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OCCURRENCE AND ABUNDANCE OF FOUR COMMERCIALLY IMPORTANT PENAEID POST LARVAE IN THE ESTUARINE WATERS OF SATKHIRA, BANGLADESH

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Till now wild penaeid postlarvae are the only source of seed supply and stocking material for the coastal brackishwater aquaculture ponds in Bangladesh. A year round investigation between June 1982 and May 1983 revealed that immigration of penaeid postlarvae takes place throughout the year in the estuarine waters in the vicinity of aquaculture farms of Satkhira. They were most abundant during monsoon (May-August), the maximum density (539 indivs./100m^3) was recorded in July and the minimum (16 indivs/100m^3) in March. The larval community of penaeid shrimps of this area was dominated by few species, *Metapenaeus monoceros* (51.05%), *Penaeus monodon* (14.75%), *Metapenaeus brevicornis* (3.02%) and *Penaeus indicus* (0.5). Their temporal and spatial distribution in the estuarine waters have been recorded.

Key words: Penaeid postlarvae, Immigration, Estuary.

Introduction

Shrimp farming in the coastal tidal areas is the most popular and profitable business in Bangladesh. The southern part of the country has a coast line of about 480 Km extending from Teknaf to Shyamnagar, which is bordered by the Bay of Bengal. The coastal and off shore waters harbour a variety of flora and fauna. Among the fishery resources, penaeid shrimp occupies a very important position in the national economy of Bangladesh. It is the third important foreign exchange earning commodity of this country [1]. Rapid increase in practice of monoculture and polyculture of penaeid shrimps depends on natural seed supply as the only source of stocking material for the coastal brackish-water aquaculture ponds. Successful shrimp farming depends on a number of vital factors of which availability of abundant fast growing fry in the vicinity of farm site is of utmost importance. An assessment of the seed resources (qualitative and quantitative) in the vicinity of the farm site is essential for planning a brackish-water aquaculture farm[2]. A limited information on changes in the abundance of postlarval shrimps and finfishes in estuaries and coastal water [3-5] is available. The present work on the distribution of postlarval penacids is the first of its kind undertaken in the estuaries of Satkhira, initiated as a part of estuarine studies of this country with a view of acquiring some knowledge on abundance, temporal and spatial distribution of commercially important shrimp postlarvae in the vicinity of aquaculture farms.

Materials and Methods

The study area is situated near the south-western corner of Bangladesh (Fig 1). It is a deltaid flat land traversed by a number of rivers the Batna, Kopotakha, Jamuna, Hariabhanga, Raimongal, Coxali, Morichap and their tributaries; and once was a part of the Sunderbans covered by dense mangroves. In the recent past it has been cleared of mangroves and almost the entire area was brought under brackishwater aquaculture operations by constructing dykes. Water of major portion of the area always remain brackish due to intrusion of saline water from the Bay of Bengal. During rainy season two sides of the rivers are often flooded. Three stations were selected for sampling in this estuarine area (Fig. 1). Station 1 was located in the Morichap river approximately 4 Km south-east of Satkhira town. Station 3 was near the junction of the Coxali, Isamati and Kalindi rivers and station 2 was 10Km upstream from the station 3.

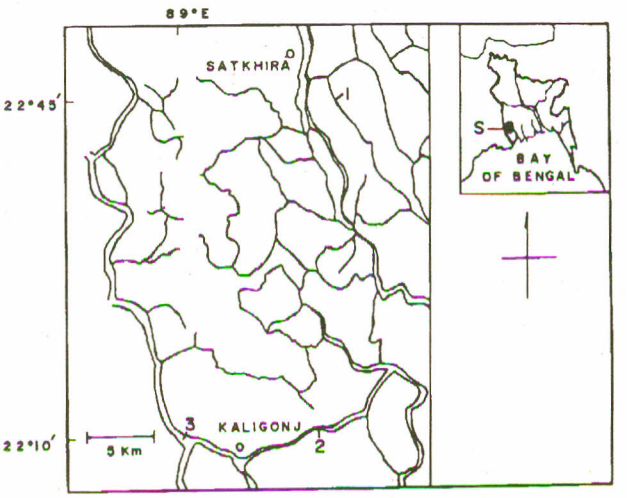

Fig 1. Right inset, showing geographical location of the study area(s) in the southwest corner of Bangladesh. The same has been expanded at left to show the exact location of the sampling stations (1,2 and 3) in the tidal area of Satkhira.

