

ON THE COMMERCIAL TRAWL FISHERY OFF VERAVAL DURING 1979-1982

G. SUDHAKARA RAO AND H. MOHAMAD KASIM

Central Marine Fisheries Reserach Institute, Cochin-18.

ABSTRACT

Estimated annual fish landings by the commercial trawlers at Veraval fluctuated between 22,221 t (in 1980-81) and 31,380 t (in 1981-82) during the three years from 1979 to 1982. The catches of individual groups varied at random without showing any seasonal trend. The prawns, for which the trawlers were mainly operating, were only 7.8% of the total catch. The other important constituents, which were landed more as bycatches, were small sciaenids (20%), ribbonfish (9%), threadfin breams (5.3%), white fish (5.1%), perches (4.7%), clupeids (4.2%), elasmobranchs (3.9%), eels (3.1%), flat fishes (3.1%) and cephalopods (4.4%). *Parapenaeopsis stylifera* was the dominant species of prawn, forming 20-31% of the prawn landings.

A comparison of the present catch rate, total landing and species composition with those of the previous years shows that the demersal fishery resources off Veraval, particularly that of prawns, are under a strain of overfishing due to the year-to-year increase of shrimp trawlers and the fishery is becoming increasingly uneconomic. If at least a part of the efforts of these shrimp trawlers are diverted to slightly deeper grounds for exploiting finfish, it may be possible not only to make the trawling more economic, but also to sustain the present prawn stock of the inshore region.

INTRODUCTION

Commercial trawling with the involvement of private entrepreneurs was started on the Saurashtra coast only in 1967. All the trawling operations done before, beginning with that by the William Carrick in 1923, were exploratory, conducted by government vessels (Hefford 1949, Jayaraman et al 1959, Rao et al 1968). However, since 1967, there has been a continuous increase in the number of commercial trawlers. The census conducted in 1980 showed that there were 900 trawlers then operating along the coast of Junagadh district alone in Saurashtra, of which 666 were registered at Veraval (CMFRI 1981). Although the fishery has thus been active for over the past 15 years, no report is available on the magnitude, catch composition and seasonal fluctuations in the fishery of the region. The present paper attempts at presenting the main characters of the

exploited demersal fishery resources of the inshore region of Veraval, particularly the seasonal trends in the catch and effort and the species composition, during the period September 1979 to May 1982.

During the period of study, the commercial trawling fleet at Veraval consisted of wooden boats of 14 m over-all length, fitted with diesel engines of 87-93 hp. The boats were designed for stern trawling with power winches. The gears operated were two-seam or four-seam shrimp trawls, with head rope length 22-24 m. The cod-end mesh size was 15-20 cm. Most of the boats used flat rectangular otter boards of 64 x 140 cm weighing 50 kg and trawled at an average speed of 2 knots.

The boats generally conducted daily fishing from early morning and landed in the evening. The time spent in actual fishing varied from 6 h to 10 h. The usual fishing grounds were in the 20-60 m depth zone between Mangrol and Diu, but the fishing occasionally extended up to the 80 m. As the bottom is mostly rocky and uneven, with every chance for gear-fouling, trawling in less than 20 m was generally avoided. A few boats conducted fishing also 3-4 days at a stretch in distant fishing grounds. They usually fished between Jaffrabad in the south and Madhavpur in the north (Fig. 1). Fishing season generally started **by the middle of September, after the monsoon, and ended with May.**

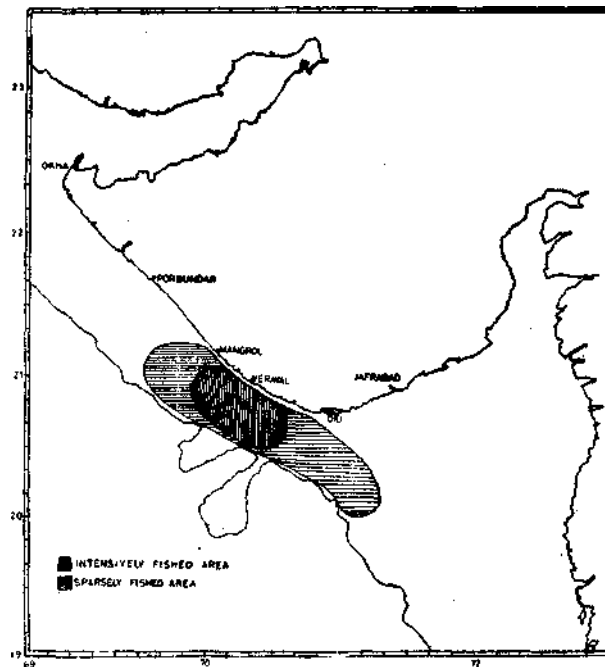


FIG. 1. Trawling grounds off Veraval.

