in 1957; area '37' a catch rate of 2·46 kg. per hour with the catch of 18 kg. in 1956; area '31' a catch rate of 8·49 kg. with a catch of 72 kg. in 1956 and lastly the area '30' a catch rate of 13·53 kg. with a catch of 18 kg. in 1958.

The areas '48', '43 A', '43', '38' and '31' prove to have rich prawn grounds. Sufficient effort was not expended in other areas but there are indications that areas like '30' may also prove to yield good quantities of prawns in this region.

TABLE VIII

Areawise distribution of prawn catch (catch-per-hour) in kg. by bull-trawlers of New India Fisheries Co. in Bombay region

Area / Year	48	43 A	43	38	37	31	30
1956	198 (11·76)	..	3,528 (7·05)	1,152 (7·77)	18 (2·46)	72 (8·49)	0
1957	...	234 (13·04)	378 (28·35)	306 (8·14)	..	0	..
1958	...	..	108 (3·63)	18 (3·93)	..	0	18 (13·53)
1959	0	0	162 (4·40)	342 (7·31)	..	..	...
1960	..	..	0	54 (7·67)	..	..	..
1961	..	..	..	18 (10·29)	..	..	..
1962	..	..	0	378 (83·62)	..	..	..
1963	..	..	0	18 (5·80)	..	..	..
Average	99 (10·95)	117 (12·25)	597 (7·11)	286 (7·76)	18 (2·46)	24 (5·12)	9 (1·50)

From south of Bombay these trawlers brought very good prawn catches in July 1963. The catches were like 108 kg. with the catch rate of 48 kg. per hour from the area '53' and 72 kg. with the catch rate of 21·6 kg. per hour from '60'. However, there was no catch from the area '54'.

Mention must be made here that a small catch of 72 kg. with the catch rate of 4·32 kg. per hour was obtained from an unclassified area in 1956.

PRAWN YIELDS FROM SUB-AREAS COVERED BY THE GOVERNMENT OF INDIA EXPLORATORY FISHING VESSELS

The Government of India fishing vessels explored the Arabian Sea from Kutch (23° N-68° E.) in the north to beyond Ratnagiri (16° N-72° E.) in the south. The sub-areas between 19° N. and 17° N. off Bombay and Ratnagiri where fishing was adequate showed some interesting results. In others fishing being occasional, it was not possible to judge the richness of those areas.

Major Area 19–72

This area is close to Versova, a fish landing place about 20 miles north of Bombay. It recorded (Table IX) an average annual fishing effort of 118·43 hours when the catch rate was 3·78 kg. per hour. The catch rates ranged from 0·70 kg. in 1962 to 7·52 kg. per hour in 1961 when the catch of 1,394 kg. was the highest.

The average annual catch rates in this area ranged from 0·21 kg. in the sub-area '1 E' to 40·66 kg. per hour in '4 E'. The most regularly fished sub-areas were '1 B', '1 C', '1 D';

moderately fished were '1 E', '2 A', '2 B', '2 C', '3 B' and '4 A' and rarely fished were the remaining ones. The annual average catch rates were good in the sub-areas '4 E', '2 D', '1 D', 1 B' and '3 A'. There was no prawn catch in the sub-areas '2 C' to '6 C' and '3 F'.

TABLE IX

Sub-areawise distribution of prawn catch (catch-per-hour) in kg. by the Government of India vessels in area 19–72

Year / Sub-area	1961	1962	1963	1964	Average
1 B	155 (5·61)	22 (7·33)	0	..	59 (5·43)
1 C	5 (1·32)	67 (1·49)	0	44 (11·0)	36 (1·82)
1 D	854 (20·25)	36 (0·83)	76 (9·92)	..	242 (10·18)
1 E	4 (0·84)	0	..	..	2 (0·21)
2 A	70 (6·08)	0	..	..	35 (3·18)
2 B	120 (5·16)	44 (1·54)	..	..	82 (3·16)
2 D	70 (35·00)	..	..	..	70 (35·0)
3 A	70 (4·72)	0	0	..	63 (4·48)
3 B	20 (1·15)	0	..	..	10 (0·73)
4 A	..	..	30 (4·93)	..	15 (2·90)
4 E	..	..	85 (40·66)	..	85 (40·66)
Total	1,394 (7·52)	169 (0·70)	191 (6·47)	44 (2·11)	450 (3·78)

Major Area 18–72

The combined effort of all these vessels was the maximum in the area 18–72, close to Bombay. An average annual effort of 1,173·15 hours was spent here bringing 6,910 kg. of prawns at a rate of 5·88 kg. per hour. The annual catch rates (Table X) ranged between 4·17 kg. per hour with the lowest catch of 4,343 kg. in 1964 (for the first six months only) and 7·55 kg. per hour with a catch of 8,503 kg. in 1961. The highest catch of 9,457 kg. was in 1962 and the catch rate was 6·62 kg. per hour.

The most extensively fished sub-areas were '5 C' to '5 E', '6 C' to '6 E' and excepting the sub-areas '2 C', '3 C', '4 A', '5 B' and '5 F' which were rarely fished, all the remaining sub-areas shown in the Table were moderately fished. The average annual catch rates fluctuated between 0·15 kg. in '4 C' and 21·65 kg. per hour in '5 B'. In the extensively fished sub-areas, the average annual catch rates ranged between 4·70 kg. in '6 D' and 12·92 kg. per hour in '5 E'. Sub-areas '3 E', '6B' and '6 E' had high average annual catch rates of 18·29 kg., 17·43 kg. and 10·90 kg. per hour respectively. The sub-areas '2 E' to '4 E', '5 C' to '5 E' and ' 6 C' to '6 E' prove to have fairly rich prawn grounds. There was no prawn catch in the sub-areas '1 B', '1 C' to '3 C' and '4 A'.

Major Area 17–73

This is close to Ratnagiri and showed a very good average annual catch rate of 10·80 kg. per hour (Table XI) with a catch of 135 kg. In 1963 the catch rate was as high as 57·26 kg. per hour when the catch was 205 kg.

TABLE X

Sub-areawise distribution of prawn catch (catch-per-hour) in kg. by the Government of India vessels in area 18–72

Year / Sub-areas	1961	1962	1963	1964	Average
1 D	30 (3·48)	55 (3·28)	0	0	21 (1·79)
1 E	0	30 (0·50)	0	0	8 (0·29)
1 F	0	41 (2·05)	78 (8·83)	0	30 (3·18)
2 D	180 (3·55)	0	0	..	60 (2·30)
2 E	270 (7·34)	50 (1·94)	...	0	107 (5·10)
3 D	40 (0·87)	0	0	46 (4·60)	22 (0·96)
3 E	215 (18·29)	..	..	..	215 (18·29)
4 C	0	0	5 (4·00)	0	1 (0·15)
4 D	58 (1·49)	0	0	0	15 (0·69)
4 E	13 (13·00)	-	0	20 (8·88)	11 (6·70)
5 B	..	..	157 (21·65)	..	157 (21·65)
5 C	7 (0·34)	200 (2·43)	831 (9·36)	200 (17·02)	310 (6·11)
5 D	2,100 (9·38)	2,318 (6·88)	957 (2·66)	404 (7·31)	1,445 (5·93)
5 E	1,607 (13·21)	1,514 (14·34)	1,430 (16·71)	13 (0·32)	1,141 (12·92)
5 F	-	8 (4·00)	-	...	8 (4·00)
6 B	340 (24·28)	..	0	..	170 (17·43)
6 C	200 (20·87)	202 (2·29)	278 (3·79)	379 (8·22)	265 (4·88)
6 D	3,071 (9·65)	2,072 (3·39)	1,068 (2·76)	3,113 (6·67)	2,331 (4·70)
6 E	732 (5·57)	3,300 (33·59)	533 (11·68)	168 (1·05)	1,183 (10·90)
Total	8,503 (7·55)	9,457 (6·62)	5,337 (4·87)	4,343 (4·17)	6,910 (5·88)

TABLE XI

Sub-areawise distribution of prawn catch (catch-per hour) in kg. by the Government of India vessels in area 17–73

Year / Sub-areas	1961	1962	1963	1964	Average
1 A	20 (5·71)	105 (19·1)	30 (20·00)	20 (4·90)	49 (13·39)
1 B	..	..	175 (84·14)	0	88 (42·40)
2 A	110 (9·16)	60 (34·30)	..	..	85 (12·37)
Total	130 (7·42)	185 (6·78)	205 (57·26)	20 (1·64)	135 (10·80)

Very good average annual catch rates ranging between 12·37 kg. in the sub-area '2 A' and 42·40 kg. per hour in '1 B' were noticed in this region. Sub-area '1 B' recorded 84·14 kg. per hour with a catch of 175 kg. in 1963. All the 3 sub-areas '1 A', '1 B' and '2 A' prove to be good for prawn. There was no catch in the sub-areas '3 A' and '4 F'.

