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On the Trend of Prawn Catch off Paradeep

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The distribution and landings of important varieties of prawns off Paradeep coast, Orissa, in relation to the climatic and hydrographic conditions from 1970-1976 are presented. The prawn fishery as a whole, showed a quadrennial cycle along the coast. The post-monsoon migration of all varieties of prawns along the coast directly depends on the annual precipitation. Temperature gradient, fluctuations in salinity and southerly wind in the Bay of Bengal influence the migration of the different species of prawns.

Paradeep coast, Lat. $19^{\circ}57'N$ to Lat. $20^{\circ}30'N$ and Long. $86^{\circ}20'E$ to Long. $86^{\circ}55'E$ is situated in Cuttack district, Orissa State, bordering the Bay of Bengal. River Mahanadi along with its tributaries empties into the Bay. Smaller rivers like Jatadhar and Devi flow into the sea along the coast.

Except for a comprehensive account of experimental trawling in Mahanadi-Godawari area within 100 metres isobath by Poliakov (1962), little information is available on the distribution of demersal fisheries of this area. In fact Poliakov's account does not give information on the occurrence, distribution and seasonal variation of prawn fishery of the coast. The exploitation of demersal fishery resources of this Bay was carried out by the Orissa State Fisheries, for the first time, in the year 1956-57 with two mechanised trawlers (10m overall length) received under the Technical Co-operation Mission and were operated through Mahanadi river mouth (Lat. $20^{\circ}19'N$ Long. $86^{\circ}45'E$). With the establishment of port in 1962, at Paradeep (Lat. $20^{\circ}15'N$, Long. $86^{\circ}45'E$) four medium sized steel trawlers (16.15m) were employed from 1970 by the State Fisheries Department. The present paper deals with the occurrence, distribution and seasonal variation of prawn catch off Paradeep coast at selected grounds from 1970 to 1976. The data were collected by four 16.15m steel trawlers, imported from Poland, namely, Kalinga-1, Kalinga-2, Kalinga-3 and Carpfish-4 of the State Fisheries Department.

Materials and Methods

Four identical 16.15m steel trawlers, with side trawling arrangements and powered by 170 B. H. P. Rolls Royce diesel engines were used for the study. These single decked trawlers were provided with two masts, straight stem, cruiser stern with four water tight bulkheads, navigational equipments, frozen storage facilities and developed a maximum speed of 8 knots. A Polish made MORS sounder was employed to record the depth of the gear.

Four seam trawl nets of 23m head rope and rectangular otter boards of $1.84m \times 0.92m$ and each weighing 85 kg were used at 10 to 20 fathoms. Beyond 20 fathoms, 32 m bulged belly four seam trawls were used in combination with oval, single slit otter boards of length 1.70 m and width 1.30 m and weighing 102 kg each. The net was made out of polythene twisted monofilament twine. Bottom trawling was done at both shallow and deep water grounds along the coast. On an average, trawling operation started from 0700 hours and continued till dusk. The duration of each haul varied from 1 to 2 hours. The catch composition in relation to rainfall, monthly and yearly distribution of prawns with respect to area and depth was also recorded.

The prawn catch of the area consisted of the following groups, arranged in the order of their economic importance.

1. White prawn
 - a) *Penaeus indicus*
 - b) *Penaeus merguensis*
2. Tiger prawn
Penaeus monodon
3. Brown prawn
 - a) *Metapenaeus dobsoni*
 - b) *Metapenaeus monoceros*
 - c) *Metapenaeus affinis*
 - d) *Metapenaeus brevicornis*
4. Small prawn
 - a) *Solenocera indica*
 - b) *Acetes indicus*

The paradeep coast is subjected to the effect of South - West monsoon (March-September) and the predominant wind is from the south-west with some variations

to both west and south. The strength of winds generally varies between Beaufort 3 and 5, but there are some periods when force increases to 6 and in June and July occasionally the strength increases to 7 or even higher. The North-East monsoon is from October to December and the predominant winds during this period flow from north and north-east, the force of which seldom exceeds 4. The annual rainfall varied from 1018.6 mm to 2473.7 mm during 1970 to 1975. Monthly rainfall, varied from 0 to 356.91 mm during the period, the lowest in December and highest in August. Diurnal fluctuation of atmospheric temperature was recorded at Paradeep port. The average minimum and maximum atmospheric temperatures during the period were recorded to be as 12.10°C and 35.66°C respectively (Table 1). The prevailing ocean surface current runs approximately parallel along the coast line of Paradeep

