A PRELIMINARY STUDY ON THE PRAWN FISHERY OF BIG TRAWLERS ALONG THE NORTHEAST COAST OF INDIA

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ABSTRACT

The number of big trawlers operating along the northeast coast increased from 55 in 1983-84 to 76 in 1985-86, increasing the prawn landings from 2353 t in 1983-84 to 3043 t in 1985-86. Catch per hour of trawling reached a peak in 1984-85 (20.1 kg) and then declined in 1985-86 (16.5 kg). The proportion of 'tigers' (8%), 'whites' (30%) and 'browns' (62%) was more or less stable during the three-year period.

There was a gradual increase in abundance of 'tigers' from 11 m depth to 60 m depth and a gradual decrease thereafter. The 'whites' were more abundant in 11-40 m depth. The abundance of 'browns' gradually increased from 11 m to 100 m depth. There are good fishing grounds in Sandheads I arid off Paradeep and Chilka for tigers', off Paradeep, Gopalpur and Kalingapatnam and in Sandheads II for 'whites', off Anchorage, Sunderbans and Gopalpur for 'browns'.

The potential yield of prawns from the trawling grounds between Pentakota and the Sunderbans is estimated at 6559 t. As the present harvest from this region is 5424 t, there is scope for an addition of 28 more trawlers to the existing fleet of 76.

INTRODUCTION

Although there had been reports of existence of good penaeid prawn resources along the northeast coast and in Sandheads (Shariff, 1961; Poliakov, 1961; Sekharan et al, 1973; Sudarsan, 1975, 1977), these were not effectively exploited till recently as these grounds were beyond the operational range of both indigenous craft and small mechanised boats. The exploitation of these resources was started in 1976, when two imported big trawlers were put in use. Since then, the fleet has increased in size and, in 1985, there were about 76 big trawlers (mostly Gulf of Mexico design) actively fishing in of this region. Thus, within a decade, the fishery has attained industrial proportions, and in 1985-86 an estimated 3043 t of prawns were landed. Another important feature of this fishery is that the whole of the penaeid prawns landed are big-sized and are in good demand in foreign markets. All the trawlers operate from Visakhapatnam

since the infrastrutural facilities suitable to them are available only at this port. The fishery as reported in this paper is based on the data for the period April 1983 to March 1986.

CRAFT AND GEAR

Most of the boats under operation are in the overall-length range of 22-24 m, and they can stay at sea for 18-23 days. These steel vessels are provided with modern gadgets such as echosounders, radio-telephones, freezers, chilling tanks and cold storage. Although they are based at Visakhapatnam, they take shelter in Paradeep Harbour whenever the sea is rough and fishing is not possible. Because of the unpredictable weather conditions of the northern Bay of Bengal, the time thus spent at Paradeep harbour is quite considerable.

Salient Features of a Trawler

Over-all-length	23.19 m
Breadth	7.33 m
Draft	3.08 m
Horsepower	380
Gross tonnage (GRT)	115.8
Registered tonnage (NRT)	78.8
Crew complement	12
Chill-tank capacity	3.5 t
Chill-tank temperature	0° to -2°C
Fish hold (cold storage)	25 t
Fish-hold temperature	— 18°C
Type of net	Four seam shrimp trawl
Length of head rope	26.25 m
Codend mesh size	25 mm
Dimensions of otter boards	1.53 x 1.07 m (rectangular)
Weight of otter boards	200 kg
Diameter of tickler chain	8 mm
Trawling speed	2.5 knots (4.km)

THE FISHING OPERATIONS

The fishing operations extend from Pentakota (17°N latitude) in south to Sunderbans (21° N latitude) in north, including the Sandheas. However, concentration of effort is more along the Orissa and West Bengal coasts (19-2TN latitudes; Fig. 1).

Generally a haul lasts for 3-4 h, though hauls of 2-6 h are not uncommon. Each day, weather conditions permitting, 15-20 h are spent in trawling. Although the trawling is for penaeid prawns, good amounts of fish are caught incidentally. Being of low quality, most of this fish are discarded. Only better