Major Area 17–72

This is further off the previous area in Ratnagiri. The average annual catch rate of 3·47 kg. per hour (Table XII) was again low and the catch was 145·5 kg. Good catch rates were observed in 1962 and 1963 with the catches of 135 kg. and 364 kg. respectively.

Only some of the sub-areas fished have yielded prawn catch. The average annual catch rates ranged between 0·09 kg. in the sub-area '3 F' and 15·45 kg. per hour in '6 F'. The sub-area '4 F' with an average annual catch rate of 5·39 kg. per hour together with '6 F' indicate good prawn grounds in this region. In most of the sub-areas, namely, '1 C' to '1 F', '4 A', '4D' to '6 D', '5 C', '5 E' and '6 C' there was no prawn catch.

TABLE XII

Sub-areawise distribution of prawn catch (catch-per-hour) in kg. by the Government of India vessels in area 17–72

Sub-areas \ Year	1961	1962	1963	1964	Average
3 F	5 (0·09)	...	...	...	5 (0·09)
4 E	0	..	30 (3·61)	0	10 (1·66)
4 F	78 (1·43)	30 (10·00)	35 (4·21)	..	48 (5·39)
5 F	0	40 (5·00)	0	..	13 (3·64)
6 E	0	0	30 (0·53)	..	10 (2·09)
6 F	0	65 (8·1)	234 (4·14)	..	100 (15·45)
Total	83 (1·28)	135 (8·43)	364 (5·61)	0	146 (3·47)

DEPTH-WISE DISTRIBUTION

To understand the pattern of distribution of prawns at different depths, the haul-wise catch data in different months, in different regions, have been studied for one year, *i.e.*, 1962 when catches were the highest in the entire 8 years period of the observations of the New India Fisheries vessels. For this purpose the depth ranges covered have been grouped at 5 metre intervals and the results are shown in Figs. 3–8.

Kutch Region

The depth ranges fished (Fig. 3) were between 16–20 and 66–70 metres. But the fishing was concentrated mostly between 21–25 metres and 46–50 metres. The catch rates ranged between 0·51 kg. per hour with a catch of 36 kg. in December at a depth of 26–30 metres and 13·04 kg. per hour when the highest catch of 558 kg. was in May at a depth of 55–60 metres. There was no fishing in June and July. Usually the catch rates were less than 10 kg. per hour at different depth ranges in this region.

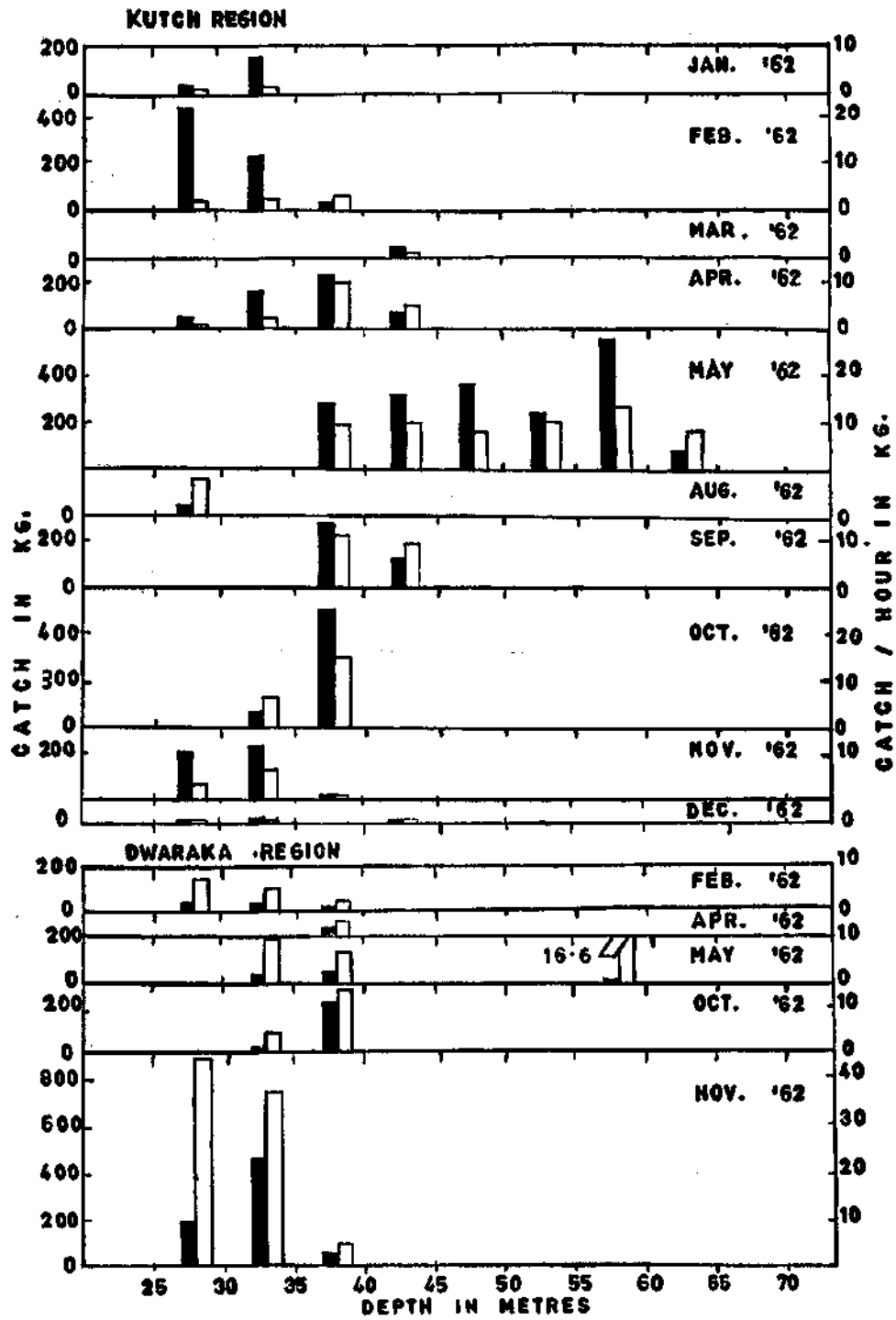

FIG. 3. Depth-wise distribution of prawns in the landings of New India Fisheries bull-trawlers in Kutch and Dwarka regions.

Dwarka Region

There was either no fishing or the catches were nil in most of the months. The fishing depth ranges varied between 21–25 metres and 56–60 metres (Fig. 3). When prawns were obtained, the catch rates ranged between 1·66 kg. per hour with a catch of 18 kg. at a depth range of 36–40 metres in February and 44·33 kg. per hour with a catch of 180 kg. at a depth range of 26–30 metres in November. Excepting in the depth ranges of 56–60 metres in May, of 36–40 metres in October and of 31–35 metres in November when the catch rates were 16·66 kg., 12·90 kg. and 36·00 kg. per hour respectively, the catch rates in all other depth-ranges were less than 10 kg. per hour.

Porbundar Region

There was no fishing in October and the catch was nil in February when the fishing was between the depth-ranges of 31–35 metres and 41–45 metres (Fig. 4). Most of the fishing was between the depth-ranges of 31–35 metres and 46–50 metres. The catch rate of 0·84 kg. per hour was the lowest in March at a depth-range of 36–40 metres and the highest of 62·06 kg. per hour in July at a depth range of 31–35 metres. The catch rates mostly were above 10 kg. and at times exceeding even 20 kg. per hour at various depth-ranges.

Veraval Region

The fishing depths ranged between 26–30 metres and 61–65 metres (Fig. 5) but much of the fishing was done in the depth-ranges of 36–40 metres and 41–45 metres. There was no prawn catch during January to March and also October when the fishing was below 41–45 metres depth-range. In September there was no fishing. The catch rates ranged between 3·10 kg. per hour with a catch of 36 kg. in April at a depth-range of 36–40 metres and 66·93 kg. per hour with the highest catch of 1,692 kg. in August at a depth of 41–45 metres. High catch rates of 57·27 kg. in August and 35·79 kg. per hour in June were registered at the depth-ranges of 46–50 metres and 51–55 metres respectively. Catch rates above 15 kg. were very often met with at various depth-ranges.