MATERIAL AND METHODS

As none of the boats maintained a log, the procedure followed for the survey of indigenous-gear catches was adopted for collecting data. Data relating to catch, effort and species composition were collected once a week from 5-10% of the total units landed, and by raising their average the data for the total number of units landed on that day were obtained. The total for all the observation days was then multiplied by a factor, depending on the number of fishing days in that month, to get monthly estimates. The composition was estimated from random samples on each observation day, and the monthly figures for each group were estimated similarly as it was done for the total catch. Species which were landed too infrequently and in less quantities were treated as 'others'. The catch per hour of trawling (cph) was taken as the index of abundance for the estimation of resource.

TRENDS IN PRODUCTION

Monthwise catch-and-effort data for trawlers at Veraval during the seasons 1979-80, 1980-81 and 1981-82 are presented in Table 1. An estimated total catch of 28,277 t was landed by trawlers in 1979-80 period for an effort of 3,60,392 trawling hours, at an average cph of 78.0 kg. The fishery exhibited peaks in October (5011 t), January (5301 t) and April (4207 t), coinciding with the peaks in the effort expended (Table 1). Cph gradually declined from

TABLE 1. *Catch and effort data for trawlers at Veraval during the period September 1979 to May 1982.*

Months	1979-1980			1980-1981			1981-1982		
	Catch in t	Effort in h	CPH in kg	Catch in t	Effort in h	CPH in kg	Catch in t	Effort in h	CPH in kg
Sep	384	10929	35	192	1584	121	1695	10263	165
Oct	5011	45200	111	2358	34801	68	2251	40508	56
Nov	2219	29890	74	1416	42100	34	4390	56725	77
Dec	4582	42713	107	2190	52331	42	4837	82910	58
Jan	5301	53937	98	2251	50057	45	4213	74480	57
Feb	1824	30800	59	3529	64272	55	3979	66486	60
Mar	2501	47706	52	3158	55476	57	5149	96207	54
Apr	4207	64896	65	4323	55008	79	3707	76694	49
May	2248	34321	66	2804	38066	74	1159	27811	42
Total	28277	360392	78	22221	393695	56	31380	532084	59

October (111 kg) to March (52 kg) and then increased till May (66 kg). In 1980-81, in spite of an increase in the effort, the landings declined considerably (22,221 t). Although three peaks in cph, corresponding to those of 1979-80, were observed also during 1980-81, they did not coincide with the peaks of effort as they did in 79-80, which accounted for the decrease in the production in 1980-81. Cph gradually declined from September (121 kg) to December (42 kg) and then increased till April (79 kg). The fishery improved considerably in 1981-82, with an estimated catch of 31,380 t, exhibiting peaks in December (4837 t) and March (5149 t) corresponding to the peaks in effort. After a random variation during September-January period, cph declined gradually from February (60 kg) to May (42 kg).

It is seen that the monthwise landing, as well as the cph, followed a variation without any seasonal trend, probably on account of the fishery being multispecies and the species exhibiting wide individual fluctuations during different months. However, the resource as a whole was always more abundant at the beginning of the season, as indicated by the higher cph in October 1979 (111 kg), September 1980 (121 kg) and September 1981 (165 kg). This abundance might be due to a revival of the stock in the absence of fishing pressure during the monsoon period.

THE FISHERY RESOURCE

Groupwise breakup of the trawler landings during the period September 1979-May 1982 showed that small sciaenids (20%), ribbonfish (90%), prawns (7.8%) threadfin breams (5.3%), white fish (5.1%), cephalopods (4.9%), perches (4.7%) and clupeids (4.2%) > were the major components of the catches (Table 2). Other groups found in the catches were elasmobranchs, eels, flat fishes, catfishes, wolf herrings, carangids, pomfrets, scombroids, ghol, koth and lobsters. Lizard fishes, red mullets, polynemids and barracudas, along with other species whose individual landings were too insignificant, are included in the 'others', (see Fig. 2).