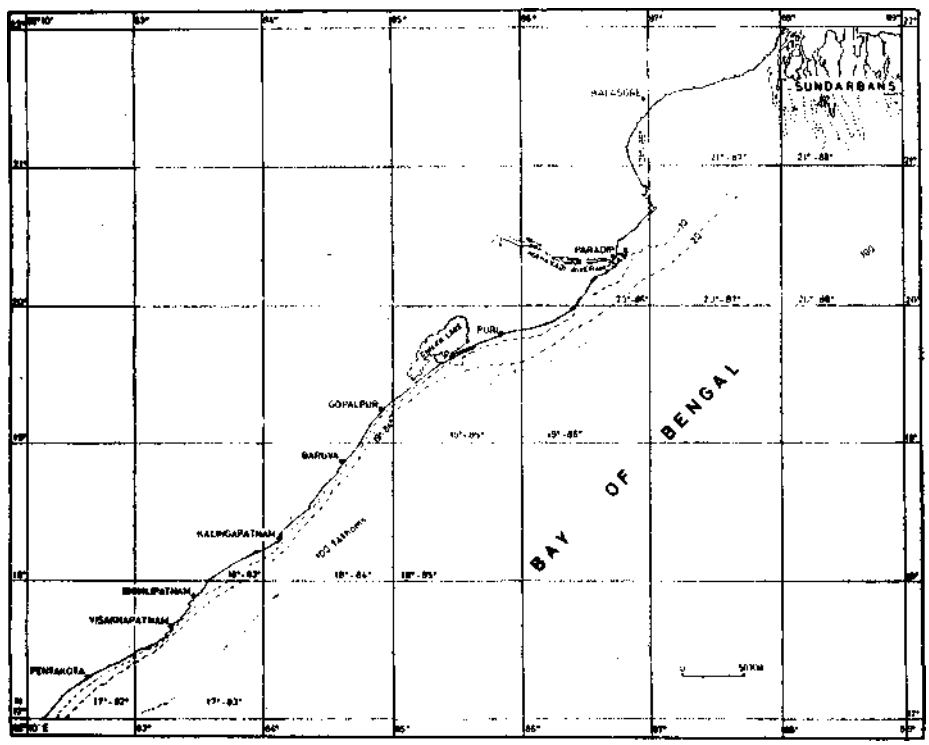

FIG. 1. Map showing the range of fishing operations.

quality fishes such as pomfret, seer, polynemid and other perches are retained. Prawn is commercially classified into 'tiger', 'white', 'brown', and 'flower'. The catch is cleaned, and the head of prawn is removed immediately. The deheaded prawns are taken in net bags of 25-35 kg capacity and kept in chilling tanks for about 24 h, after which they are transferred to the fish hold.

The magnitude of discards varies from haul to haul and seasons to season. As the details of these discards are not recorded in the fishing log, it has not been possible to estimate the total catch of these trawlers.

COLLECTION AND ANALYSIS OF DATA

Data on catch, effort and catch composition were collected from the fishing log of the vessels. The following particulars for each voyage were collected from the fishing log;

Voyage No.
Date of departure (sailed out)
Date arrival (sailed in)

Days at sea
Actual fishing days
Total fishing hours
Total prawn catch
Catch of 'tigers'
Catch of 'whites'
Catch of 'browns'
Catch of 'flower'
Value of the catch

The operators were requested to furnish the fishing log. The facts mentioned in the log were counter checked by meeting the owners and skippers of the vessels. Additional information was gathered from weather records and in consultation with the operators and owners of freezing plants.

The year considered in this report is from April to March since the main season ends in March and there is a lull in the fishing activity during April-June. Fiftyfive vessels operated during 1983-84, but only 13 vessels furnished data for this period. Of the 60 vessels operated in 1984-85, only 38 vessels supplied the fishing log, whereas, in 1985-86, out of 76 vessels operated only 43 vessels supplied the fishing log. Total estimates for the number of vessels operated in a particular year were based on the vessels for which fishing log were available.

Since the catch is recorded as 'headless tiger', 'headless white', 'headless brown' and 'headless flower' it was not possible to give a species-wise break up of the catch. However, the species composition of the different categories was found to be as follows:

headless tiger: *Penaeus mondon, P. semisukatus* and P. *japonicus*
headless white: P. *indicus, P. merguiensis* and P. *penicillatus*
headless brown: *Metapenaeus monoceros, M. ensis* and *M. affinis*
headless flower: *M. brevicornis* and *M. dobsoni*

It was not possible also to estimate the magnitude of landings of different species. Hence, the catch composition is given with reference to these broad groups as recorded in the fishing log. And also no biological data could be collected since the catches were landed in the headless condition.

As the fishing hour, or trawling hour, is a better index of fishing effort, CPUE was considered to be the index of abundance of prawns. Since some of the boats started the voyage in the middle of a month and landed in the following month, for purpose of analysing the data, the number of landings at Visakhapatriam fishing harbour in a month was taken to be the number of voyages in that month.

Data from 6 vessels, 2 belonging to Gujarat Fisheries Corporation and 4 belonging to Kerala Fisheries Corporation, were analysed to study the depth-wise abundance of prawn catches. Depth zones were classified as 11-20 m, 21-30 m. 31-40 m etc. to get a comparative picture of prawn abundance in different depth zones. Only data for the period April 1985 to March 1986 were analysed for this purpose.