Table 1. Average rainfall, air temperature and wind speed at Paradeep during 1970-1975

Month	Rainfall mm	Atmospheric temperature °C		Wind speed km/h	
		Minimum	Maximum	Minimum	Maximum
January	5.76	12.10	30.06	5.00	29.66
February	5.68	13.41	31.91	4.66	39.33
March	47.50	17.90	34.78	5.00	47.66
April	31.00	22.01	33.88	11.00	50.00
May	108.40	22.28	35.66	8.33	52.00
June	197.91	23.11	35.55	5.33	63.15
July	271.20	23.15	34.13	5.33	56.66
August	356.91	22.21	33.43	4.33	59.00
September	236.06	22.55	34.31	4.33	60.66
October	199.03	19.08	33.53	4.33	49.66
November	73.71	14.21	31.55	6.50	58.00
December	0.00	12.45	29.90	5.66	45.66

(Source - Paradeep Port Authorities)

in the directions from south-west to north-east during February to April and from north-east to south-west during August to October. A tidal stream (1 to $1\frac{1}{2}$ knots) in addition to ocean current also set on the surface, parallel to the coast at spring tides for both ebb and flood running in a north-east and south-west direction, which remain more pronounced in the inshore regions. The average monthly wind speed recorded at Paradeep from 1970 to 1975 varied from 4.33 to 63.15 km per hour (Table 1).

Results and Discussion

Poliakov (*loc cit.*) reported the presence of two kinds of active currents (ebb and flow) which run along the coast of Godavari-Mahanadi area changing its direction by 180° twice a year and also in speed ($\frac{1}{2}$ to 3 knots).

The data in Table 2 indicates a quadrennial cycle for prawn fishery (48179 kg in 1971-72 and 36959 kg in 1975-76) along the coast. Since the effort varied from month to month and year to year, the catch per hour was taken as an index for

assessing the trend in prawn catch. In 1970-71, the average catch was 5.61 kg per hour which rose to 14.66 kg per hour (first peak) during 1971-72. The catch fell and rose during subsequent years and reached a peak (second peak) in 1975-76. The total annual precipitation when compared with catch exhibited a direct relation during 1970-71 and 1975-76 (Fig. 1)

The fishing season of the area started from September, the average catch per hour during this month was much lower than that of the average catch for the fishing season (10.38 kg). The average catch per hour shot up higher than the season's average (14.27 kg) during October and continued to increase till December when the peak average catch registered at 16.02 kg. From January onwards the average catch showed a decline and again fell below that of the average catch of the season from April onwards (Table 3).

It is, therefore, concluded that the peak prawn season during the coast prevails during November and December, when the migration of prawn in the inshore and offshore areas occurred due to available

Table 2. Catch compositions of prawns during 1970-1976

Period	Fish and prawns kg	Total prawns kg	Percentage	White and tiger prawns kg	Percentage	Brown prawns kg	Percentage	Small prawns kg	Percentage
1970 December to 1971 March	160462	6323	03.94	1076	0.67	4842	3.02	405	0.25
1971 October to 1972 April	371995	48179	12.95	18100	4.87	28410	7.63	1669	0.45
1972 November to 1973 March	335380	17933	05.34	13154	3.92	4451	1.32	328	0.10
1973 December to 1974 April	123696	18721	15.13	10472	8.46	7747	6.26	502	0.41
1975 October to 1976 May	384197	36959	09.62	5621	1.46	21220	5.53	10118	2.63
Total	1375730	128115	09.31	48432	3.52	66670	4.84	13022	0.95

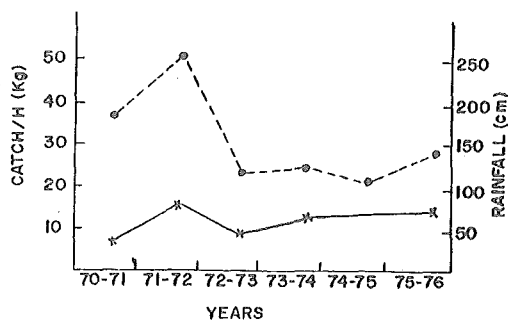


Fig. 1. Correlation of annual rainfall and prawn catch.