Catch trends of the important groups of fishes, the prawns and cephalopods are individually dealt with in detail for understanding their status in the fishery. The average estimated monthly landings of these groups, based on the data collected during September 1979 to May 1982, are presented in Table 2.

Small Sciaenids {Dhoma}: A number of small species of sciaenids (Dhoma) formed an important item of the trawler landings, of which the common ones were, in the order of numerical abundance, *Otolithus cuvieri*, *J. sina*, *I. vogleri* and *Nibea semiluctuosa*. Estimated 3886 t, 3759 t and 8730 t of small sciaenids, forming about 13.7, 16.9 and 27.9% of the total landings, were caught respectively in 1979-80, 1980-81 and 1981-82. Average annual landings were estimated at 5459 t. Annual cph varied from 9.5 kg in 1980-81 to 16.4 kg in

TABLE 2. Average estimated monthly total catch (in tonnes) of the important groups of fishes by trawlers at Veraval during the period September 1979-May 1982.

Particulars	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
Total catch (t)	757	3207	2675	3870	3922	3110	3602	4079	2071	27293
Effort in (h)	7592	40170	42905	59318	59491	53853	66463	65533	33399	428724
C.P.H. (kg)	100	80	62	65	66	58	54	62	62	64
Small scieanids	472	737	501	822	745	533	495	681	473	5459
Ribbonfish	41	100	157	128	311	391	310	623	383	2444
Threadfin breams	—	442	9	93	146	229	261	253	24	1457
Whitefish	37	42	304	199	249	261	188	103	15	1398
Perches	6	22	108	448	320	129	119	74	59	1285
Clupeids	34	63	169	233	160	76	160	201	36	1132
Elasmobranchs	15	61	86	148	238	104	192	183	42	1069
Eels	3	91	132	99	136	97	201	153	20	932
Flat fishes	20	133	82	96	106	102	91	117	87	834
Catfishes	3	91	45	55	43	23	44	43	55	402
Pomfrets	1	—	59	200	72	38	28	33	13	444
Ghol	4	5	49	35	77	38	88	75	34	405
Prawns	57	285	406	353	205	107	260	211	256	2140
Cephalopods	1	176	68	132	197	154	287	291	40	1346
Others	63	959	500	829	917	828	878	1038	534	6546

1981-82. The fishery exhibited peaks in October (952 t), January (809 t) and May (2755 t) during 1979-80, cph for the respective months being 21.1, 15.0 and 80.3 kg. Annual average cph was 10.8 kg. In 1980-81, though the catch rate was better in September-October and April-May, the annual cph was only 9.5 kg. In 1981-82, catch rate was good in most of the months, with the average cph at 16.4 kg. There was no seasonal trend in the abundance of the small sciaenids, since their catches and catch rates varied randomly during the three years.

Ribbonfish: Ribbonfish formed an important constituent with an average annual landing of 2444 t. Annual landings varied from 2368 t in 1979-80 to 2482 t in 1981-82, forming 7.9% (1979-80) to 11.2% (1981-82) of the total catches. Although the total landings of ribbonfish were almost equal during the three years, the catch rate was found gradually to decline from 6.6 kg in 1979-80 to 4.6 kg in 1981-82. The fishery was generally better during January-May, both with better landings and with better catch rates. *Trichiurus lepturus* was the dominant species, *Lepthracanthus savala* and *Eupleurqgrammus muticus* occurred sporadically.

Threadfin breams: Nemipterus japonicus was the most dominant species in this group. Landing 1744 t and 2287 t respectively in 1980-81 and 1981-82, this group contributed to 7.9% and 7.3% of the total catches. Annual cph did not