Data from April 1985 to March 1986 of two vessels of Gujarat Fisheries Corporation were analysed to study the relative productivity of different areas. Each 1° latitude-1° longitude square was taken as a unit. To avoid repetition, latitude-longtitude zones are referred to by the names of adjacent coastal towns. For instance, latitude 19°N-longitude 84°E zone is referred to as off Gopalpur.

Stock assessment was based on the 'swept area' method (Gulland 1965) with necessary alterations (Pauly 1983).

PRAWN LANDINGS

1983-84: Fifty-five trawlers were in operation during the year 1983-84. The catch data are presented in Table 1. The trawlers conducted 630 voyages and spent an estimated 11051 seadays. However, they fished only on 8071 days and trawled for 143962 hours. An estimated 2353 t of prawns were landed with an average cph of 16.3 kg. The catch was composed of 'tigers' (194.3 t), 'whites' (719.7 t), 'browns' (1417.5 t) and 'flowers' (21.5 t). Fishing effort gradually increased from May till January and then decreased till May (Table 1). Similarly, prawn landings also gradually increased from May till January and then decreased til May. However, cph has shown a slightly different trend. The cph gradually increased from May (6.31 kg) and reached a **peak** in **October** (27.2 kg) and then declined thereafter till April (5.86 kg).

With an estimated catch of 194.3 t 'tigers' formed about 8.3% of the landings. The landings gradually increased from May (1.4 t) till November (34.3 t) and then decreased till January (14.3 t), followed by an increasing trend from January till March. The cph of'tigers' increased gradually from June (0.6 kg) till November (2.4 kg) and declined till January (0.7 kg) and increased till March (1.1 kg).

With an estimated catch of 719.7 t, 'whites' formed 30.6% of the prawn landings. The landings exhibited peaks in August (53.6 t), October (121.6 t) and January (154.0 t), whereas the peaks for cph were observed in June (5.3 kg), October (10.0 kg) and January (7.4 kg).

With an estimated catch of 1417.4 t, 'browns' formed 60.2% of the prawn landings. The landings and cph for 'browns' indicated peaks in September, January and March. Annual average cph for 'browns' was 9.9 kg.

TABLE 1. *Monthwise effort, catch and catch composition of* 55 *big trawlers operated from Visakhapatnam during the year April* 1983 *to March* 1984.

	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Total
EFFORT AND CATCH													
No. of voyages	51	17	30	64	64	47	56	60	56	73	52	60	630
No. of days at sea	475	142	400	1042	1113	792	1134	1012	1200	1346	1063	1321	11051
No. of fishing days	248	95	228	670	662	604	687	794	993	1150	910	1030	8071
No. of fishing hours	3871	1705	3896	11781	11710	10822	12154	14174	17965	20885	16482	18514	143961
Prawn catch in t	22.7	10.8	45.7	152.1	216.7	243.7	330.5	246.0	311.5	395.5	193.9	183.9	2353.0
Cph in kg	5.9	6.3	11.7	12.9	18.5	22.5	27.2	17.4	17.3	18.9	11.8	9.9	163
CATCH COMPOSITION													
Tiger													
Catch in t	2.4	1.4	2.2	15.3	18.5	20.9	28.7	34.2	20.4	14.3	15.6	20.4	194.3
Cph in kg	0.6	0.8	0.6	1.3	1.6	1.9	2.4	2.4	1.1	0.7	1.0	1.1	1.4
%	10.5	13.4	4.7	10.1	8.5	8.6	8.7	13.9	6.6	3.6	8.0	11.1	8.3
White													
Catch in t	6.0	3.0	20.6	49.1	53.6	26.1	121.5	119.5	il4.6	154.0	41.2	10.3	''19.7
Cph in kg	1.6	1.8	5.3	4.2	4.6	2.4	10.0	8.4	6.4	7.4	2.5	0.6	5.0
%	26.5	28.3	45.0	32.3	24.8	10.7	36.8	48.6	36.8	38.9	21.3	5.6	30.6
Brown													
Catch in t	14.3	6.2	23.0	87.1	143.7	195.5	177.1	89.8	171.5	219.4	136.9	153.0	1417.5
Cph in kg	3.7	3.7	5.9	7.4	12.3	18.1	14.6	6.3	9.5	10.5	8.3	8.3	9.9
%	63.0	58.0	50.2	57.3	66.3	80.2	53.6	36.5	55.1	55.5	70.6	83.2	60.2
Other prawns in kg	—	0.1	0.1	0.5	OS	1.3	3.2	2.4	5.0	7.7	0.2	0.2	21.5
Value in lakhs of Rs.	19.2	9.4	30.4	95.4	113.8	145.8	286.4	238.8	235.1	380.5	151.8	143.9	i 850.5

The value realised for the catches gradually increased from May (Rs. 9.4 lakhs) till October (Rs. 286.4 lakhs) and then decreased till December (Rs. 235.1 lakhs). The earnings reached a maximum in January (Rs. 380.5 lakhs) and then gradually decreased till May. The fishery realised an amount of Rs. 18.5 crores (ex-vessel) during the year 1983-84.

