Observations on the Ingression and Distribution of Larval Prawns in the Nethravati-Gurupur Estuary, Mangalore

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The spatial and temporal distributions of larval prawns of penaeids and non-penaeids in the estuarine waters of Mangalore were studied. Larvae appears to be passively brought in by the incoming flood tides to the estuary, enjoy a wider distribution throughout the estuarine complex with abundance towards the mouth. The distribution of larval prawns were more in Nethravati than in the Gurupur stretch. The influence of temperature, hydrogen-ion-concentration, salinity and dissolved oxygen on the distribution of larvae in the estuaries is discussed. Inference on spawning seasons of commercially important prawns in the neighbouring waters has been arrived at based on their larval abundance.

Of late, emphasis is given to scientific prawn farming in our national plans. Large scale scientific commercial shrimp farming, calls for enormous supply of seeds, collected from wild stock or from hatchery for tangible production. The availability of prawn seed from natural resources depends on various factors which widely fluctuates over time and space. Estuaries and backwaters, have long been recognised as 'cradles' or nursery ground for several types of fish and shellfishes (Mohamed & Rao, 1971; George, 1958). It is well known that marine prawns breed in the near shore waters and the larvae migrate towards the brackishwater for further development. Several estuaries, backwaters and brackishwater environment of the country have been thoroughly investigated for the availability of prawn seeds (Rao, 1983).

Karnataka, interspersed with several estuaries, tidal creeks and mangrove swamps offers ample scope for development of brackishwater shrimp farming (Bhat, 1983). However, details on the prawn larval abundance, its availability and distribution are scarce. It is in this background, some observations were made on the ingression and distribution of prawn larvae in the estuaries of Mangalore during 1978–79. Prawn seed resources of this estuary received more attention recently (Rao, 1980; Ramamurthy, 1982), although the later work emphasises the juvenile prawn fishery of Mangalore in relation to hydrography.

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Materials and Methods

Larval prawns were separated from the zooplankton samples collected fortnightly from the nine stations in the estuarine complex of Mangalore (Fig. 1) during high tides for 12 months from March 1978 covering an area of 7.3 km^2. Owing to the non-availability of boats only one sampling was done during the months of June, July and December. Zooplankton samples from surface and columnar waters were collected using a HT net (mouth area 0.25m^2 and mesh size 200 μm). No columnar water collection was taken when the depth was less than 4 m. The volume of water filtered was calculated using standard methods (Tranter & Smith, 1972). The samples were preserved in 4% buffered formalin. Qualitative and quantitative composition of the larval prawn were analysed in the laboratory (Rao, 1973). Temperature, salinity, pH and dissolved oxygen of surface and sub-surface water were analysed by the method of Strickland & Parsons (1968)

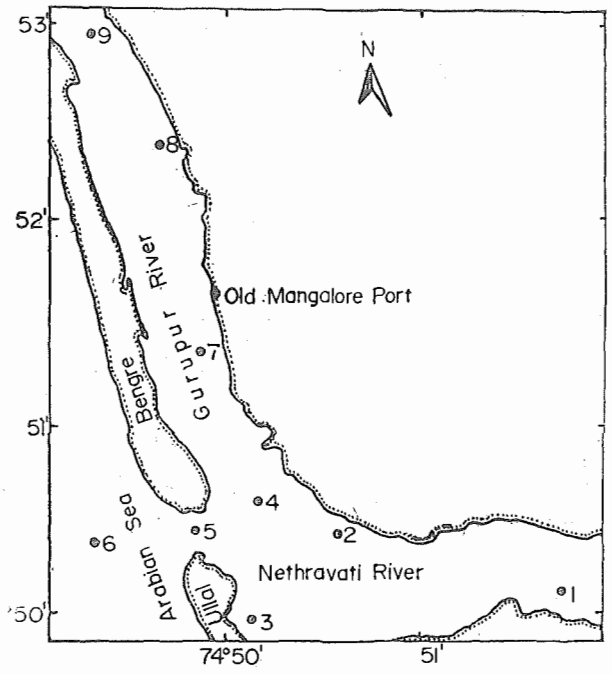

Fig. 1. Mangalore estuarine complex showing the nine sampling stations

Results and Discussion

Hydrography

Heavy precipitation reduced salinity, temperature, pH and increased dissolved oxygen values (7.49 ml/l) during the monsoon months in the estuary (Table 1). A clear-cut inverse relation was observed between salinity and dissolved oxygen values. Cooler conditions prevailed during the south-west monsoon and early post-monsoon periods. At many instances the sub-surface waters were highly saline and less oxygenated. Situation akin to this was observed in the other estuarine areas of west coast (Achuthankutty *et al.*, 1977; George, 1958; Silas & Pillai, 1975).