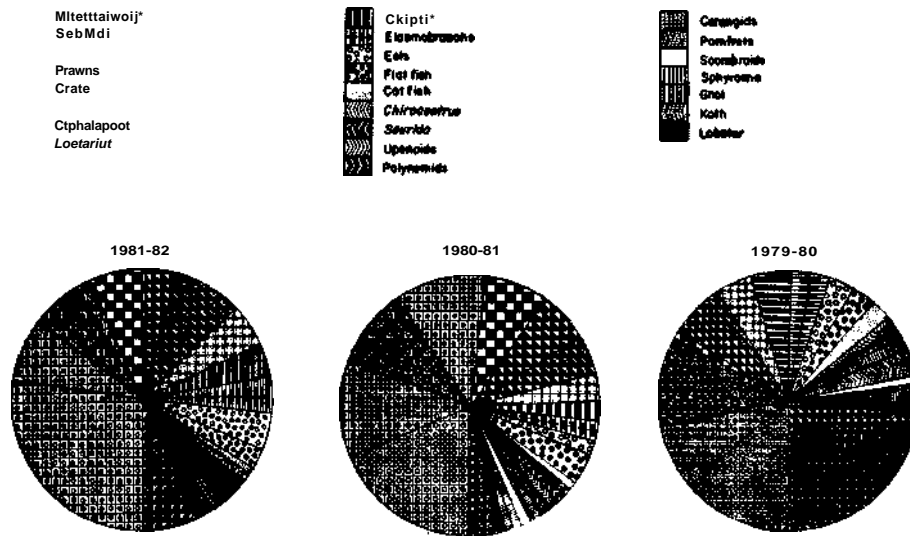


FIG. 2. Annual percentage composition of different groups of ground fishes.

vary much between the years. The fishery showed peaks in October (1028 t, with cph of 29.5 kg) and April (249 t, with cph of 4.5 kg) in 1980-81 and in October (298 t, with cph of 7.4 kg) and March (556 t, with cph of 5.8 kg) in 1981-82.

White fish: The white fish, *Lactarius lactarius*, was a dominant item in the fishery, with landings estimated at 1986 t (4.9%) in 1980-81 and 2681 t (8.5%) in 1981-82. There was an increase in the cph from 2.8 kg in 1980-81 to 5.0 kg in 1981-82. In both the years, November-March was the better period for the species.

Perches: The group was constituted by a number of species belonging to different families. The species, in the order of abundance, were *Argyrops spinifer*, *Chrysophrys berda*, *Lutjanus russelli*, *L. johni*, *L. malabaricus*, *Apogon quadrifasciatus*, *Diagramma griseum*, *Serranus diacanthus*, *S. salmoides*, *Pomadasy kasta*, *P. maculata*, *Drepane punctata*, *Epinephelus fasciatus* and *Pristipoma furcatus*. Average annual landings were estimated at 1285 t. Estimated 1321 t (4.7%), 811 t (3.7%) and 1715 t (5.5%), with the cph 3.7 kg, 2.1 kg and 3.2 kg, of perches were landed in 1979-80, 1980-81 and 1981-82, respectively. Total catch as well as cph showed peaks in December-January in all the three years. However, in 1981-82, perches were landed in greater quantities throughout November-March.

Clupeids: *Ilisha filigera* was the dominant clupeid, *Coilia dussumieri*, *Thrissocles mystax*, *Dussumeiria acuta* and *Opisthopterus tardoore* were also caught considerably throughout the year. An estimated catch of 1564 t of clupeids, forming about 5.5% of the trawler catches, was landed in 1979-80 with an annual cph of 4.3 kg. In 1980-81, both annual landings (547 t forming 2.5% of the catches) and cph were poor. The fishery in 1981-82 improved considerably, though not to the level of 1979-80. November-December and March-April were the peak periods for clupeids.

Elasmobranchs: Elasmobranchs formed an important group of the trawler landings. The landings for the three years were estimated to be 1305 t (4.6%) 480 t (2.2%) and 1421 t (4.5%), respectively. Cph varied from 0.4 kg (in October 1980) to 8.3 kg (in January 1980) (Fig. 3), whereas the annual cph varied between 1.2 kg (1980-81) and 3.6 kg (1979-80). Rays and skates, such as *Mobula diabolus*, *Manta birostris*, *Pteroplatea poecilura*, *P. micrura* and *Rhynchobatus djiddensis*, formed about 60% of elasmobranchs in 1980-81 and 68% in 1979-80. Sharks, represented by *Scoliodon laticaudus*, *Rhizoprionodon acutus*, *Sphyrna blochii* and *Carcharhinus melanoptera*, formed about 40% in 1979-80 and 32% in 1980-81 with estimated landings of 525 t and 155 t. Cph for different species of sharks are given in Fig. 4. *S. laticaudus* with a cph range of 0.29-0.87 kg dominated in the shark landings in 1979-80 and 1980-81, followed by *R. acutus* with a cph of 0.02-0.39 kg.