1984-1985: During this year 60 trawlers undertook 628 voyages and spent 10518 days in the sea. The fishing was for 139929 hours in 7746 fishing days. The estimated landings were 2816 t (Table 2). Although the fishing effort in terms of fishing hours declined by about 3%, the landings increased by about 16% compared to those of previous year. Prawn landings and cph more or less gradually increased from May till November and then decreased gradually till May. Annual average cph was estimated at 20.1 kg, the highest in the three-year period. Value of the landings also gradually increased from May (Rs. 1.4 lakhs) till November (Rs. 411.9 lakhs) and then decreased gradually till May.

WMh an estimated landings of 236.5 t, 'tigers' formed 8.4% of the prawn landings. The increase in the landings from that of the previous year was about 18%. The cph increased from 1.4 kg in the previous year to 1.7 kg in the present year. The percentage composition of 'tigers' in the prawn landings varied from 4.4% in May to 15.1% in March. The landings had peaks in September (43.8 t), November (37.7 t) and February (23.0 t), whereas peaks for cph were in August (2.7 kg), November (2.1 kg) and February (1.5 kg).

The 'whites' increased by 11% from the previous year. 'Whites' formed 28.9% of the prawn landings, ranging from 1% in April to 49% in December. The annual landings are estimated at 236.5 t, with an average cph of 5.8 kg. The landings of 'whites' gradually increased from June (14.8 t) to October (190.6 t) and then decreased more or less gradually till May (nil catch). Similar trend was observed in the cph also.

An estimated 1757.1 t of 'browns' were landed with an average cph of 12.6 kg. Compared to the previous year, the increase in landings was 20% while the increase in cph was 22%. The landings and cph exhibited peaks in September, November and January. 'Browns' formed 62.4% of the prawn catch with a range of 44.7% in December to 95.6% in May.

1985-86: Seventy-six trawlers operated during this year, spending 14175 sea-days and 10306 fishing days (Table 3). The fishing effort was estimated at 184874 h, which was 25% more than the previous year. The annual prawn landings were estimated at 3043 t. an increase of only 7% over that of the previous year. Cph varied from 9.2 kg in February to 21.7 kg in September with annual average of 16.3 kg. The peak in May is ignored since the effort put in was too meagre to give a correct index of abundance. Prawn landings

TABLE 2. *Catch, effort and catch composition of* 60 *big trawlers operated from Visakhapatnam during the year April* 1984 *to March* 1985.

	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Total
EFFORT AND CATCH													
No. of voyages	36	12	20	46	62	66	70	66	62	80	70	38	628
No. of days at sea	273	68	277	915	975	1282	1293	1204	1119	1336	1092	683	10518
No. of fishing days	121	19	150	576	607	938	988	1009	965	1082	857	434	7746
No. of fishing hours	2133	346	2572	9995	10575	17050	17904	18075	17633	19732	15811	8101	139929
Prawn catch in t	14.2	1.8	43.3	190.8	256.5	431.2	426.7	314.9	377.6	329.0	164.6	64.9	2815.5
Cph in kg	6.7	5.2	16.8	19.1	24.3	25.3	23.8	28.5	21.4	16.7	10.4	8.0	20.1
CATCH COMPOSITION													
Tiger													
Catch in t	1.4	0.1	4.4	19.2	27.5	43.8	27.7	37.7	22.6	19.4	23.0	9.8	236.6
Cph in kg	0.7	0.2	1.7	1.9	2.7	2.6	1.6	2.1	1.3	1.0	1.5	1.2	1.7
%	9.9	4.4	10.2	10.0	10.7	10.2	6.5	7.3	6.0	5.9	14.0	15.1	8.4
White													
Catch in t	0.1.	—	14.8	55.8	65.6	118.6	190.6	115.2	185.8	59.2	6.2	0.7	812.6
Cph in kg	0.1	—	5.7	5.6	6.2	7.0	10.6	6.4	10.5	3.0	0.4	0.1	5.8
%	1.0	—	34.1	29.2	25.6	27.5	44.7	22.4	49.2	18.0	3.7	1.1	28.9
Brown													
Catch in t	12.7	1.7	24.1	114.9	162.6	266.3	205.2	360.7	168.9	250.3	135.3	54.4	1757.1
Cph in kg	5.9	4.9	9.4	11.5	15.4	15.6	11.5	20.0	9.6	12.7 '	8.6	6.7	12.6
%	89.2	95.6	55.7	60.2	63 4	61.8	48.1	70.1	44.7	76.1	82.2	83.8	62.4
Other prawns catch in t	—	—	—	1.0	0.8	2.4	3.2	1.3	0.3	0.2	0.2		9.4
Value in lakhs of Rs.	11.4	1.4	34.6	152.7	205.2	344.9	341.4	411.9	302.1	263.2	131.7	51.9	2252.4

gradually increased from May (20.3 t) to November (471.0 t) and then declined gradually till May, whereas cph gradually increased from July (15.7 kg) to September (21.7 kg) and then declined gradually till February (9.2 kg).