Cambay Region

Fishing was more or less uniformly distributed between the depth-ranges of 26–30 metres and 71–75 metres (Fig. 6). Fishing with no prawn yield was at the dapth-ranges of 36–40 metres in February and 31–35 metres and 36–40 metres in December. The lowest catch rate of 2·78 per hour with the catch of 18 kg. at the depth-range of 41–45 metres. in September and the highest catch rate of 37·26 kg. per hour with the catch of 702 kg. at the depth range of 61–65 metres in July were observed in this region. In general the catch rates were mostly above 15 kg. per hour at different depth-ranges.

Bombay Region

Fishing in 1962 was carried out during May and September only. In May the fishing was at the depth-range of 41–45 metres when the prawn catch was nil. In September there was an exceptionally good catch of 378 kg. with a catch rate of 112·82 kg. per hour at the depth-range of 46–50 metres.

The Government of India vessel, *M.F.V.* '*Jheenga*', fished between the depths 9 and 60 metres in different areas in 1962, covering the major areas between 23° N. and 17° N. Most of the areas fished in different months at all the depth-ranges could not give any picture of the depth-wise distribution as the prawn catch was nil except in 20–72, 19–72, 17–72 and 17–73 as detailed below.

In January the area 20–72 had the maximum of 5 kg. per hour with the catch of 10 kg. in the depth-range 36–40 metres. The catch of 37 kg. with 1·89 kg. per hour was in the depth-range of

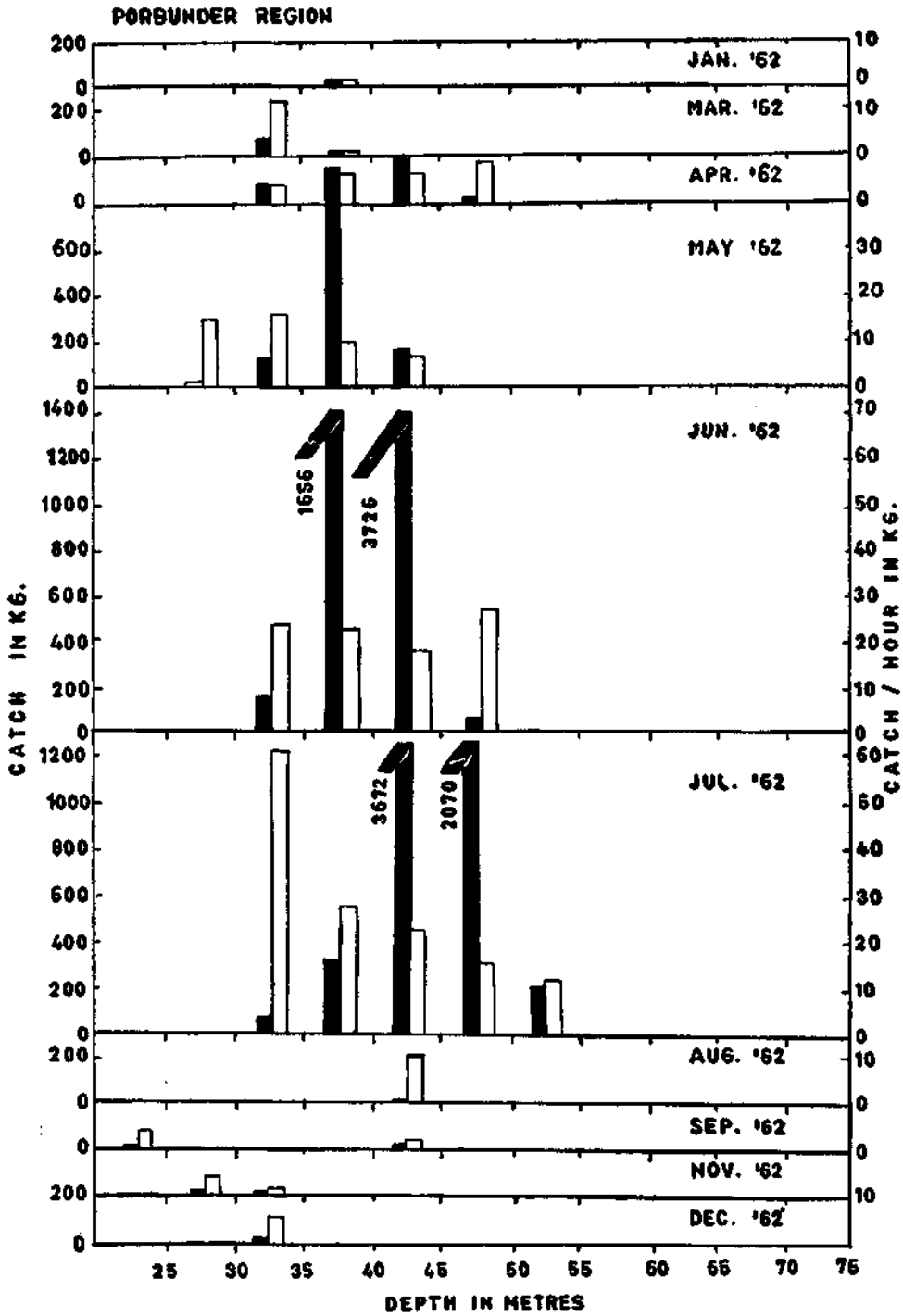

FIG. 4. Depth-wise distribution of prawns in the landings of New India Fisheries bull-trawlers in Porbundar region.

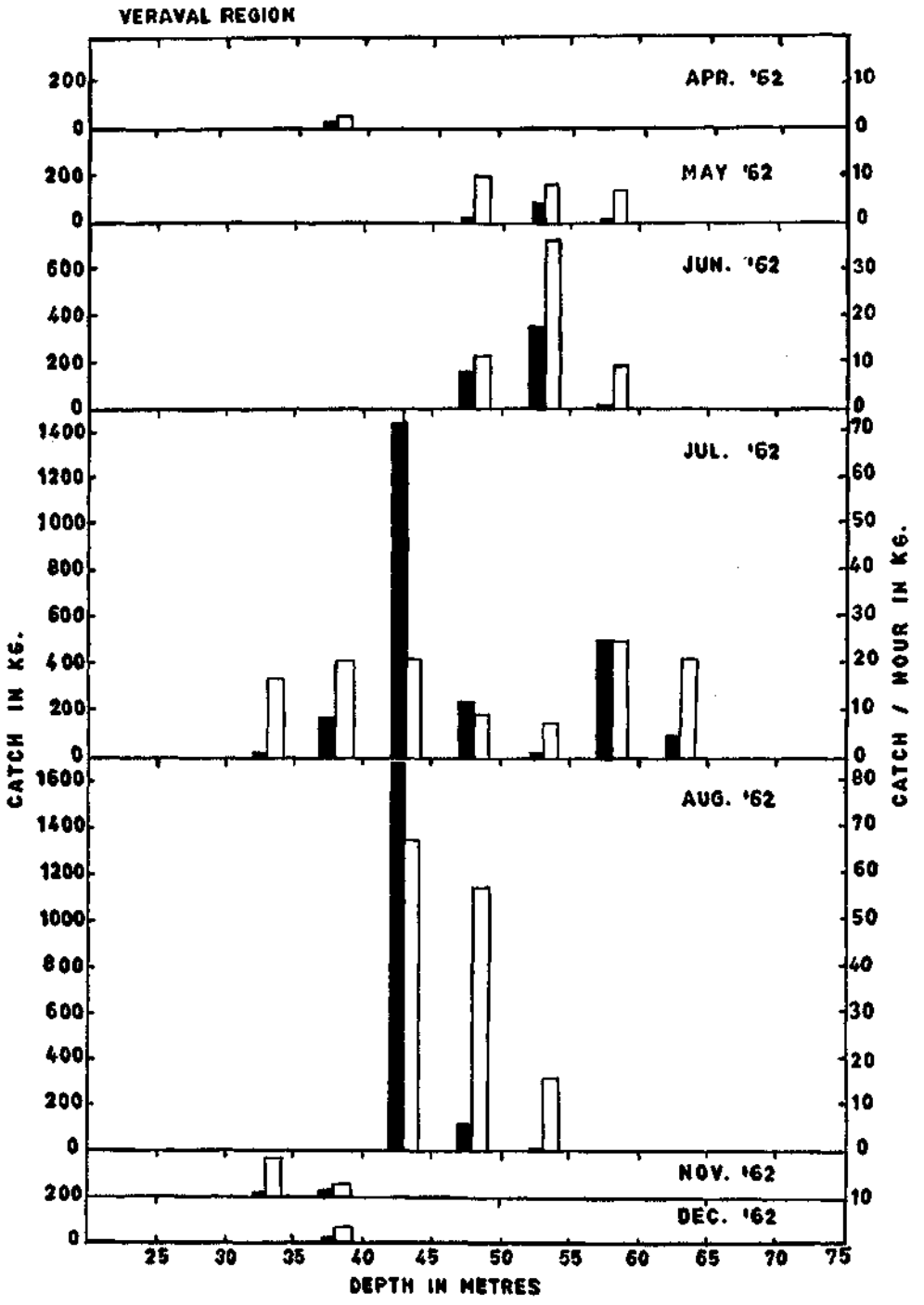

FIG. 5. Depth-wise distribution of prawns in the landings of New India Fisheries bull-trawlers in Veraval region.