Samples were collected at fortnightly intervals from surface and bottom waters for one year (June 1982-May 1983). A rectangular plankton net similar to that described by Mahmood and Khan [6] having 0.5m$_2$ mouth opening and netting material of Hydrobios nylon mesh with aperture size of 0.5 mm was used. A karl kolb digital flowmeter was used. Samples were immediately preserved in 5% neutralized formalin and stored for further analysis. Surface water

temperature was recorded by a bucket thermometer and that of the bottom by a thermometer mounted inside the transparent Kemmerer bottle. Salinity and dissolved oxygen were recorded following standard procedures [7]. A secchidisc (30 cm in diameter) was used to record the transparency of water. Data on atmospheric temperature and rainfall were obtained through the courtesy of the Meteorological Department, Climatic Division, Dhaka.

In the laboratory Zooplankton samples were separated into major taxonomic groups, the shrimp larvae were sorted out to penaeids and cardeans. Identification of shrimp larvae were based on morphometric characters followed earlier by a number of workers [4,5,8-16].

The postlarvae of the four species of shrimps were measured for recording total length, from the posterior margin of the orbit to the tip of the telson. Monthly occurrence of different size groups of penaeid shrimp postlarvae, their modal, maximum, minimum length size, peak recruitment period and probable spawning season has been worked out.

Result

Results of hydro-meteorological parameters of the studied area have been discussed in detail earlier [17], which are summarized as follows:

Parameters	Annual range of variation
Salinity	5.13-21.02%
Rainfall	0-38.5cm
Water temperature	21.88-31.23°
Dissolved oxygen	3.62-5.43 ml/l
Secchi depth	7.4-14.21 cm

Penaeid postlarvae occupied only 0.78% of the total zooplankton population of Satkhira estuarine water (Fig. 2). They were recorded throughout the period of study with maximum density (539 indivs/100m^3) in July when higher salinity (21.02%) also prevailed (Fig. 3) and the minimum (16 indivs./100m^3) in March. Year round occurrence of penaeid postlarvae were also recorded from two other estuaries of this country by Elias [4] and Ahmed [5] relative abundance of different species.

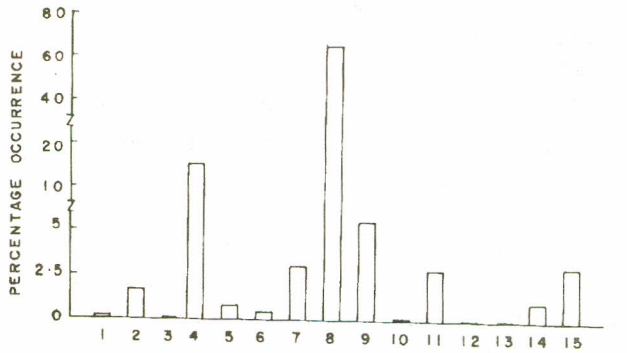

Fig 2. Annual percentage occurrence of different groups of zooplankton (1, Hydromedusae, 2 Chaetognaths, 3 Polychaetes, 4 Copepodes, 6 Caridean postlarvae, 7 Crab larvae, 8 Mysids, 9 Amphipods, 10 Lucifers, 11 Acetes, 12 Squilla larvae, 13 Horse shoe crab larvae, 14 Finfish larvae, 15 Other zooplanktons) including penaeid postlarvae (5).

A total of 250 tows were performed during the year round observation reveals the comparative abundance of postlarvae of four commercially important species as follows:

Species	Frequency occurrence
Metapenaeus monoceros	158
Penaeus monodon	140
Metapenaeus brevicornis	28
Penaeus indicus	16

Abundance of these species has been expressed in two ways viz. in terms of frequency occurrence as shown above and as percentage based on the sum of all the larvae expressed in numbers/100m^3 of water at each of the sampled stations (Table 1).

The first method may over emphasize the importance of some species merely because they have longer spawning seasons and the larvae were therefore, present in the estuary for longer periods of time. On the other hand the second method may bias the importance of a single species due to one or even several patchy encounters of the species in focus.