Faunistic composition and total abundance of prawn larvae

As more importance was given for meroplanktonic larvae in general during the study, much emphasis was not given to analyse the prawn larval samples to generic and species level. However, a general observation was made on the composition of larval penaeid and non-penaeid prawns such as *Penaeus indicus, P. monodon, Matapenaeus dobsoni, M. monoceros, M. affinis, Macrobrachium* sp. *Palaemon* sp. etc. Larvae of these species co-exist in the ground and exhibited wide seasonal fluctuations during the one year period. Mohamed & Rao (1971) observed larvae and juveniles of all commercially important species with the exception of *Parapenaeopsis stylifera* in the Cochin Backwaters. However, Achuthankutty *et al.* (1977) observed *P. stylifera* along with other prawn larvae in the estuarine waters of Goa. Columnar water registered more number of larvae than surface water. Two main peaks, one during pre-monsoon (March to May) and another during post-monsoon (November to January) were observed. Negligible numbers of larvae were found during the monsoon period. Surface waters showed maximum peaks during March (pre-monsoon) and December (post-monsoon). Rao, (1980) observed larvae of *P. indicus* dominating during 1979–80. He further observed that *P. indicus* was the prime species from March–June. In the remaining period *M. dobsoni* was dominant with two peaks of abundance in September and December. *M. monoceros* was also caught in appreciable numbers in March, May, December and January. *P. monodon* was fairly abundant in the estuary during March, April, January and February.

The nearshore waters with planktonic larval prawns penetrates the estuaries during high tide and consequently more larvae are brought in and distributed in the ecosystem. This would explain the difference in the total number of larvae recorded in the estuary. Achuthankutty *et al.* (1977) observed that salinity does not play an important role in the distribution of penaeid larvae as he observed larvae both at the barmouth and upstream regions in different salinity regimes. Situation akin to this was observed in the present study also. It is known that penaeid larvae are euryhaline in behaviour (Rao, 1972). A relation between the larval abundance and water temperature by way of decreasing trend of catches with progress of warmer months was observed by Rao (1972) in the inshore waters of Cochin.

Relative abundance of larval prawns in the estuary

Protozoea and mysis stages of penaeids and non-penaeids were observed during the present study in the estuarine waters.

Table 1. *Hydrographical values (based on fortnightly samples) in the waters of Nethravati-Gurupur Estuary, Mangalore (March 1978 to February 1979)*

		Stations																	
		1		2		3		4		5		6		7		8		9	
		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Temperature °C	S	31.3	25.1	31.2	25.2	32.6	26.1	32.5	24.9	31.7	27.4	31.6	27.1	31.7	26.1	32.0	25.6	32.2	25.1
	SS	31.4	25.0	31.0	24.4	—	—	—	—	31.4	24.5	31.3	25.8	31.4	26.0	—	—	—	—
	S	8.5	7.3	8.6	7.4	8.5	7.6	8.6	7.4	8.5	7.8	8.6	8.2	8.6	7.4	8.4	7.4	8.5	7.4
pH	SS	8.5	7.4	8.6	7·5	—	—	—	—	8.6	8.2	8.6	8.2	8.6	7.4	—	—	—	—
	S	35.66	0.9	37.25	0.08	35.02	0.06	37.57	0.08	37.57	2.32	36.75	—	36.39	0.08	35.66	0.08	34.38	0.06
Salinity, ‰	SS	36.29	0.06	37.57	0.06	—	—	—	—	38.93	2.77	38.20	—	36.93	0.06	—	—	—	—
Dissolved	S	7.24	3.62	7.24	3.90	6.91	3.64	7.28	3.62	6.78	4.18	6.23	3.90	6.69	3.9	6.72	3.34	7.24	3.34
oxygen, ml/1	SS	7.52	3.62	7.52	3.89	—	—	—	—	5.93	2.49	5.40	4.02	6.13	3.9	—	—	—	—

—=No data; S=surface; SS=sub-surface

Table 2. *Distribution of protozoea (no/m³) in the Nethravati-Gurupur Estuary, Mangalore*