Eels: *Muraenesox talabonoides*, locally known as 'Warn', was the dominant eel, followed by *M. einereus* and *M. talabon*. An estimated 932 t of eels, forming about 3.3% of the catches, were landed in 1979-80, with an average cph of 2.6 kg. The fishery was poor in 1980-81, but was better in 1981-82, with a total catch of 1433 t, and cph at 2.7 kg. There were peak landings in October, January and April during 1979-80 and in November and March during 1981-82.

Flat fishes: Average annual landings of flat fishes were estimated at 834 t. The estimated landings were 781 t (2.8%) in 1979-80, 894 t (4.0%) in 1980-81 and 831 t (2.7%) in 1981-82, with respective cph of 2.2, 2.3 and 1.6 kg. January and April 1979-80, October, February and May 1980-81 and December 1981-82 had better landings. The species in the catches, in the order of abundance, were *Cynoglossus macrolepidotus*, *C. macrostomus*, *C. somifasciatus*, *Psetodes erumei* and *Zebrias zebra*.

Catfishes: Estimated 727 t (2.6%), 187 t (0.8%) and 292 t (0.9%) of catfishes were caught, with cph of 2.0 kg, 0.5 kg and 0.5 kg, in 1979-80, 1980-81 and 1981-82, respectively; with the annual average catch working out to 402 t. Catfishes were landed throughout the year. The species were, in the order of abundance, *Tachysurus dussumieri*, *Osteogeniosus militaris*, *T. tenuispinis*, *T. thalassinus*, *T. coelatus* and *T. sona*. Average cph for each species is presented in Fig. 4.

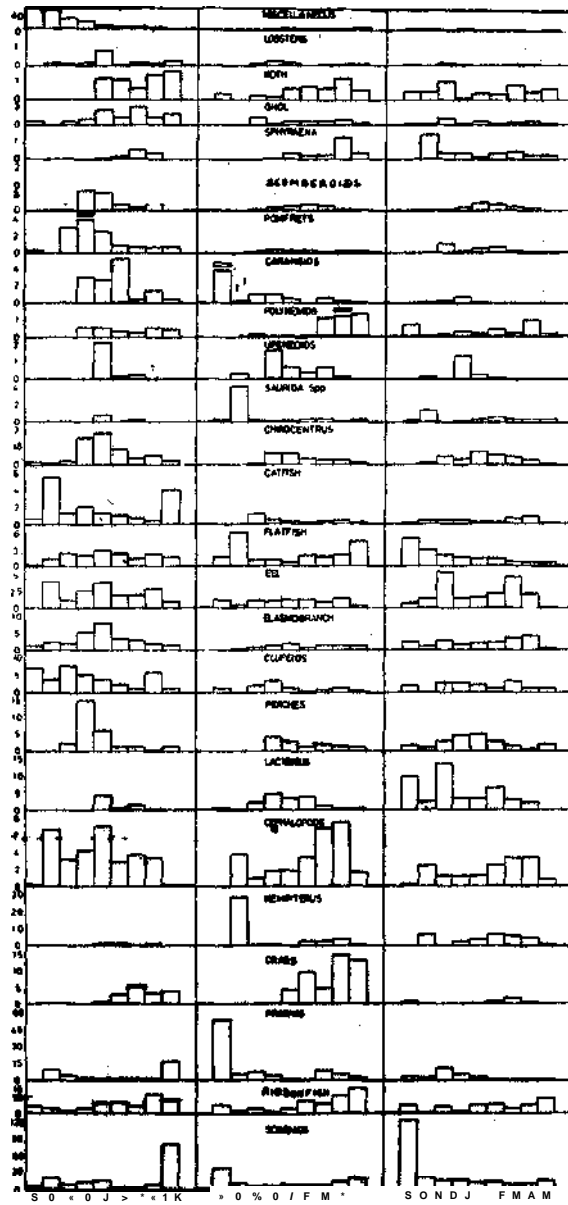


FIG. 3. Seasonal catch rates of different groups in the trawl fishery.

Wolf herrings: Chirocentrus dorab was the main species with *C nudus* occurring sporadically. Estimated 425 t (1.5%), 221 t (1.0%) and 357 t (1.1%) of Wolf herrings were landed with cph of 1.2, 0.6 and 0.7 kg in 1979-80, 1980-81 and 1981-82. Annual average catch was estimated at 334 t.

Saurida tumbii. Estimated landings varied from 275 t (1.2%) in 1980-81 to 262 t (0.8%) in 1981-82. There was a decline in the average annual cph from 0.7 kg in 1980-81 to 0.5 kg in 1981-82. October and February-March was the periods of abundance.