.....Rainfall; — Catch

food brought in by the river discharges along with the run off silt and detritus consequent to the rainfall from May to October in the area, and due to favourable temperature conditions in the inshore and offshore regions (21.18° to 22.88° C). But due to changing weather conditions, the migration of prawn started as early as October (1975-76) and continued to persist as late as February in some years (1971-72). This is especially true when the cold water conditions (20.45° to 24.3° C) prevailed along the coast. In 1971-72 and 1975-76 three such conditions occurred as below:

Year	Month	Average catch per hour (kg)	Average temperature $^{\circ}$ C
1971-72	January	24.94	20.45
	February	22.07	22.4
1975-76	October	18.26	24.3

According to Hela and Laevastu (1961), both pelagic and demersal fish undertake migrations usually in shallow waters or closer to the surface during summer and into deeper waters during the winter depending on the effect of temperature, light and availability of food. But the migration of prawn in the shallower regions of the coast during winter might be due to optimum cold water conditions prevailed in the region in addition to search for their food brought by the run off silt and detritus by annual precipitation and ri-

verine discharge in the Bay. With the rise in temperature and appearance of strong southerly wind along the coast from March onward, the concentration of prawn stock along the coast might have been disturbed and moved into deeper areas, resulting in poor catch during these months.

The abundance of white and tiger prawns along Paradeep coasts showed a sudden rise from October onwards and thereafter steady till January. The catch per unit effort abruptly dropped from February (Table 3). Higher catches of 6.57 kg and 7.87 kg per hour were, however, noticed in March during 1971-72 and 1973-74 respectively. Similarly very low catches of 1.45 to 3.13 kg/h were also recorded in November to January during 1975-76 suggesting a failure of the fishery during the year.

According to Gopalakrishnan (1972) the white prawns, *Penaeus indicus* and *Penaeus monodon*, migrate to the lower reaches of estuaries and coastal waters for feeding.

The higher catch along Paradeep coast during post-monsoon period (October to January) is due to the congregation of these species for grazing in the Bay, enriched with detritus laden discharges of the rivers.

The average monthly catch of brown prawn rose up abruptly to 5.11 kg per hour during October and showed a further increasing trend till December, when the highest catch registered at 7.98 kg/h. From January onwards, the catch exhibited a gradual decline till March and the catch during April onwards became the lowest (Table 3).

This suggests that the migration pattern of all the species of brown prawn is similar to that of white and tiger prawns, when the post-monsoon congregation of the species were observed in the inshore areas during October.

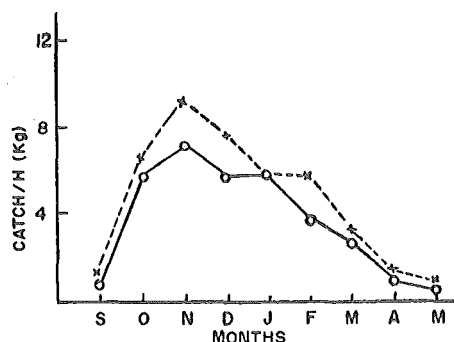
The small prawns, *Solenocera indica* and *Acetes indicus*, exhibited two annual peaks during October (3.05 kg/h) and March (5.67 kg/h), confirming their maxi-

Table 3. Monthly average catch of prawn per hour during 1970-1975

Month	Total catch of prawn (kg)	White & tiger prawn (kg)	Brown prawn (kg)	Small prawn (kg)
September	02.46	0.66	1.64	0.16
October	14.27	5.71	5.51	3.05
November	15.34	6.66	6.22	2.46
December	16.02	5.98	7.98	2.06
January	12.59	6.11	5.83	0.65
February	10.68	3.65	6.05	0.98
March	12.02	3.12	3.23	5.67
April	07.15	1.01	1.72	4.42
May	02.96	0.90	1.26	0.80
Seasons average	10.38	3.75	4.38	2.25