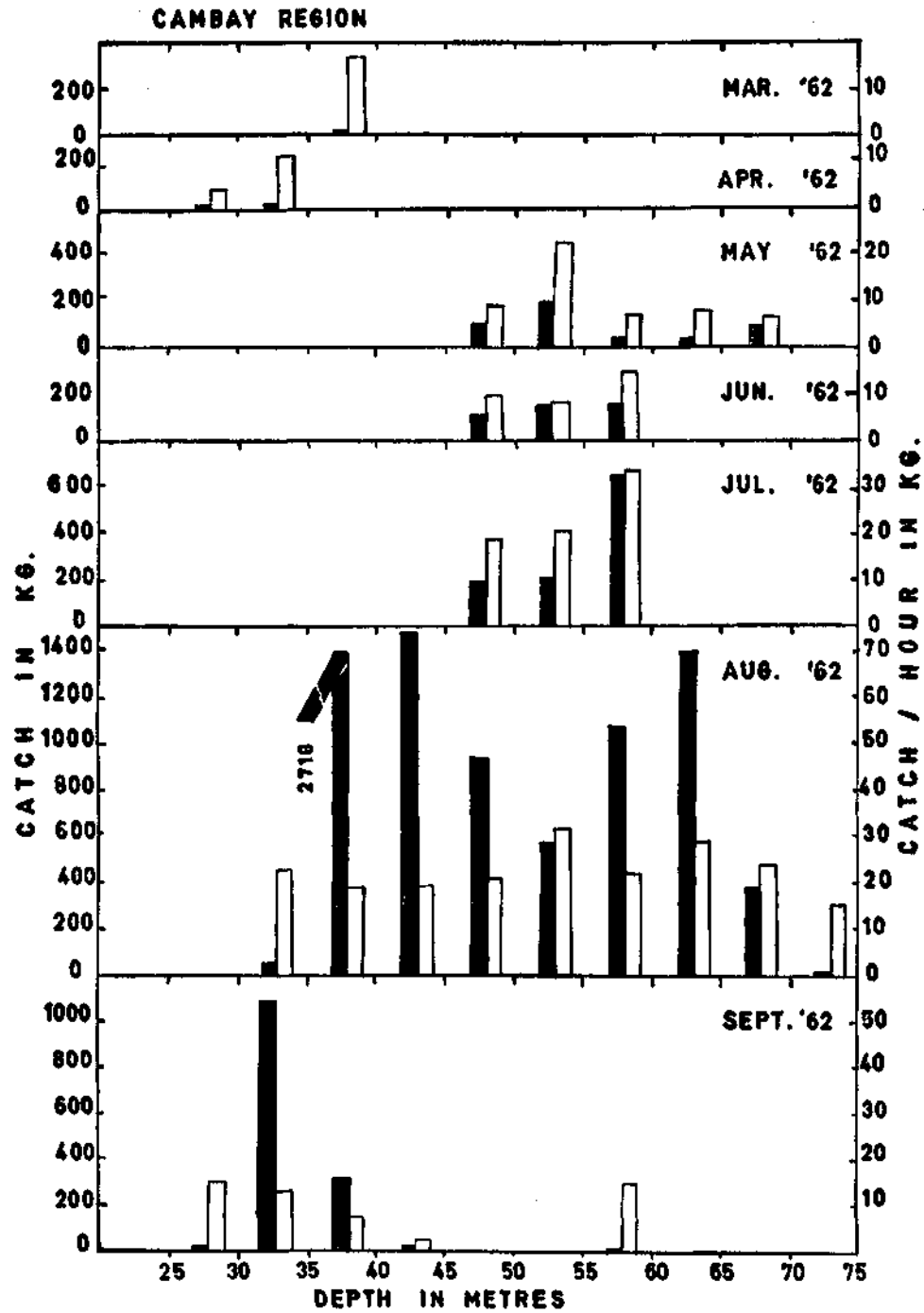

FIG. 6. Depthwise distribution of prawns in the landings of New India Fisheries bull-trawlers in Cambay region.

26–30 metres while in the depth-range of 31–35 metres the catch of 30 kg. had 1·62 kg. per hour of fishing.

The area 19–72 was fished from January to March and also in June and October (Fig. 7) with no prawn catch in January when the fishing was between the depth-ranges 26–30 metres and 46–50 metres and in March in the depth-ranges of 31–35 metres and 36–40 metres. February showed the catches of 14 kg. with 1·27 kg. per hour and 30 kg. with 1·61 kg. per hour in the depth ranges of 31–35 and 36–40 metres. In the very next higher and lower depth-ranges, the catch was nil. In June the catch rates were fairly good ranging between 4 kg. and 16·66 kg. per hour in the different depth-ranges fished. The highest of 16·66 kg. for the catch of 25 kg. was in the depth-range of 31–35 metres. There was a small catch of only 1 kg. with the catch rate of 0·28 kg. per hour in December in the depth-range of 16–20 metres while in the next two higher depth-ranges, the catch was nil.

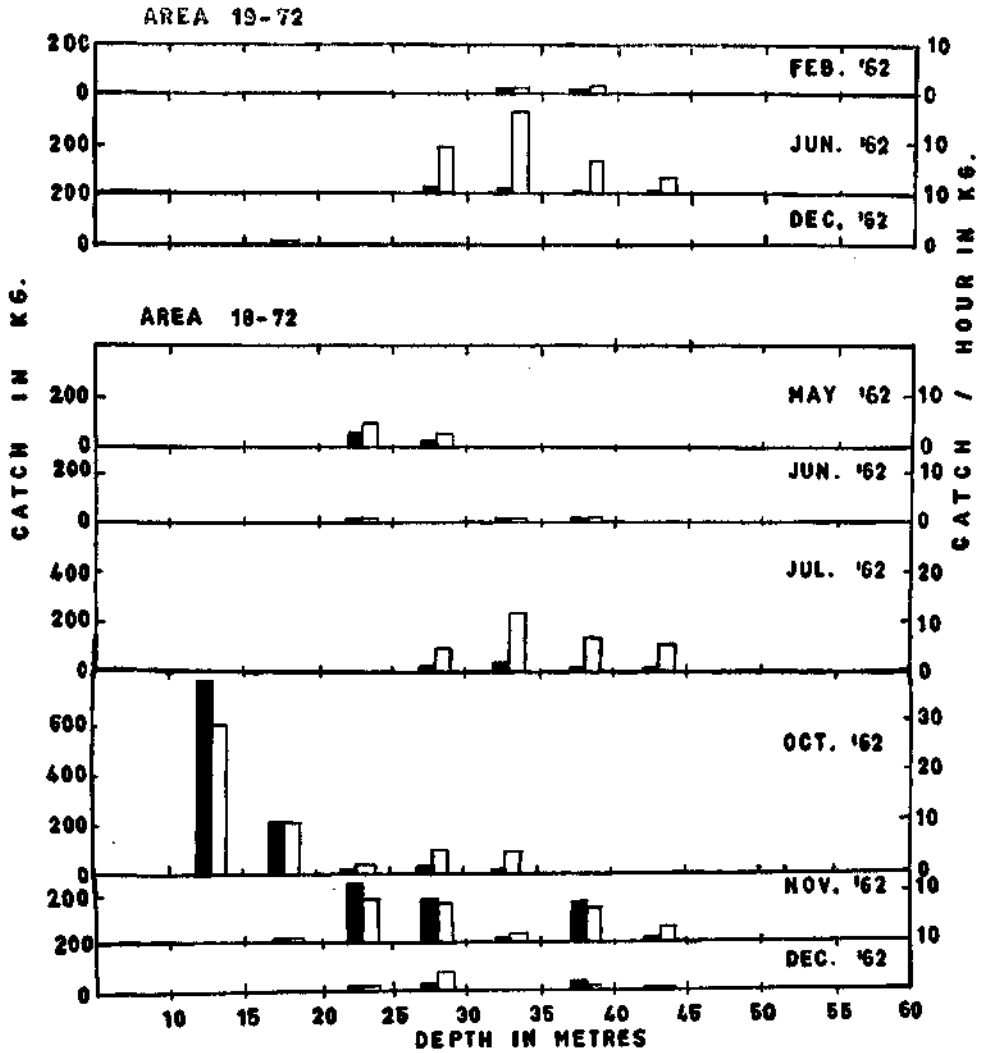

FIG. 7. Depthwise distribution of prawns in the landings of otter-trawlers of Government of India Deep Sea Fishing Station, Bombay, in the areas 19–72 and 18–72.