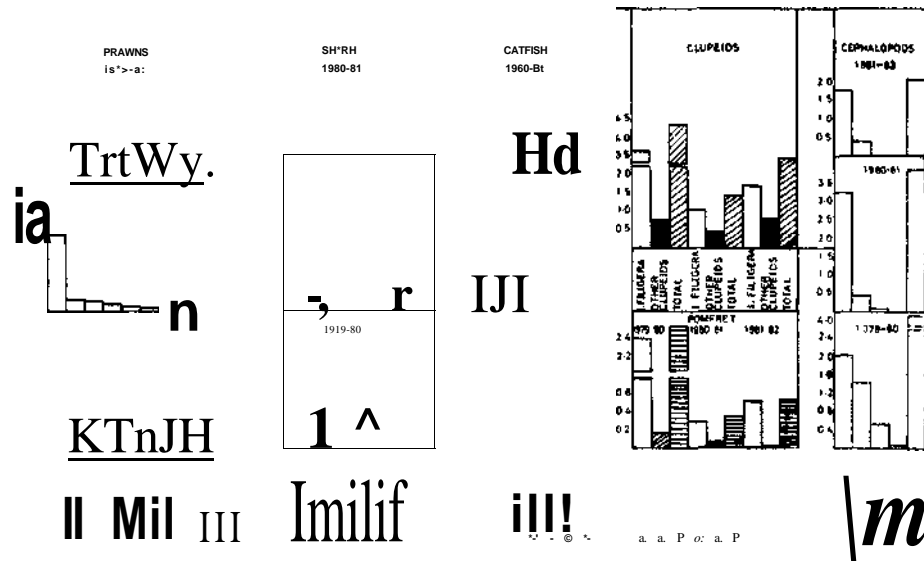


FIG. 4. Catch rates of the major groups in the fishery.

Red mullets: 243 and 149 tonnes of red mullets were caught respectively in 1980-81 and 1981-82, forming about 1.1% and 0.5% of the total catches. *Upeneus vittatus*, *U. moluccensus* and *U. sulphurus* were the species forming the group.

Polynemids: Estimated 137 t (0.5%), 293 t (1.3%) and 234 t (0.8%) of polynemids were landed in 1979-80, 1980-81 and 1981-82. Monthly cph varied from 0.1 to 2.5 kg during the three years of study, whereas the annual cph varied from 0.4 to 0.7 kg (Fig. 3). *Polynemus heptadactylus* was the main species, followed by *P. indicus* and *Eleutheronema tetradactylum*.

Carangids: The species in the order of abundance were *Atropus atropus*, *Megalaspis cordyla*, *Decapterus russelli*, *Chorinemus lyson*, *Caranx kalla* and *C. malabaricus*. About 601 t (2.1%), 260 t (1.2%) and 178 t (0.6%) were landed respectively in the three successive years. Cph gradually declined from 1.7 kg in 1979-80 to 0.3 kg in 1981-82 (Fig. 3). Carangids were landed throughout the season. Average annual landing was 345 t.

Pomfrets: *Pampus argenteus* was the main pomfret, forming 83-97% of the annual pomfret catches; *Parastromateus niger* and *Pampus chinensis* were in less quantities. They were together forming 912 t, 139 t and 281 t, contributing,

3.5%, 0.6%, and 0.9% of the trawler catches, in the three successive years. Average annual catch was estimated at 444 t. There was a decline in cph for pomfrets from 1979-80 (2.5 kg) to 1980-81 (0.4 kg). Pomfrets were caught in good quantities throughout the November-May periods.

Scombroids: The scombroids showed a decline from 349 t in 1979-80 to 84 t in 1980-81, but had improved slightly to 120 t in 1981-82. Average annual catch was estimated at 185 t. They were generally abundant during January-April period. *Scomberomorus guttatus*, *S. commerson*, *Acanthocybium solandri*, *Euthynnus affinis* and *Thunnus tongol* were the species in the order of abundance.

Barracudas: *Sphyraena jello* and *S. obtusata* were landed in considerable quantities in some of the months. Barracuda landings gradually increased from 63 t in 1979-80 to 235 t in 1981-82. They formed about 0.2% to 0.8% of the total trawler catches with cph varying from 0.2 kg to 0.4 kg.