		1978																1979		
Stations		March		April		May		June	July	Aug.		Sep.		Oct.		Nov.		Dec.		Jan.	Feb.	
		1	2	1	2	1	2	2	2	1	2	1	2	1	2	1	2	1	2	2	1	2
1	S	0	70	0	359	0	—	—	0	—	0	0	0	32	0	0	0	34	0	0	0	0
	C	0	0	718	0	363	—	—	—	—	—	0	0	0	195	0	0	1414	191	0	0	0
2	S	72	66	263	266	72	—	—	0	0	0	0	0	0	0	0	139	320	0	0	36	0
	C	0	0	614	1573	647	—	—	—	—	—	0	0	0	0	0	0	10	0	0	0	0
3	S	0	65	0	0	107	0	—	—	—	0	0	0	72	0	0	0	0	0	0	0	0
4	C	0	145	0	71	72	0	—	0	0	0	0	0	19	0	0	99	—	0	35	34	0
5	S	0	107	0	215	321	0	—	—	—	—	—	0	0	0	0	0	—	0	105	0	0
	C	0	349	623	565	833	0	—	—	—	—	0	0	0	0	0	0	288	533	0	0	0
6	S	171	179	0	105	464	—	—	—	—	—	—	—	71	65	—	33	—	70	104	71	72
	C	0	400	619	781	1446	—	—	—	—	—	—	—	0	0	—	—	313	0	1240	426	0
7	S	0	143	0	0	253	54	—	0	0	0	0	16	0	0	0	72	—	128	0	0	35
	C	0	548	1506	2788	612	0	—	—	—	—	—	0	438	0	810	—	866	0	0	0	0
8	S	71	0	175	88	0	0	—	0	0	0	0	0	0	0	0	0	339	34	0	0	0
9	S	—	0	0	0	0	—	—	0	0	0	0	0	0	0	0	32	69	0	0	0	0

– =No data; S=surface; C=columnar waters

Table 3. *Distribution of penaeid mysis (no/m³) in the Nethravati-Gurupur estuary, Mangalore*

Station		1978 March 1	March 2	April 1	April 2	May 1	May 2	June 2	July 2	Aug. 1	Aug. 2	Sept. 1	Sept. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	1979 Dec. 1	Jan. 1	Jan. 2	Feb 1	Feb 2
1	S	0.85	0.57	2	1	3	—	—	0	—	0	0	0	0.43	0.2	0.21	0	0	0	0	0	0
	C	3	7	20	43	37	—	—	—	—	—	0	0	13	6	0	0	3	0	0	0	0
2	S	0	0.14	0.71	1	0.28	—	—	0	0	0	0	0	0	0	0	1	1	0	0	0	0.28
	C	4	0	4	16	3	—	—	—	—	—	0	0	3	0	0	7	0	4	3	1	0
3	S	0.43	0.57	0.85	0.85	4	0	—	—	—	0	0	0	0.14	0.28	0	0.14	0	0.14	0.28	0	1
4	C	0.28	1	1	0.43	0.85	0.50	—	0	0	0	0	0	0	0	0.64	0.85	—	0	0.43	0.85	0.71
5	S	0.85	0.28	1	3	4	0.21	—	—	—	0	0	—	0	0	0	0.71	—	0	0.14	0.57	0.43
	C	9	4	19	29	48	5	—	—	—	—	0	0	0	0	3	1	0	0	10	0	0
6	S	0.28	0	0.43	0.71	6	—	—	—	—	0	—	—	0	0	0	1	—	1	0	0	0.28
	C	6	3	9	0	10	—	—	—	—	—	—	—	0	0	—	3	0	0	16	4	0
7	S	3	0.57	2	0.85	0.28	0.14	—	0	0	0	0	0	0	0	0.21	0	—	1	0.43	0.71	0.71
	C	6	0	0	8	32	6	—	—	—	—	—	0	0	0	8	—	0	2	0	0	0
8	S	0.86	2	2	2	4	3	—	0	0	0	0	0.24	0	0	0.07	0.43	0	0.29	0.29	0.57	0
9	S	—	1	1	2	3	—	—	0	0	0	0	0	0	0	0.36	0.21	0.28	0.43	0.28	0.57	0

– =no collection; S=surface waters; C=columnar waters

Table 4. *Distribution of caridean larvae (protozoea and mysis) (no/m³) in the Nethravathi-Gurupur estuary Mangalore*