Fishing in area 18–72 in the first 4 months of the year, covering the depth ranges between 16–20 metres and 51–55 metres (Fig. 7) did not register any prawn catch and there was no fishing in August and September. During rest of the 6 months, the catch rates ranged between 0·64 kg. per hour for the catch of 5 kg. in the depth-range of 21–25 metres in December and 29·98 kg. per hour for the highest catch of 788 kg. in the depth-range of 11–15 metres in October. In fairly good number of other depth-ranges, the catch rates varied between 5 and 12 kg. in different months.

The area 17–72 was fished in May at the two successive depth-ranges of 21–25 metres and 26–30 metres when the catches were like 65 kg. with the catch rate of 8·12 kg. per hour and 70 kg. with the catch rate of 5·60 kg. per hour respectively.

The area 17–73 which was also fished in May had a very good catch rate of 21·14 kg. per hour for the catch of 185 kg. in the depth range of 26–30 metres.

Generally fishing by these trawlers was concentrated between the depth-ranges of 21–25 metres and 46–50 metres. It is observed that the catch rates were less than 10 kg. per hour in Kutch and Dwarka regions, and up to 20 kg. and even more in other regions at differant depth-ranges covered by bull-trawlers. The catch rates were between 5 and 12 kg. per hour in the Bombay region and 8 and 21 kg. in south of Bombay for the vessel *M.F.V.* '*Jheenga*'.

The above observations, based on the operations of bull-trawls and other trawls in Bombay-Saurashtra waters show that the prawns are not confined in their distribution to any particular depth range; that they inhabit in higher or lower densities of populations at all depths between 9 and 72 metres and that they occur in good quantity in as shallow a depth-range as 11–15 metres and as deep a depth-range as 61–65 metres.

Seasonal Variations

Unlike some of the commercially important fish species, the prawns in general are not highly seasonal in their occurrence in the trawler landings. They are found all round the year. All the same, in certain months they occur in comparatively greater abundance. The catch usually begins to rise by May and dwindles down by November, accompanied with slight variations and exceptions in the trawling grounds of the different regions.

Kutch Region

This region was fished regularly in almost all the months from 1960 onwards. Prawn catch showed a tendency to increase from May onwards, with an annual average of 0·5% and to decrease after October when the annual average was 0·36%. The period from July to October was the peak one for prawn catches, the percentage in July ranging between 0·69 with the catch of 810 kg. in 1961 and 1·03 with the catch of 216 kg. in 1960 whereas in October between 0·15 with the catch of 450 kg. in 1960 and 0·92 with the catch of 1,080 kg. in 1963. However, a fairly good catch of 1,026 kg. forming 0·64% of the total landings was met with in March 1963 (Table XIII).

Dwarka Region

Excepting in 1960 and 1961, there was almost no fishing from May to September in the Dwarka region. Though the catch was good forming 1·24% in April 1963, 1·12% in May 1962 and 1·28% in June 1960 and with no sufficient information about July and August, high catch percentages were obtained in most of the years from September to December. Very high percentages of 4·54 with the catch of 666 kg. and 4·10 with the catch of 162 kg. were obtained in November 1962 and October 1963 respectively (Table IV).

TABLE XIII

*Monthly prawn catch by bull-trawlers of New India Fisheries Co. in Kutch region**

Year / Month	1958 Catch in kg. (catch rate) %	1959 Catch in kg. (catch rate) %	1960 Catch in kg. (catch rate) %	1961 Catch in kg. (catch rate) %	1962 Catch in kg. (catch rate) %	1963 Catch in kg. (catch rate) %	Average Catch in kg. (catch rate) %
January	..	..	198 (0·62) 0·06	558 (1·58) 0·17	198 (0·50) 0·04	414 (1·31) 0·14	342 (3·95) 0·10
February	..	..	36 (0·10) 0·01	180 (0·51) 0·04	702 (1·98) 0·19	36 (0·11) 0·01	238 (0·70) 0·06
March	..	0	270 (0·65) 0·06	558 (1·42) 0·14	54 (0·16) 0·01	1,026 (4·95) 0·64	362 (1·28) 0·13
April	..	261 (1·09) 0·12	1,350 (3·75) 0·42	1,242 (4·17) 0·42	486 (2·96) 0·36	252 (2·26) 0·29	718 (3·06) 0·34
May	..	..	744 (3·04) 0·32	396 (3·11) 0·36	1,854 (9·30) 0·96	..	998 (5·25) 0·50
June	..	..	522 (14·59) 2·02	54 (0·80) 0·12	..	..	144 (4·87) 0·76
July	..	..	216 (10·64) 1·03	810 (4·22) 0·69	..	18 (4·15) 0·90	348 (4·82) 0·74
August	..	..	2,070 (5·97) 0·96	126 (1·40) 0·26	54 (3·10) 0·60	..	750 (4·97) 0·82
September	..	..	846 (2·46) 0·30	630 (4·58) 0·51	432 (7·11) 1·01	1,153 (5·29) 0·61	555 (2·92) 0·42
October	..	0	450 (1·49) 0·15	648 (3·49) 0·29	576 (12·06) 0·86	1,080 (6·33) 0·92	551 (3·60) 0·36
November	18 (0·57) 0·11	54 (0·48) 0·03	774 (3·51) 0·29	738 (4·85) 0·47	432 (3·19) 0·35	..	403 (3·09) 0·28
December	..	162 (0·75) 0·06	1,260 (2·79) 0·34	558 (1·77) 0·15	72 (0·41) 0·04	..	362 (1·91) 0·19

* There was no fishing in 1956 in this region. In 1957 there was fishing only in December and the catch was nil.

TABLE XIV

Monthly prawn catch by bull-trawlers of the New India Fisheries Co. in Dwarka region

Year / Month	1956 Catch Kg. (c.p.h.) %	1957 Catch Kg. (c.p.h.) %	1958 Catch Kg. (c.p.h.) %	1959 Catch Kg. (c.p.h.) %	1960 Catch Kg. (c.p.h.) %	1961 Catch Kg. (c.p.h.) %	1962 Catch Kg. (c.p.h.) %	1963 Catch Kg. (c.p.h.) %	Average Catch Kg. (c.p.h.) %
January	..	54 (0·17) 0·02	36 (0·29) 0·04	90 (0·96) 0·18	54 (0·56) 0·08	0	0	0	33 (0·35) 0·05
February	..	0	126 (0·72) 0·06	90 (0·40) 0·06	0	0	90 (3·67) 0·47	0	44 (0·41) 0·06
March	...	54 (0·22) 0·04	0	144 (0·53) 0·10	0	72 (1·07) 0·01	0	0	39 (0·34) 0·05
April	0	0	..	63 (0·52) 0·09	0	0	18 (1·84) 0·35	90 (7·37) 1·24	24 (0·60) 0·11
May	..	..	..	..	72 (2·81) 0·31	36 (2·94) 0·39	108 (7·80) 1·12	..	72 (4·20) 0·05
June	..	..	..	..	288 (15·44) 1·28	18 (1·43) 0·20	..	..	153 (9·80) 0·97
July	..	..	..	..	..	18 (1·02) 0·20	..	..	18 (1·02) 0·20)
August	..	..	..	..	0	18 (2·37) 0·39	..	..	9 (0·95) 0·18
September	..	..	..	..	216 (3·10) 0·41	126 (12·35) 2·87	..	234 (5·96) 0·50	192 (4·83) 0·55
October	..	990 (11·30) 1·81	90 (2·66) 0·31	18 (0·28) 0·04	0	198 (4·28) 0·32	144 (10·21) 0·68	162 (23·41) 4·10	229 (6·17) 0·74
November	504 (1·66) 0·14	1,080 (3·02) 0·74	1,746 (6·23) 0·75	216 (5·1) 0·50	18 (1·54) 0·29	..	666 (26·57) 4·54	..	705 (4·29) 0·54
Dcember	0	126 (1·05) 0·24	702 (4·04) 0·63	72 (3·54) 0·71	72 (2·98) 0·68	0	0	..	139 (1·26) 0·21

Porbundar Region

The fishing operations in this region were carried out in almost all the months every year, but the catch with an exception in October 1963, when it formed 0·97%, proved to be quite poor in almost all the years from September to November. The catch started increasing from May and showed a good peak from June to August with the highest annual average of 1·70% in July when the percentages ranged from 0·37 with the catch of 216 in 1958 and 2·69 with the lowest catch of 18 kg. in 1956. The highest catch of 6,372 kg. in July was in 1962 and it formed 2·61% of the total landings. A fairly good catch of 468 kg. giving 0·68% was observed in April 1962 (Table XV).