It is apparent from the data (Table 1) that the percentage composition of the four penaeid species if viewed in respect of total penaeid postlarvae appears as follows: *Metapenaeus monoceros* occupied 51.05%, *Penaeus monodon* 14.75%,

TABLE 1. COMPARATIVE EVALUATION OF MAJOR COMMERCIALLY IMPORTANT PENAEID POSTLARVAE AND THEIR MINIMUM MODEL AND MAXIMUM SIZES SAMPLED DURING ONE YEAR'S INVESTIGATION (JUNE 1982 - MAY 1983)

Species	Percentage composition with respect to total			Mean no 100m^3	Total length (mm)		
	Zooplankton	Shrimp larvae	Penaeid postlarvae		Minimum	Modal	Maximum
Metapenaeus monoceros	0.40	32.70	51.05	71.58	3.4	4.1	5.2
Penaeus monodon	0.12	9.45	14.75	18.81	9.0	10.0	16.0
Metapenaeus brevicornis	0.024	1.94	3.02	4.30	3.5	3.7	4.0
Penaeus indicus	0.004	0.32	0.50	0.78	8.2	10.2	14.0
Other penaeids	0.15	12.32	30.69	67.06	–	–	–

Metapenaeus brevicornis 3.02%, *Penaeus indicus* 0.50% and others 30.69%.

The percentage composition of these penaeid postlarvae in the light of both types of shrimp (Penaeid and caridean) postlarvae reveal that *Metapenaeus monoceros* occupied 32.70% *Penaeus monodon* 9.45% *Metapenaeus brevicornis* 1.94%, *Penaeus indicus* 0.32% and other penaeids 12.32%.

In view of the total Zooplankton the status of these four species appear as *Metapenaeus monoceros* occupied 0.40%, *Penaeus monodon* 0.12%, *Metapenaeus brevicornis* 0.024%, *Penaeus indicus* 0.004% and other penaeids 0.15% of the total population.

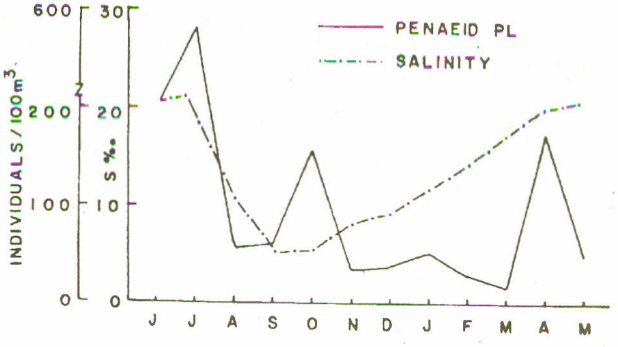

Fig 3. Seasonal variation in occurrence of penaeid postlarvae and salinity of the studied area.

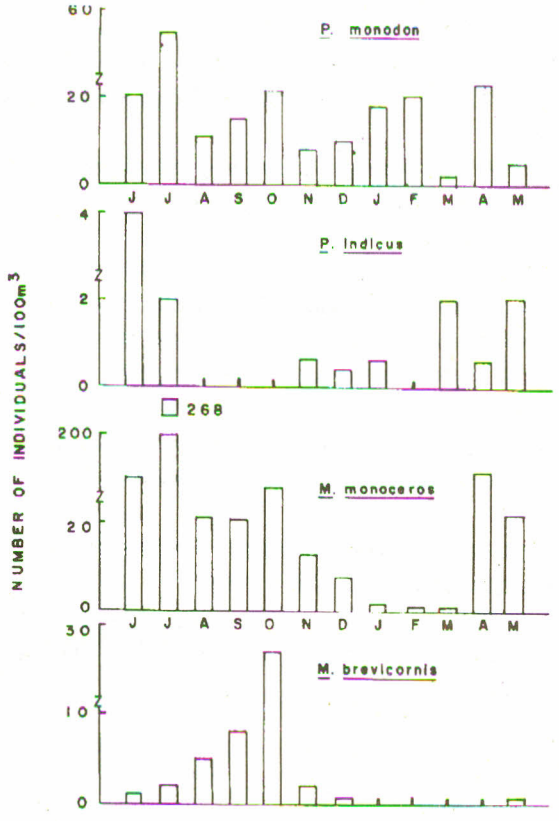

Fig 4. Monthly distribution and abundance of postlarvae of four species of penaeid shrimps in the estuarine system of Satkhira.

Mahmood and Khan [3] in Bankhali estuary; Elias [4] in Mathamuhuri estuary; Ahmed [5] in Karnafuli estuary also recorded *Metapenaeus monoceros* to be the dominant member of the larval community of penaeid shrimp. As in the present investigation postlarvae of the most important and widely cultured shrimp *Penaeus monodon* appeared as the second dominant member of the penaeid population in the Mathamuhuri estuary [4]. Ahmed [5] noted this species to occupy 10.84% of shrimp postlarval community in the karnafuli estuary. Temporal and spatial distribution.