Station		1978 March 1	March 2	April 1	April 2	May 1	May 2	June 2	July 2	Aug. 1	Aug. 2	Sep. 1	Sep. 2	Oct. 1	Oct. 2	Nov. 1	Nov. 2	1979 Dec. 1	Jan 1	Jan 2	Feb 1	Feb 2
1	S	0	0	0	0	0	—	—	0	—	0	0.36	0.71	3	1	3	0.36	0	0.85	0	0	0
	C	0	0	0	0	0	—	—	—	—	—	0	0	0	1	9	3	0	0	0	0	0
2	S	0	0	0	0	0	—	—	0	0	0	0.24	0.83	0.43	2	0.78	0.85	0.21	0.21	0	0	0
	C	0	0	0	0	0	—	—	—	—	—	20	3	0	0	11	0	0	0	0	0	0
3	S	0	0	0	0	0.43	0	—	—	—	0	0.24	0	0.43	0.14	0.14	0.21	0	0	0	0	0
4	S	0	0	0	0	0	0.14	—	0	0	0	0.24	2	0	0.14	0	0.85	—	0	0	0	0
5	S	0	0.43	0	0	0.28	0	—	—	—	—	0.83	—	0	1	0.14	0.85	0	0	0	0	0
	C	0	0	0	0	0	0	—	—	—	—	20	0	0	0	0	0	0	0	0	0	0
6	S	0	0	0	0	0	—	—	—	—	—	—	—	0	0	0	0	0.57	0.57	0	0	0
	C	0	0	0	0	0	—	—	—	—	—	—	—	0	0	—	0	0	0	0	0	0
7	S	0	0	0	0	0	0.29	—	0	3	0	0.95	0.30	0	0.14	0.29	0	0	0	0	0	0
	C	0	0	0	0	0	2	—	—	—	—	—	14	0	0	0	—	0	0	0	0	0
8	S	0	0	0	0	0	—	—	7	2	0	3	2	0	0	0.14	0.57	0	0	0	0	0.29
9	S	—	0	0	0	0	—	—	0.21	1	0	3	1	0.36	0.21	0.93	0.36	0	0	0	0	0

– =no collection; S=surface waters; C=columnar waters

A general abundance of penaeid protozoea was noticed at all stations during the months of February, April, early May, November, December 1978 and January 1979 with some exception in the columnar waters. The pre-monsoon contributed substantially than the other seasons. A record number of penaeid protozoea were collected from station 6 (May 1978) and station 2 (April 1978) in surface and columnar waters.

The contribution of protozoea during the post-monsoon was rather meagre. Achuthankutty *et al.* (1977) recorded peak abundance of these larval stages during late January in Mandovi and November in Zuari estuaries of Goa.

Appearing in good numbers in the pre-monsoon months mysis stage was generally less represented in the surface waters. However, columnar waters harboured these stages of the penaeid during the pre-monsoon and later post-monsoon months (Table 3).

The appearance of caridean larvae in appreciable numbers in these waters coincided with the onset of monsoon and the months experiencing substantial quantum of precipitation.

Prominent peaks were noted from September onwards in Nethravati and confluence section, whereas the months commencing from July, noticed the appearance of large numbers of these larvae in the Gurupur region (Table 4). George (1958) observed an increasing trend of carideans belonging to *Periclimenes* sp. and *Palaeomon* sp. after August, reaching a maximum during December to February in Cochin backwaters.

Spawning season

Spawning seasons of the penaeid prawns were studied based on the abundance of their larval stages in the estuaries. Penaeid prawns appears to breed continuously as protozoea and mysis were present in the estuarine waters throughout the period of investigation (Table 2 and 3). But intensive breeding was in the pre-monsoon season (January to April) with peaks in February and March. Two peak breeding seasons have been identified for the penaeid prawns, namely, October–December and May–August in the nearshore waters of Cochin (Rao, 1972). Carideans are found to breed only during monsoon period and early post-monsoon as larvae are observed in the month of July to November.

A perusal of the literature on the breeding periodicity of commercially important prawns in the inshore and backwaters indicate a continuous breeding for species like *P. indicus, M. dobsoni* and *M. monoceros* with peaks during November and May. Depending upon the geographical location on the south-west coast of India there could be slight shifting in the peaks (Menon, 1953; George, 1958, 1962; Rao, 1968, 1972 and Pillay & Nair, 1973).

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