Veraval Region

The fishing was fairly good throughout. Very high percentages of prawns were noticed from May to October extending even upto December. The best months were from July to September when the average annual percentages ranged between 1·31 and 1·75. The catch in May was fairly good and excepting in 1957 and 1958, it ranged from 0·50% with the catch of 297 kg. in 1959 to 1·32% with the catch of 162 kg. in 1962. August catch was the best with its percentages varying between 0·44 with the catch of 324 kg. in 1958 and 6·67 with the catch of 1,836 kg. in 1962. November showed an indication of a good catch with 0·66% for a small catch of 36 kg. in 1962. In December 1961 very high percentage of 4·81 was shown with a catch of 54 kg. In March 1958, there was a fairly good record of 126 kg. forming 0·73% (Table XVI).

Cambay Region

Fishing was good throughout. High prawn yields in this region were noticed for a fairly prolonged period every year, from March to November when the average annual percentages were 0·55 and 0·86 respectively. The best period for prawn was observed to be from June to October when the average annual percentages varied from 1·08 to 1·83. Fairly good prawn catches forming 1·43% and 1·32% in March 1962 and 1963 respectively and also in certain years forming above 0·46% in April were observed in this region. Very high percentage of 7·44 with the catch of 2,304 kg. was recorded in July 1962. In most of the years, the highest catch recorded was in September when the percentages varied between 1·01 with the catch of 1,458 kg. in 1962 and 2·94 with the catch of 6,732 kg. in 1957. In November 1957 the highest prawn percentage of 5·88 for the year was recorded when the catch was 54 kg. (Table XVII).

Bombay Region

The fishing by the bull-trawlers in this region was comparatively very poor. The effort of 703·92 hours put in the 9 months fishing in 1956 alone was good, but in the subsequent 3 years it was less being 75·77, 79·74 and 91·75 hours. In the last 3 years the effort was reduced to 11·24, 1·75 and 5·69 hours only. However, the data are far too insufficient to draw any conclusions (Table XVIII).

Prawns started appearing in the catches of this region from March and continued to occur in increasing quantities till October, the peak period shown being from July to October with the last two months as the best months. In September 1962, the highest percentage of 16·32 with a catch of 378 kg. and in October also of the same year, a very high percentage of 15 to 29 with the catch of 234 kg. were recorded. The highest yield of 1,782 kg. in this region giving 3·56% was in July 1956.

To supplement the information and to substantiate the results obtained, the data from operations of the Government of India vessels in the major area 18–72 was made use of. Prawns started appearing in good quantity from May and extended upto December with July to October as an extremely good period for this fishery. Highest of 28·25% with a catch of 4,826 kg. was obtained in September 1962. The highest yield of 4,827 kg. had 11·79% in October 1961. A catch of 1,340 kg. formed 10·31% in August 1963. A very good catch of 2,833 kg. forming 6·59% was met

TABLE XV

Monthly prawn catch by bull-trawlers of New India Fisheries Co. in Porbundar region

Year / Month	1956 Catch Kg. (c.p.h.) %	1957 Catch Kg. (c.p.h.) %	1958 Catch Kg. (c.p.h.) %	1959 Catch Kg. (c.p.h.) %	1960 Catch Kg. (c.p.h.) %	1961 Catch Kg. (c.p.h.) %	1962 Catch Kg. (c.p.h.) %	1963 Catch Kg. (c.p.h.) %	Average Catch Kg. (c.p.h.) %
January	..	0	18 (0·05) 0	180 (0·56) 0·09	0	90 (3·84) 0·50	18 (0·81) 0·17	0	44 (0·35) 0·05
February	..	0	36 (0·24) 0·04	54 (0·31) 0·05	36 (0·59) 0·08	..	0	0	21 (0·21) 0·03
March	..	0	0	54 (0·35) 0·06	0	..	90 (3·16) 0·30	18 (0·13) 0·01	27 (0·19) 0·04
April	0	0	36 (0·39) 0·04	36 (0·75) 0·10	0	72 (1·53) 0·15	468 (6·22) 0·68	216 (1·90) 0·23	104 (1·17) 0·15
May	18 (1·56) 0·34	0	360 (2·78) 0·39	45 (1·25) 0·17	306 (3·52) 0·39	252 (2·21) 0·23	1,062 (40·84) 1·05	90 (8·13) 2·08	267 (3·99) 0·46
June	..	0	468 (6·71) 1·23	234 (3·37) 0·59	3,150 (10·72) 2·00	612 (2·64) 0·37	5,580 (19·38) 2·04	504 (1·45) 0·21	1,507 (8·06) 1·16
July	18 (4·31) 2·69	540 (5·48) 1·42	216 (1·78) 0·37	342 (3·65) 0·83	3,816 (10·88) 1·95	540 (4·84) 0·87	6,372 (20·24) 2·61	2,610 (8·71) 1·26	1,807 (10·37) 1·70
August	0	..	..	..	414 (13·42) 3·91	216 (3·52) 0·74	36 (2·87) 1·45	36 (3·13) 0·97	140 (0·58) 1·51
September	0	0	..	..	..	0	36 (1·69) 0·44	0	7 (0·83) 0·32
October	..	0	0	0	0	36 (3·16) 0·43	..	54 (8·09) 0·97	15 (0·92) 0·14
November	0	54 (0·35) 0·07	0	0	0	0	36 (1·50) 0·20	..	13 (0·28) 0·04
December	0	18 (0·06) 0·01	108 (0·38) 0·05	0	18 (1·03) 0·11	18 (0·54) 0·03	36 (3·34) 0·58	..	28 (0·30) 0·04

TABLE XVI

Monthly prawn catch by bull-trawlers of New India Fisheries Co. in Veraval region

Year / Month	1956 Catch Kg. (c.p.h.) %	1957 Catch Kg. (c.p.h.) %	1958 Catch Kg. (c.p.h.) %	1959 Catch Kg. (c.p.h.) %	1960 Catch Kg. (c.p.h.) %	1961 Catch Kg. (c.p.h.) %	1962 Catch Kg. (c.p.h.) %	1963 Catch Kg. (c.p.h.) %	Average Catch Kg. (c.p.h.) %
January	..	0	18 (0·34) 0·06	9 (0·17) 0·03	0	90 (2·40) 0·21	0	0	17 (0·64) 0·08
February	..	0	0	0	18 (0·82) 0·09	..	0	0	3 (0·11) 0·01
March	..	0	126 (3·66) 0·73	0	0	0	0	90 (1·57) 0·20	31 (1·61) 0·24
April	0	0	0	0	18 (1·09) 0·11	0	36 (3·10) 0·25	54 (1·00) 0·12	14 (0·74) 0·08
May	36 (3·58) 0·84	0	18 (0·72) 0·10	297 (2·96) 0·50	432 (6·68) 0·98	162 (4·54) 0·74	162 (3·07) 1·32	..	158 (4·10) 0·67
June	..	486 (2·76) 0·44	216 (4·20) 0·84	756 (6·44) 1·01	828 (6·42) 1·07	450 (7·18) 1·24	558 (20·72) 4·61	360 (2·66) 0·49	522 (5·23) 0·89
July	0	828 (5·16) 1·17	216 (0·86) 0·14	792 (7·89) 1·57	810 (8·44) 2·06	414 (6·42) 1·78	2,484 (18·77) 3·29	468 (6·77) 1·04	752 (6·88) 1·31
August	198 (10·77) 0·72	306 (11·77) 1·34	324 (3·4) 0·44	270 (5·91) 1·38	540 (17·22) 4·50	1,656 (11·46) 1·38	1,836 (64·19) 6·67	90 (4·35) 1·09	652 (12·79) 1·68
September	0	0	126 (4·11) 0·62	54 (46·15) 5·35	..	576 (15·67) 3·01	..	..	151 (8·86) 1·75
October	..	0	0	18 (3·77) 1·44	..	18 (5·14) 2·27	0	..	7 (1·51) 0·66
November	0	0	..	0	18 (4·07) 0·45	..	36 (4·85) 0·66	..	11 (1·94) 0·28
December	0	0	0	0	..	54 (38·57) 4·81	18 (1·68) 0·36	..	12 (0·33) 0·06