With an estimated catch of 233.5 t, 'tigers' formed 7.7% of the prawn landings of tralwers. The peaks in landings were in August (30.4 t), October (33.7 t), January (32.6 t) and March (19.9 t), while the peaks for cph were in July (1.9 kg), October (1.7 kg), January (1.3 kg) and March (1.0 kg). The average cph was 1.3 kg, 0.4 kg less than in the previous year.

An estimated 889.6 t of 'whites' were landed with an average cph of 4.8 kg. Although there was an increase in total landings of 'whites' during 1985-86, the cph declined, compared to that of the previous year. The landings of 'whites' gradually increased from April (0.8 t) and reached a peak in November (172.2 t) and then declined thereafter till March (53.3 t). The cph gradually increased from July (3.9 kg) to October (7.7 kg) and then declined gradually till March (2.6 kg). The composition of 'whites' in the total prawn landings varied from 2.1% in April to 39.9% in October, with an annual average of 29.2%.

An estimated 1912.8 t of 'browns' were landed with an average cph of 10.4 kg. The landings more or less gradually increased from May (10.2 t) and reached a peak in January (294.7 t). The cph varied from 5.2 kg in February to 14.6 kg in September. The proportion of 'browns' in the prawn landings varied from 50.2% in May to 89.9% in April, with the average at 62.9%.

The foregoing analysis shows that the fishery is developing. There is an increase in the number of boats and, consequently, the prawn landings during the three-year period 1983-84 to 1985-86. However, there was a slight decline in effort during 1984-85, in spite of the increase in number of boats from 55 to 60. The cph in 1984-85 was far higher (20.1 kg) than in the other two years. The sudden decline in the cph from 20.1 kg in 1984-85 to 16.5 kg in 1985-86 had created some doubts about the future of the fishery. However, the present analysis shows that 1984-85 could be an unusually favourable year for prawns. It may be noted that the abundance as indicated by the cph is higher in 1985-86 than in 1983-84, indicating that there is no threat of overfishing for the time being. To support this inference further, data of two trawlers of Gujarat Fisheries Corporation are presented in Table 4. It may be noted that cph for prawns gradually increased from 1979 (10.7 kg) to 1985 (17.2 kg) with an abnormally high value in 1984 (22.5 kg) perhaps due to highly favourable hydrological conditions. Similar observation was made in respect of the small mechanised boats operating at Visakhapatnam during the same period (personal observation). Hence, it may be concluded that the resource is exploited within a safe limit and there is no cause for anxiety.

TABLE 3. *Catch, effort and catch composition of* 76 *big trawlers operated from Visakhapatnam during the year April* 1985 *to March* 1986.

	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Total
EFFORT AND CATCH													
No. of voyages	22	5	66	71	86	71	78	81	81	81	71	81	794
No. of days at sea	420	56	391	1094	1482	1637	1640	1751	1564	1654	1016	1470	14175
	197	39	268	699	972	975	1140	1383	1226	1369	822	1216	10306
No. of fishing hours	3331	765	5540	12979	17085	16259	19952	25048	22730	25365	15249	20572	184874
Prawn catch in t	40.2	20.3	102.8	204.1	294.1	352.0	386.0	471.0	422.5	401.3	139.7	209.0	3043.0
Cph in kg	12.1	26.5	18.5	15.7	17.2	21.7	19.4	18.8	18.6	15.8	9.2	10.2	16.5
CATCH COMPOSITION													
Tiger													
Catch in t	3.3	1.0	8.0	24.6	30.4	27.3	33.7	22.9	18.2	32.6	11.8	19.9	233.7
Cph in kg	1.0	1.4	1.4	1.9	1.8	1.7	1.7	0.9	0.8	1.3	0.8	1.0	1.3
%	8.1	5.1	7.8	12.0	10.3	7.8	8.7	4.9	4.3	8.1	8.4	9.5	7.7
White													
Catch in t	0.8	9.1	37.9	50.2	85.8	86.3	153.9	172.2	117.3	74.0	48.6	53.3	S89.4
Cph in kg	0.3	11.9	6.8	3.9	5.0	5.3	7.7	6.9	5.2	2.9	3.2	2.6	4.8
%	2.0	44.7	36.8	24.6	29.2	24.5	39.9	36.6	• 27.8	18.5	34.8	25.5	29.2
Brawn													
Catch in t	36.1	10.2	56.8	128.8	177.3	237.8	198.1	273.7	284.7	294.7	79.0	135.5	1912.7
Cph in kg	10.9	13.3	10.3	9.9	10.4	14.6	, 9_9	10.9	12.5	11.6	5.2	6.6	10.4
%	89.9	50.2	55.3	63.1	f0.3	67.6	51.3	58.1	67.4	73.4	56.5	64.8	62.9
Other prawns catch in t	—	—	0.1	0.5	0.7	0.5	0.3	2.2	2.2	0.1	0.3	0.3	7.2
Value in lakhs of Rs.	22.8	17.2	75.7	182.8	266.2	306.5	371.8	413.2	329.4	333.9	175.3	234.2	2729.0