Ghol: An estimated 622.9 t, 282.9 t and 308 t of *Protonibea diacanthus*, locally known as 'ghol', were landed during the periods 1979-80, 1980-81 and 1981-82, respectively, forming 1.0-2.2% of the total trawler landings. Average annual landings were estimated at 405 t (Fig. 3). *Ghol* landings were generally poor during September-October and in the other months varied at random in different years. Cph varied from 0.1-3.5 kg.

Koth: Landings of *Otolithoides biauritus*, locally known as 'Koth', varied from 244 t (1.1%) in 1980-81 to 300 t (1.0%) in 1981-82 with better landings during January-May. However, during 1981, good quantities of *Koth* were landed in November. Average monthly cph varied from 0.1 (December 1981) to 1.7 kg (May 1980) during the period of investigation. Average annual landings were estimated at 278 t. *

Prawns: Prawn landings gradually declined from 2335 t in 1979-80 to 1938 t in 1981-82 with the reduction in cph from 6.5 to 3.6 kg (May 1980). Peak catches were in October-December and in May during 1979-80, in September-December and March-April during 1980-81 and in November-December during 1981-82 (Fig. 3). Average annual landings were estimated at 2140 t. *Parapenaeopsis stylifera* was the main species, forming about 20.4-30.8% of the annual prawn catches, followed by *Solenocera crassicornis* (4.3-10.8%), *P. hardwickii* (4.7-10.7%), *Metapenaeus kuthchensis* (4.2-10.1%), *M. affinis* (3.3-7.8%), *M. monoceros* (2.2-7.7%), *Penaeus penicillatus* (1.7-2.2%) and *P. semisulcatus* (0.6-3.4%), in the order of abundance. Non-penaeids such as *Acetes indicus*, *Exhippolysmata ensirostris* and *Nematopalaemon tenuipes* contributed 29.3-39.9% of the annual prawn catches. *Metapenaeopsis stri-dulans*, *Trachypenaeus curvirostris*, *Parapenaeus longipes*, *P. japonicus* and *jP. monodon* formed about 1.0-4.8% of the catches. Cph of different species of

prawns are given in Fig. 4. It is seen that cph for *M. kutchensis*, *M. affinis*, *P. penicillatus* and *S. crassicornis* gradually declined from 1979-80 to 1981-82 whereas for the other species it varied at random.

Crabs: *Charybdis callianassa*, *C. bimaculata*, *C. truncata*, *C. cruciata* and *C. leucifera* were landed in large quantities in all the three years. Estimated 830 t (2.9%), 2525 t (11.4%) and 467 t (1.5%) of crabs with cph of 2.3, 6.4 and 0.9 kg were landed in 1979-80, 1980-81 and 1981-82, respectively. Crab landings and cph were generally better during January-May period (Fig. 3).

Cephalopods: This group, comprising squids and cuttlefishes, formed an important item of the trawler catches. Cephalopod catches gradually declined from 1477 t in 1979-80 to 1128 t in 1981-82, with a corresponding reduction in cph from 4.1 kg to 2.1 kg. Average annual landings were estimated at 1346 t. Although cephalopods were landed in all the months, they were better caught during February-March and in October. *Loligo duvauceli* was the main species, forming as much as 50-84% of the cephalopod catches. *Sepia aculeata*, *S. inermis* and *S. rouxii* also occurred.

GENERAL REMARKS

In the early 60s, the experimental fishings with shrimp trawls are reported to have produced fish and prawns at the rate of 71 to 145 kg per haul and, of which, prawns alone to have formed 25 kg per haul (forming 22.4% of the total catch) (Deshpande and Kartha 1964). Subsequently, even better catch rates, 139 to 166 kg per haul (prawn forming 20%) in 1966-68 (Deshpande et al 1969) and 240 kg per haul (prawns forming 13%, with cph 30.5 kg) in 1968-69 (Deshpande et al 1970), were reported. Later, Panicker et al (1977) reported catches at the rate of 74 kg to 80.6 kg per hour of trawling, consisting of 23.5-42.7% prawns, also in experimental fishing. Although these were all experimental fishings, using different types of gear and vessel, their results show one thing in common, that is, in the 60s the abundance of ground fishes, including prawns, off Veraval was significantly better than what it was at the time of our study; compared to the figures of 60s, in 79-82 the overall catch rates were less than half. The steep fall in the catch rates of fishes and prawns over these two decades was due to the fast increase in the number of trawlers in the region, a trend noticed all over the regions of mechanized fishing in India (Ramamurthy 1972, Sudhakara Rao et al 1980), indicating that the population of ground fishes everywhere was exposed to an imminent threat of overfishing. In Veraval, this threat was all too clear in the case of prawns, of which, not only the cph, but also the percentage contribution to the total catch has come down steeply from what it was in the 60s.