TABLE XVII

Monthly prawn catch by bull-trawlers of New India Fisheries Co. in Cambay region

Year / Month	1956 Catch Kg. (c.p.h.) %	1957 Catch Kg. (c.p.h.) %	1958 Catch Kg. (c.p.h.) %	1959 Catch Kg. (c.p.h.) %	1960 Catch Kg. (c.p.h.) %	1961 Catch Kg. (c.p.h.) %	1962 Catch Kg. (c.p.h.) %	1963 Catch Kg. (c.p.h.) %	Average Catch Kg. (c.p.h.) %
January	..	0	0	27 (0·27) 0·05	0	0	..	0	5 (0·19) 0·03
February	..	..	0	18 (0·20) 0·01	18 (3·15) 0·37	..	0	0	7 (0·22) 0·01
March	..	0	0	0	..	..	18 (5·50) 1·43	540 (9·81) 1·32	112 (3·38) 0·55
April	0	0	90 (0·69) 0·09	36 (2·42) 0·46	72 (3·74) 0·66	36 (3·55) 0·65	54 (7·71) 0·79	90 (1·54) 0·25	47 (0·83) 0·13
May	432 (1·96) 0·22	738 (4·94) 0·73	180 (1·30) 0·21	450 (3·68) 0·80	18 (0·90) 0·27	288 (6·11) 1·15	534 (10·12) 2·08	0	330 (3·51) 0·53
June	288 (4·41) 0·72	4,878 (14·53) 1·01	180 (3·04) 0·60	396 (5·41) 1·06	36 (3·44) 0·63	432 (5·22) 1·13	450 (10·14) 2·22	72 (2·52) 0·52	842 (9·63) 1·78
July	540 (3·19) 0·27	1,890 (7·47) 1·01	270 (2·20) 0·36	864 (8·08) 1·45	504 (8·25) 1·86	252 (4·82) 0·97	2,304 (32·43) 7·44	414 (5·77) 0·90	880 (7·76) 1·08
August	2,412 (7·89) 1·49	6,714 (13·88) 1·81	3,024 (7·73) 0·95	3,720 (11·79) 2·00	126 (6·78) 1·40	2,358 (12·52) 2·45	8,658 (22·02) 2·33	1,602 (3·52) 0·53	3,577 (11·22) 1·46
September	2,106 (10·11) 1·30	6,732 (18·05) 2·94	3,654 (9·19) 1·19	3,060 (10·12) 1·71	..	5,364 (19·61) 2·88	1,458 (10·19) 1·01	504 (7·80) 1·24	3,268 (12·98) 1·83
October	612 (3·63) 0·48	2,520 (10·06) 1·94	2,592 (7·32) 0·82	1,368 (12·03) 3·40	..	..	..	0	1,418 (7·96) 1·15
November	0	54 (7·54) 5·88	0	..	..	..	..	..	18 (2·95) 0·86
December	..	0	0	..	..	..	..	..	0

with in May 1964. A fairly good prawn catch appeared in December also, forming 3·09% with the catch of 480 kg. in 1963. However, in January 1961, there appeared exceptionally good catch of 400 kg. giving 1·61% in this region.

TABLE XVIII

Monthly prawn catch by bull-trawlers of New India Fisheries Co., Bombay region

Year / Month	1956 Catch Kg. (c.p.h.) %	1957 Catch Kg. (c.p.h.) %	1958 Catch Kg. (c.p.h.) %	1959 Catch Kg. (c.p.h.) %	1960 Catch Kg. (c.p.h.) %	1961 Catch Kg. (c.p.h.) %	1962 Catch Kg. (c.p.h.) %	1963 3Ctch Kg. (c.p.h.) %	Average Catch Kg. (c.p.h.) %
January	..	0	..	..	..	..	..	..	0
February	..	..	0	0	..	..	..	..	0
March	..	..	0	0	..	..	..	18 (3·42) 0·79	6 (0·74) 0·17
April	..	378 (81·00) 25·59	0	18 (3·54) 0·88	18 (5·26) 2·67	—	—	—	104 (22·22) 8·84
May	54 (1·37) 0·28	0	0	18 (0·08) 0·38	36 (8·16) 3·38	—	0	—	18 (0·93) 0·19
June	810 (3·13) 0·47	0	54 (2·93) 1·16	0	..	—	..	..	216 (3·05) 0·48
July	1,782 (11·56) 3·56	18 (5·66) 1·23	18 (13·53) 2·55	..	0	—	..	—	454 (11·20) 3·42
August	0	0	0	..	..	18 (10·28) (4·08)	..	..	5 (2·76) 0·80
September	828 (8·90) 0·70	288 (8·05) 4·74	54 (4·44) 1·27	216 (12·86) 3·51	..	..	378 (112·83) (16·32)	..	353 (10·96) 1·28
October	1,494 (9·57) 1·07	234 (93·60) 15·29	18 (1·63) 0·35	252 (21·31) 5·68	..	..	..	..	500 (11·03) 1·33
November	0	..	0	..	..	..	..	..	0
December	..	..	..	0	..	..	..	..	0

Right from Kutch in the north to Bombay in the south, the prawn catch shows a good rise from May onwards till October. The tendency towards increase is observed as early as March-April in almost all the regions. In regions excepting Kutch and Porbundar, the fishery continues to be good till November-December. In general, July to October with slight shift at times by a month this side or that, is noticed to be the peak period in all the regions excepting Dwarka where it is from September to December. The best months within this peak period vary in different regions. January and February are the poorest months for this fishery in Bombay region.

Prawn Catch from Trawls in Other Parts of India

Several of the Government of India exploratory fishing vessels are operating on the east and west coasts of India with bases at Mangalore ,Cochin, Tuticorin and Waltair. At Mangalore in addition to these, a good number of mechanised vessels belonging to the State Fisheries Department and at. Karwar and Cochin, vessels belonging to the Indo-Norwegian Project are also engaged in fishing. The reports (monthly offshore catch data: Central Marine Fisheries Research Institute, Mandapam Camp) on the operations of the above vessels for the period April 1963 to March 1964 give the following information.

Karwar

The fishing started in September 1963. The effort put in 7 months was 844·8 hours for a total catch of 167,092 kg., of which prawn formed 11,131 kg. giving 6·66% with a catch rate of 13·17 kg. per hour. There was no record for prawns in September and October 1963. The percentages of prawn catches ranged between 4·50 in January for a catch of 1,186 kg. and 14·01 in February for a catch of 3,938 kg. with the highest catch rate of 33·28 kg. per hour of fishing in the latter month.

Mangalore

There was no fishing during the monsoon months of June to August. A number of boats working here had an annual landing of 1,432,149 kg. of which 487,146 kg. forming 34% were prawns. The monthly analysis of the Government of India vessels alone showed that the highest of 27·07% and the catch rate of 61·33 kg. per hour for the prawn yield of 1,840 kg. was obtained in January 1964. But April showed a maximum catch of 4,327 kg. forming 24·54% with 55·47 kg. per hour of fishing. The lowest catch of 120 kg. giving 5·27% and 7·50 kg. per hour of fishing was in February 1964.

Kozhikode

The recorded data for Kozhikode show fishing operations during April, May and October to December 1963. A very high prawn catch of 159,786 kg. in the total landings of 225,910 kg. fished in 4,208 hours was obtained giving 70·72% with 38 kg. per hour of fishing during the period. The catch which was almost steady ranged between 66·19% in April and 78·07% in November. But in the previous year though November showed a high catch of 111,681 kg. forming 80·78%, the highest of 82·70% for a catch of 45,612 kg. was obtained in February.

Cochin

The Indo-Norwegian vessels based at Cochin did not fish in July 1963. They showed a poor prawn catch of only 20,323 kg. forming 20·68% with 23 kg. per hour of fishing. The Government of India vessels working there had 22·59% for the prawn catch of 26,966 kg. when the catch rate was 47 kg. per hour. This year proved to be poor for prawns in this region because in the earlier two years the Indo-Norwegian vessels had the annual prawn percentages of 52·06 and 46·44. The monthly percentage catch in 1963–64 ranged from 2·55 in September to 70·33 in June, but in the earlier two years the highest of 79·42% and 59·30% were in February.

Tuticorin

Coming to the east coast where the general catch is much smaller, the annual prawn yield in Tuticorin was 3,833 kg. giving 2·95% at a cacth rate of 4·29 kg. per hour when the effort put was 892·44 hours and the total landings were 129,798 kg. In April 1963, February and March 1964, the prawn catch was nil. The catch ranged between 0·06% in January and 10·96% in September.

Waltair

The prawns formed 3·46% of the total catch of 238,737 kg. fished in 2,200 hours. The prawn yield was 8,272 kg. with the catch rate of 3·75 kg. In January there was no record of prawn. The percentage of catch ranged from 0·03 in August for the catch of 4 kg. and 19·81 in February for the catch of 1,720 kg.