TABLE 4. *Yearwise catch, effort and catch composition of two trawlers of Gujarat Fisheries Corporation.*

	1979	1980	1981	1982	1983	1984	1985
EFFORT AND CATCH							
No. of trawlers	2	2	2	2	2	2	2
No. of voyages	14	37	29	30	27	22	23
No. of fishing hours	2776	7725	6737	8157	7062	6249	5961
Prawn catch in t	29.5	109.4	94.4	129.5	112.1	140.6	102.9
Cph in kg	10.7	14.2	14.0	15.9	15.9	22.5	17.2
CATCH COMPOSITION							
Tiger							
Catch in t	4.9	13.1	10.8	12.8	8.5	8.9	7.6
Cph in kg	1.8	1.7	1.6	1.5	1.2	1.4	1.3
White							
Catch in t	6.3	32.5	20.5	27.0	40.2	50.9	32.1
Cph in kg	2.3	4.2	3.0	3.3	5.7	8.1	5.4
Brown							
Catch in t	18.3	63.8	63.1	90.0	63.4	80.8	63.2
Cph in kg	6.6	8.3	9.4	11.0	9.0	12.9	10.6

Seasonal variations'. To get a picture of seasonal variations, the data for all the three years are pooled and the averages presented in Table 5. Effort in fishing days and fishing hours gradually increased from May to a peak in January and then decreased. Prawn landings increased from May, reached a peak in November and decreased thereafter, whereas the cph gradually increased from May, reached the peak in September, and then decreased gradually till April. It may be stated that, in general, the fishery was better during August-January in respect of both the magnitude of landings and the cph. The cph of 'tigers' gradually increased from April and reached the peak in September and then declined gradually till January. The cph for 'whites' also more or less gradually increased from April, reached the peak in October and declined thereafter. The cph for 'browns' was better during August-January.

Depthwise abundance: Depthwise analysis of the trawling effort and prawn catches (Fig. 2) shows that, though depths between 11m and 100 m were covered in the fishing, only the depths between 21 m and 70 m were fished intensively, and those beyond 100 m were not at all fished. The abundance of 'tigers' gradually increased from 11 m to 60 m and decreased gradually beyond this depth. Similarly 'whites' were better represented in 11-40 m and thereafter decreased gradually. The abundance of 'browns' gradually increased from 11 m till 100 m depth. From Fig. 2 it is evident that a very good resource of browns is

TABLE 5. *Monthly catch and effort data of large trawlers operating from Visakhapatnam (data pooled for the period April* 1983 *to March* 1986)