The year-to-year increase in the trawler effort at Veraval, mainly for catching prawns, has resulted in the decline of prawn catches and, consequently,

in the trawl fishing's becoming increasingly uneconomic. However, some economically less important ground fishes such as the smaller sciaenids, ribbonfish, threadfin breams, cephalopods and white fish appearing as bycatches have been sustaining the industry to some extent. Results of the earlier trawling by bigger vessels, as well¹ as the recent survey conducted by M. T. Murena (Bapat et al 1982), have indicated that there are good resources of these finfishes off Veraval in slightly deeper waters. Therefore, if at least a part of the present shrimp trawler effort is directed towards tapping the finfish resources, by using appropriate gears, it might help to improve the economics of the trawling industry and, at the same time, to sustain the prawn stock in the inshore region.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. E. G. Silas, Director, Central Marine Fisheries Research Institute, Cochin, for the encouragement during the course of the investigations. Thanks are also due to S|Shri P. D. Solanki, B. P. Thumber, and H. K. Dhokia for their help in collection and processing of the data.

REFERENCES

- BAPAT, S. V., V. M. DESHMUKH, B. KRISHNAMOORTHY, C. MUTHIAH, P. V. KAGWADE, C. P. RAMAMRITHAM, K. T. MATHEW, S. KRISHNAPIIXAI AND C. MUKUNDAN. 1982. Fishery resources of the exclusive economic zone of the Northwest coast of India. *Bull. Cent. Mar. Fish. Res. Inst.*, No. 33.
- CMFRI. 1981. All India Census of Marine Fisheries Craft and Gear, 1980. *Mar. Fish. Infor. Serv.*, No. 30: 2-32 p.
- DESHPANDE, S. D. AND K. N. KARTHA. 1964. On the results of preliminary experiments with otter trawls off Veraval. *Proc. Indo-Pacific. Fish. Coun.*, 11(2): 184-190.
- DESHPANDE, S. D., S. V. S. RAMA RAO AND K. N. KARTHA. 1968. Certain observations on the effectiveness of rectangular and oval otter boards. *Proc. Indo-Pacific. Fish. Coun.*, 13(3): 431-436.
- DESHPANDE, S. D., T. M. SWAN AND S. V. S. RAMA RAO. 1970. Results of comparative fishing trails with rectangular flat and rectangular covered otter boards. *Fish. Tech.*, 7(1): 38-41.
- HEFFORD, A. E. 1949. *Report on the work of 'William Carrick'*. Government Press, Bombay.
- JAYARAMAN, R., G. SESHAPPA, K. H. MOHAMED AND S. V. BAPAT. 1959. Observations on the trawl fisheries of the Bombay and Saurashtra waters 1949-50 to 1954-55. *Indian J. Fish.*, 6: 58-144.
- NAIR, K. P. 1974. Exploratory trawl fishing in Bombay Saurashtra waters during 1968-70. *Indian J. Fish.*, 21(2): 406-426.
- PANICKER, P. A., T. M. SIVAN, S. V. S. RAMA RAO AND T. P. GEORGE. 1977. Double-rig shrimp trawling, its rigging, comparative efficiency and economics. *Fish Tech.* 14(2): 142-152.

- RAMAMURTHY, S. 1972. Trawl fisheries of the South Kanara coast during 1967-70. *Indian J. Fish.*, 19: 54-59.
- RAMARAO, S. V. S., P. G. MATHAI AND P. A. PANICKER. 1977. Twin trawling for shrimp with dummy doors. *Fish. Tech.*, 14(2): 153-158.
- RAO, K. V., P. T. MEENAKSHISUNDARAM AND K. DORAIRAJ. 1968. Relative abundance of trawl fishes in the Bombay-Saurashtra waters. *J. mar. biol. Ass. India.*, 8(1): 205-212.
- RAO, G. SUDHAKARA. 1980. Impact of mesh size reduction of trawl nets on the prawn fishery of Kakinada in Andhra Pradesh. *Mar. Fish. Infor. Serv.*, No. 21: pp. 1-6.