There were no fishing operations by the trawlers at Calcutta during this year, but the earlier records show that in 1962–63 the annual prawn catch of 119 kg. gave 0·11% and in 1961–62, the catch of 15,059 kg. gave 3·09%.

From the foregoing account it is seen that the prawn resources in the grounds trawled increase from north to south along the west coast of India, being fair to moderate from Kutch to Veraval, good in Cambay and Bombay, better in Karwar and Mangalore and best in Kozhikode-Cochin regions. On the east coast, however, the resources all through appear to be poor off Tuticorin, Waltair and West Bengal in so far as the data reveal.

General Considerations

That richness of different areas is judged on the basis of catch rates obtainad in trawling is well known. If the catch rates are thus to be used as an index, it is desirable that the vessels and the gear employed should be identical. In the case of bull-trawling by the New India Fisheries vessels, the size and construction of 'Arnalla'-'Paj' and 'Satpati'-'Pilotan' as also their gear are identical. The coverage obtained so far in the regions and areas in different months over several years is very adequate and the results are comparable. For determining the relative seasonal and regional abundance of prawn catches the conclusions arrived at are mostly based on the operations of the vessels of the New India Fisheries Company. The vessels operated by the Government of India Deap Sea Fishing Station are of different constructional design and fishing powers, as pointed out by Rao and Meenakshisundaram (1964) it is imperative in such cases to know their relative fishing power factors and convert accordingly the fishing time of different vessels to standard units for assessing the relative potentialities of the resources in different areas.

It may be noted that the gear employed by the New India Fisheries vessels or the Government of India fishing vessels are not specially suited for shrimp trawling. The bull-trawls by the former and the otter-trawls by the latter are no doubt efficient for catching varieties of demersal fish but their prawn catches should be considered only incidental. In Veraval region in May 1964, in area 20–70: 6 B, fished by the Government of India vessel *M.L. 'Sagarpravasi'*, the prawn catch by Shrimp trawl was 600 kg. with 35·29 kg. per hour of trawling as compared to 394 kg. of catch at 19·95 kg. per hour by Otter-trawl. It may thus be seen that the amount of catch can be substantially increased by using the right type of gear in areas shown as very productive ones. For instance very rich prawn grounds have been revealed by the present investigations in Bombay and Cambay regions which if sufficiently exploited by suitable gear in May to October months will not fail to yield adequate amount of large-sized prawns fit for export trade.

It is worthwhile giving here a brief account of the distribution of the prawn species in the offshore waters and comparing them with those obtained in the inshore waters. In Bombay the more commonly occurring species obtained in the trawler catches are *Metapenaeus affinis, M. monoceros, Parapenaeopsis stylifera* and *P. hardwickii* along with less common species as *Solenocera indicus, Palaemon tenuipes, Penaeus penicillatus, P. monodon* and *Hippolysmata ensirostris*. In the inshore waters there is a rich variety of species of which the more common are *Palaemon tenuipes, Parapeneopsis hardwickii, P. stylifera, P. sculptilis, Metapenaeus affinis, M. brevicornis, Solenocera indicus* and *Hippolysmata ensirostris* along with the less common forms as *M. dobsoni, M. monoceros, Metapenaeopsis novaeguineae, Parapenaeopsis cornutus, Palaemon stiliferus, Penaeus monodon, P. semisulcatus* and *P. penicillatus. Macrobrachium rosenbergii* and *M. malcolmsoni* which are found

common in Hooghly estuary and Kerala backwaters are only occasionally met with in the region (Shaikmahmud and Tembe, 1960; Kunju, 1964*).

In Kutch region *M. monoceros*, *M. brevicornis* and *M. kutchensis* comprise the important prawn species. In Veraval *M. affinis* constitutes the bulk of the catch followed by *M. monoceros*, *Penaeus indicus* and *Parapenaeopsis stylifera*. South of Bombay upto Mangalore, *Metapenaeus affinis* is the dominant species in the offshore catches followed by *M. dobsoni*, *Parapenaeopsis stylifera* and *Penaeus indicus*. At Cochin *M. dobsoni* and *Parapenaeopsis stylifera* are the main species contributing to the major portion of the catches followed by *M. affinis* and *P. indicus*. On the east coast of India, in the landings by trawlers at Tuticorin and Visakhapatnam *P. indicus*, *P. monodon* and *M. monoceros* are the dominant species and at Calcutta in addition to these, *M. brevicornis* and *Parapenaeopsis stylifera* also occur in fair quantities (Annual and Quarterly Scientific Reports, Central Marine Fisheries Research Institute, 1963, 1964).

One interesting point to be noted in regard to the location of the rich prawn grounds in all the regions from Kutch in the North to Bombay in the South is that almost all of them fall about 20 fathom (36 metres) line on the continental shelf (Fig. 1). The areas falling about these depth zones are productive not only in regard to the prawn species, but also in respect of all commercially important fishes in general as observed by several workers of Central Marine Fisheries Research Sub-Station, Bombay, engaged in the analysis of landings by trawlers.

Summary

With a view to finding out the regional and seasonal abundance of the prawn catches in Bombay and Saurashtra waters, the catch data of the New India Fisheries Company's vessels and the Government of India vessels of the Deep Sea Fishing Station, Bombay, were analysed.

The New India Fisheries Company operated two pairs of bull-trawlers, 'Satpati'-'Pilotan' and 'Arnalla'-'Paj' between the latitudes 18° N. and 24° N. from April 1956 to October 1963; the Government of India vessels, *M.F.V.* '*Jheenga*', *M.F.V.* '*Bumili*', *M.L.* '*Meera*' and *M.L.* '*Sagarkanti*' fished between latitudes 16° N. and 23° N. on the continental shelf on the west coast of India, from January 1961 to June 1964, using Indian and Russian types of otter-trawls. For convenience of description, the areas covered by these vessels are grouped into Kutch, Dwarka, Porbundar, Veraval, Cambay and Bombay regions.

During the period for which the catch data have been analysed the prawn landings for bull-trawlers were the best in 1962 with a catch of 38,070 kg. and a catch rate of 10·04 kg. per hour of fishing, comprising 1·07% of the total landings. The highest prawn catch of 10,540 kg. for the otter-trawlers, was in 1961 with a catch rate of 6·04 kg. per hour, forming 1·74% in the total landings.

From the point of view of the abundance of the catch, the highest catch rates and also the highest percentage of prawns in the total landings, Cambay region ranked first. Catch rates were in the decreasing order in other regions, *viz.*, Bombay, Veraval, Porbundar, Kutch and Dwarka.

Of the areas covered by the bull-trawlers 'Q', 'R', 'S', 'T', 'V' and 'Y' in Kutch, 'L' and 'N' in Dwarka, 'H', 'E' and 'B' in Porbundar, '2' and '3' in Veraval '25', '24', '18', '17', '11' and '10' in Cambay and '48', '43 A', '43', '38' and '31' in Bombay regions appear to yield good prawn catches.

In the sub-areas '4 E', '2 D', '1 D', '1 B' and '3 A' in 19–72, '2 E' to '4 E', '5 C' to '5 E' and '6 C' to '6 E' in 18–72, '1 A', '1 B' and '2 A' in 17–73 and 4 F, and '6 F' in 17–72 covered by the otter-trawlers prawn resources are revealed to be high.

*Information elicited in personal discussion.

In the off-shore grounds covered by the bull-trawlers and the otter-trawlers in Bombay-Saurashtra waters, prawns were found at all depths from 9–72 metres. There was no marked concentration of prawns in any definite depth-zone.

In all the regions from Bombay to Kutch prawns occur throughout the year in the off-shore fishing grounds; the catches begin to increase from March; the best months for the fishery are from July to October and in some regions it extends to November or even December.

Prawn resources in the off-shore fishing grounds appear to increase from north to south off the west coast of India with the most potentially rich grounds in Kozhikode-Cochin region. On the east coast the resources appear to be much restricted.

The possibility of stepping up prawn catch has been visualised by introducing instead of the present types of gear, suitable shrimp trawls in certain months in Bombay-Saurashtra waters in areas shown to be rich in the present investigations. An account of the distribution of prawn species contributing to the off-shore catches along the east and west coasts of India has been given.

Acknowledgements

The author takes the opportunity to offer sincere thanks to Dr. S. Jones, the Director, Central Marine Fisheries Research Institute, for the interest shown in this work, to Shri K. Virabhadra Rao, Senior Research Officer, for suggesting this problem and critical perusal of the manuscript and to Shri M. M. Kunju, Assistant Research Officer, for valuable information on the species composition of prawns in the fish landings.

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