	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Total
EFFORT AND CATCH													
No. of voyages	36	11	39	60	71	61	68	69	66	78	64	60	683
Days at sea	389	89	356	1017	1190	1237	1356	1325	1294	1445	1057	1158	11913
Actual fishing days	189	51	215	648	747	839	938	1062	1061	1200	863	893	8706
Fishing hours	3112	939	4003	115*5	13123	14710	16670	19099	19443	21994	15847	15729	156255
Prawn catch in kg	25712	10950	63927	182337	255772	342300	381098	410652	370523	375275	166034	152598	2737178
Cph in kg	8.26	11.67	15.97	15.74	19.49	23.27	22.86	21.50	19.06	17.06	10.48	9.70	17.52
SPECIES COMPOSITION													
Tiger													
Catch in kg	2350	851	4856	19676	25424	30672	30027	31613	20391	22078	16172	16708	221418
Cph in kg	0.76	0.90	1.21	1.70	1.94	2.09	1.80	1.66	1.05	1.00	1.06	1.06	1.42
%	9.14	7.77	7.60	10.79	9.94	8.96	7.88	7.69	5.50	5.88	10.10	10.95	8.09
White													
Catch in kg	2328	4040	24395	51721	68355	77025	155343	135650	139250	95725	32006	21455	807293
Cph in kg	0.74	4.30	6.69	4.46	5.21	2.24	9.32	7.10	7.16	4.35	2.02	1.36	5.17
%	9.05	36.90	38.16	28.37	26.72	22.50	40.76	33.03	37.58	25.51	19.28	14.06	29.49
Brown													
Catch in kg	21034	6046	34623	110278	161221	233204	193479	241423	208363	254788	117032	114281	1695782
Cph in kg	6.76	6.44	8.65	9.52	12.29	15.85	11.61	12.64	10.72	11.58	7.38	7.27	10.86
%	81.80	55.22	54.18	60.48	63.04	68.13	50.77	58.79	56.24	67.89	70.49	74.89	61.95
Others													
Catch in kg		13	43	662	772	1399	2249	1966	2519	2684	224	154	12685
Cph in kg	—	0.01	0.01	0.06	0.06	0.10	0.15	0.10	0.13	0.12	0.01	0.01	0.08
%	—	0.12	0.06	0.36	0.30	0.41	0.59	0.48	0.68	0.72	0.13	0.10	0.46

available in the 71-100 m depth zone. And it can reasonably be expected that this extends even beyond 100 m depth.

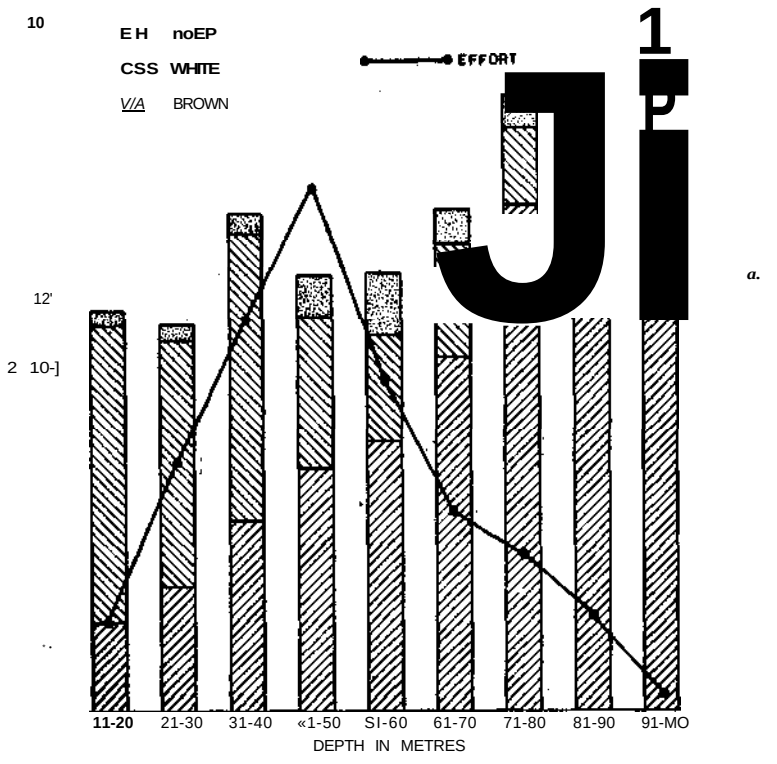

FIG. 2. Depthwise distribution of trawling effort and the CPH of the three groups of prawns.

Abundance in different areas: Data from two vessels of Gujarat Fisheries Corporation for the year 1985-86 were analysed to find the areas of abundance for the different groups of prawns (Table 6). During the year, these vessels fished from Kalingapatnam (latitude 18°N, longitude 84°E) to the Sunderbans (latitude 21°N and longitude 89°E). The maximum effort was expended off Chilka, in Sandheads II, off Balasore, Anchorage and Sunderbans. The reasons for not putting similar effort in areas off Puri was that there was a concentration of indigenous craft in these areas. Good catches of 'tigers' were obtained from Sandheads I (2.0 kg), off Paradeep (1.9 kg) and off Chilka (1.5 kg). Moderate catches' were obtained from off Kalingapatnam, Sandheads II, off Balasore and Anchorage. The 'whites' were caught well from off Paradeep, Gopalpur and Kalingapatnam and from Sandheads II and moderately from off Balasore, Chilka and Anchorage. The catches of 'browns' were good off Anchorage, Sunderbans and Gopalpur, while they were moderate off Kalingapatnam, in Sand-

heads II, off Chilka and Balasore. So, it may be stated in general that the grounds off Anchorage, Kalingapatnam, Sunderbans and Chilka are more productive than the others.