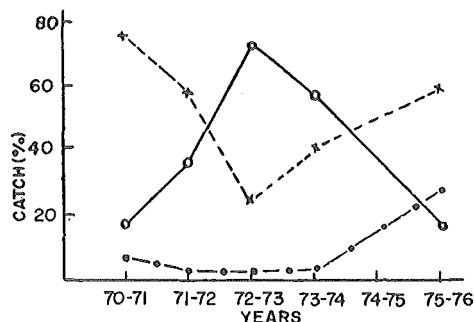
imum concentrations in the inshore regions during these months, which according to Poliakov (*loc cit.*) was possibly due to changes in water temperature brought about by the precipitation and local upwelling associated with strong southerly winds from March onwards (Table 3).

The white prawns and tiger prawns contribute to a major part of the total prawn catch for the period October to February. The catch rate declines in the subsequent months (Fig. 2). The annual catch rate

**Fig. 2.** Average catch for the dominant group of prawns 1970-'76

○—○ White and tiger prawns;
 ×—× Brown prawns

of these two groups clearly indicates an inverse relationship (Fig. 3), the abundance of white and tiger prawn reaching a peak in 1972-73. Their peak abundance in 1972-73 was followed by a steep decline which continued till 1975-76. Brown prawns however, were caught in abundance in 1970-71, followed by a similar catch in 1975-76, showing a three-year cycle of occurrence. The small prawns also exhibited a similar trend.

**Fig. 3.** Yearly correlation between prawn groups

○—○ White and tiger prawns;
 ×—× Brown prawns; ●—● Small prawns

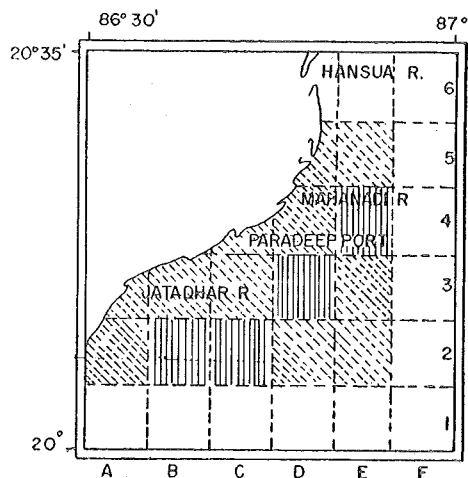
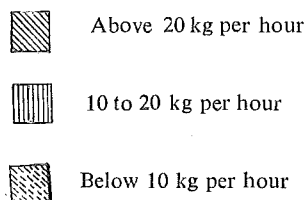


Fig. 4. Tiger and white prawns—Intensity of catch groundwise 1970-'76



The groundwise distribution of white and tiger prawns is given in Fig. 4. The distribution pattern, as analysed by comparing the catch per unit effort (catch per hour) is represented as 20 to 30 kg per hour, 10 to 20 kg per hour and below 10 kg per hour. The ground 2D and 2E off Jatadhar river mouth yielded the highest catch of 29.47 kg per trawling hour. The next higher catch of 16.27 to 19.03 kg. per hour was observed in grounds 3E, 4E, 3B and 3C off Mahanadi river mouth to Jatadhar river mouth.

A maximum catch of 51.32 kg per trawling hour was recorded from the ground 2D and 2E at a depth of 21 fathoms, when individual catches of this group from different grounds were considered.

For brown prawn, the groundwise distribution is given in Fig. 5. The ground 4E located off Mahanadi river mouth, 3D located off Paradeep port and 2B & 2C located off Jatadhar river mouth have

yielded an average catch of brown prawn over 10kg per hour. The highest individual catch of 39.19 kg per hour has been recorded in the ground 4E and 3D at a depth of 11 to 17 fathoms.

The distribution pattern of small prawn is shown in Fig. 6. An average catch of 0.27 to 4.6 kg/h has been encountered throughout the entire fishing grounds covered by all the four trawlers. Individual highest catch of 34.08 kg/h was obtained in the grounds of 4C and 4D at a depth of 7 to 10 fathoms.

The distribution of different groups of prawn, in relation to the depth of the fishing ground has been recorded for three different ranges, namely, 5 to 10, 11 to 20 and 21 to 30 fathoms. Table 4 represents the average catch/h for the five years in three depth ranges for three different groups of prawns. The highest concentrations (29.47 kg/h) of white and tiger prawns were recorded at a depth of 21 to 30 fathoms in 1971-72 and 1972-73 respectively, indicating their preference for the outer zones of the inshore areas along the coast.