STOCK ASSESSMENT

It was not possible to collect any data on length composition of the species landed since the landings were in headless state. Hence, the analytical methods for stock assessment were not adopted, and, so, the potential yield was estimated by the 'swept area' method (Gulland 1965). The big trawlers operated between Pentakota and the Sunderbans (latitude 17° 20' to 21° 10' up to 100 m depth), in an area of 32768 sq km. In areas where the sea bottom is smooth enough for trawling, standing stock sizes can be obtained from the relationship.

$$B \sim \frac{C/F \quad A}{a \quad X},$$

where C/F is the mean catch per unit effort

A the total area of exploitation
a the area swept per unit of effort
Xi the proportion of prawns in the path of the gear that are actually retained by the net

In South East Asian waters, a value of X'I — 0.5 is commonly used (Isarankura 1971; Saeger *et al* 1976) and there is some evidence for this value being realistic (Paully 1979).

The bottom surface swept by the gear during one unit of effort is computed from the expression

$$a = t.\ v.\ h.\ X_2$$

where v =• velocity of the trawler while trawling

t = time spent on trawling
h = length of the trawl head rope
X: = is a fraction expressing the width of the area swept by the net decided by the length of the head rope.

In South East Asian waters, values for X2 ranging between 0.4 (SCSDP, 1978) and 0.66 (Shindo 1973) have been used, with 0.5 possibly being.the best compromise (Pauly 1979).

Although the method is generally adopted for the data collected by exploratory vessels, Pauly (1983) is of the opinion that the method can also be

TABLE 6. *Area-wise abundance of prawns along the northeast coast of India (Data for two vessels for the year* 1985-1986)

	Kalin 84°	Gopa 84°	Chilka 85°	Puri 86°	Paradeep 86°	Cdhead 86°-87°	Cdhead 87°-88°	Off Balasore 87°	Anchora 88°	Sunderb 89°-	Tot
EFFORT AND CATCH											
No. of hauls	24	6	236	2	55	30	346	314	106	84	1203
Trawling time in hours	103.2	27.2	993.5	9.0	236.0	138.2	1527.2	1352.2	465.2	445.8	5297.5
Prawn catch in kgs	1568	285	12799	60	2884	1241	19311	16465	7583	6613	68809
Cph in kg	15.2	10.5	12.9	6.7	12.3	9.0	12.6	12.2	16.3	14.8	13.0
CATCH COMPOSITION											
Tiger											
Catch in kg	110	10	1520	—	447	271	812	1272	321	91	4859
Cph in kg	1.1	0.4	1.5	—	1.9	2.0	0.5	1.0	0.7	0.2	0.9
White											
Catch in kg	484	130	3983		1173	34	6797	5711	1617	1194	21123
Cph in kg	4.7	4.8	4.0	—	5.0	0.3	4.5	4.2	3.5	*1.1*	4.0
Brown											
Catch in kg	974	145	7296	60	1264	936	11702	9482	5645	5328	42832
Cph in kg	9.4	10.5	7.3	6.7	5.4	6.8	7.7	7.0	12.1	12.0	8.1

used with data collected from commercial trawlers, provided their catch and effort, head rope length and trawling speed are known. In the present case these parameters are considered to provide an estimate of standing stocks. The parameters taken to estimate the area swept are:

t = One hour of trawling
v = 4 km per hour
h = head rope length (26.25 X 2) since two nets are operated simultaenously
X_2 = 0.5

The area swept in one hour is thus calculated as 0.105 sq km. The parameters used to estimate the standing stock are:

C/F - 17.52 kg (average for the year 1983-84 to 85-86) for one hour of trawling

A = total area of operation 32768 sq km.
a = area swept in one hour 0.105 sq km.
X_i = 0.5

The standing stock of penaeid prawns in this region was estimated at 10931 tonnes and the potential yield at 60% exploitation level was estimated at 6559 t (headless).

CONCLUSIONS

Areawise, the prawn landings (headless) along the northeast coast (based on data collected by the CMFRI) are:

West Bengal coast (indigenous craft), 129 t
Orissa coast (indigenous and small mechanised boats), .975 t
North Andhra Coast (indigenous and small mechanised boats), 1277 t
Big trawlers (Visakhapatnam), 3043 t
Total landings, 5424 t

Hence another 1135 t of prawns can be harvested without any damage to the fishery. If no increase in the number of indigenous craft and small mechanised boats is envisaged, the entire surplus may be allocated to the big trawlers. It so, as each big trawler can harvest about 40 t of prawns, another 28 big trawlers may be needed to harvest this 1135 t of catch, raising the number of trawlers from the present 76 to 104. However, it may be mentioned that, though this study has given good indicative results, a closer study on the biological and population parameters of the species is needed for a precise assessment of the stocks, which will pave the way for better management of the resource.

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