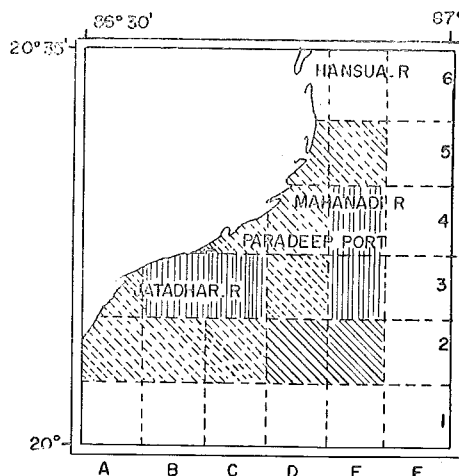


Fig. 5. Brown prawns—Intensity of catch groundwise 1970-'76

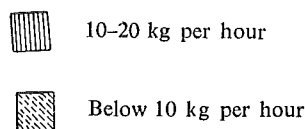
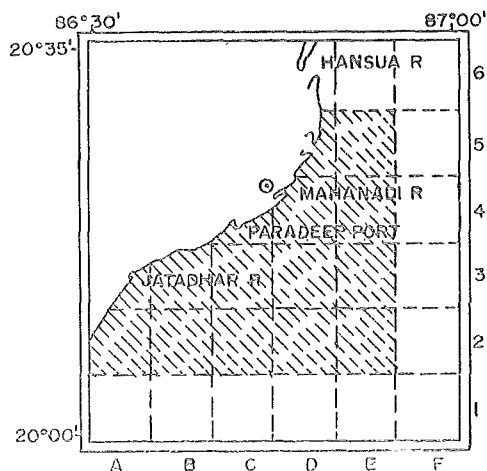



Table 4. Annual groundwise catch per hour of different varieties of prawns

Period	Depth fathoms	Average catch of white and tiger prawn kg	Average catch of brown prawn kg	Average catch of small prawn kg
1970-71	5-10	1.55 (2A, 3A)	6.97 (3A, 3B)	0.77 (3B, 3C)
	11-20	1.13 (2B)	5.09 (2A, 3C)	0.56 (2C, 3D)
1971-72	5-10	10.01 (3B)	2.10 (5D)	0.80 (3B, 3C)
	11-20	16.27 (3C)	3.25 (5E)	1.30 (3D, 3E)
	21-30	29.47 (2D, 2E)	5.85 (3E)	2.34 (2E)
1972-73	5-10	5.32 (4D, 5D)	1.64 (4C, 4D)	0.13 (2A, 5D)
	11-20	19.03 (3E, 4E)	6.00 (3C)	0.50 (2B, 2C)
1973-74	5-10	8.74 (4D)	6.43 (4D)	0.39 (4D)
	11-20	7.15 (2A, 2B)	5.48 (3B, 3C)	0.27 (3B)
1975-76	5-10	0.81 (4C)	4.48 (3C, 4D)	4.60 (4C, 4D, 5D)
	11-20	4.96 (3D, 5E)	12.10 (2B, 2C, 3D, 4E)	3.64 (3E, 4E, 5E)
	21-30	2.01 (2C)	6.25 (2D, 2E)	1.09 (2E)

The numbers in parenthesis refer to grounds

**Fig. 6.** Small prawns-Intensity of catch groundwise 1970-76

 Below 10 kg per hour

The brown prawn, however, showed preference for shallower regions as evidenced by their congregations at a depth of 11 to 20 fathoms, where the highest average catch of 12.1 kg/h was obtained.

The small prawns concentrated in maximum numbers at a depth of 5 to 10 fathoms recorded by their average catch of 4.6 kg/h during 1975-76.

Thus it is clear that the post-monsoon migration of all the varieties of prawns in the inshore areas of Paradeep coast took place from October and persisted till February depending on the precipitation, temperature condition and onset of southerly wind along the coast. The preference of depth ranges by different prawn species may be attributed to the influence of temperature and salinity gradient along the coast.

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