Monthly distribution of commercially important penaeid postlarvae in the estuarine area of Satkhira (Fig. 4) indicates large variation in quantity.

Penaeus monodon. postlarvae occurred in the estuary (Fig. 4) throughout the period of investigation, but in higher densities in April and July (26 and 50 indivs./ 100m³, respectively) and the minimum was in March (2 indivs./100 m³) Rao and Gopalakrishnayya [18] observed that the postlarvae were available throughout the year and also mentioned the peak recruitment period of this species during July through November and March to April in the Pulicate lake. Kibria [19] reported only Juveniles or immature specimens of *Penaeus monodon* being available from June through October in the Sunderban area.

Postlarvae of *Penaeus indicus* occurred continuously from March through July and November through January. The peak (4 indivs./100 m³) was recorded in June (Fig. 4). Menon [20] stated that postlarvae of *Penaeus indicus* were encountered more in numbers during May to June in Korapuzha estuary of India. Mahmood and Khan [3] reported its occurrence in the Bankhali and adjacent coastal waters of Cox's Bazar with a peak in June. Ahmed [5] reported the peak abundance of its postlarvae in April to June in the Karnafuli river estuary.

Metapenaeus monoceros was recorded throughout the year. The maxima were recorded throughout in April and July (129 and 268 Indivs./100m³) respectively (Fig. 4). The minimum density was found in February and March (1 indiv./ 100 m³). Haque [21] stated that fry of *Metapenaeus monoceros* are available in the mangrove areas of Cox's Bazar round the year with peak in April to June.

The postlarvae of *Metapenaeus brevicornis* occurred between May and December (Fig. 4) with the maximum during August through October, and the minimum in December (less than 1 indiv./100 m³). Amin and Mahmood [15] stated that the occurrence of this species was from April to September in Karnafuli estuary, but from the month of June through August they occur at high magnitude. Das [22] stated that its occurrence was significantly higher in the months of August and October.

Seasonal occurrence. It is apparent from Table, 2 that maximum of penaeid postlarval ingress (867 indivs. 100 m^3) took place during monsoon in the Satkhira estuarine area. Three major commercially important species viz. *Peanaeus monodon, Penaeus indicus, Metapenaeus monoceros* were also abundant in monsoon period. But in case of *Metapenaeus brevicornis* maximum ingress occurred during postmonsoon. The minimum number of penaeid postlarvae were recorded during premonsoon period.

TABLE 2. SEASONAL DISTRIBUTION OF COMMERCIALLY IMPORTANT PENAEID POSTLARVAE (INDIVS./100m^3) IN THE STUDIES AREA.

Species	Premonsoon	Monsoon	Postmonsoon
Penaeus monodon	67	87	56
P. indicus	1	6	+
Metapenaeus monoceros	133	452	142
M. brevicornis	–	9	34
Other penaeids	71	313	53
Total number	272	867	285

(+) indicates presence but density being < 1 indiv./100m^3 (-) indicates absence;
Premonsoon, January- April; Monsoon, May- August; Postmonsoon, September - December

Spawning periodicity. Spawning periods were determined on the basis of postlarval recruitment in the Indian estuaries. Achuthankutty *et.al.* [23] and George [24] studied spawning seasons of penaeid shrimps on the basis of abundance of their larval stages in the estuary.

By observing the size of postlarvae of four commercially important penaeids *Penaeus monodon*, 9-14 mm, rarely 16 mm; *Penaeus indicus*, 8.2-12 mm, rarely 14 mm; *Metapenaeus monoceros*, 3.4-5, rarely 5.2 mm; and *Metapenaeus brevicornis*, 3.5-4 mm), it is assumed that they immigrated into this estuarine area within 15-20 days after hatching in off-shore waters. According to different workers [5,10,13,25-28] postlarvae of penaeid shrimp needs 15-20 days to develop from eggs through the various larval stages, meaning, that postlarvae enter the estuarine brackishwater at an age of 15-20 days. So, in order to determine the probable spawning period or season of a species, 15-20 days may be substracted from the date of occurrence in a particular area.

The spawning period of shrimps and its duration varies from species to species [29-31]. In the present investigation it was noted that the two dominant species, *Metapenaeus monoceros* and *Penaeus monodon*, occurred throughout the year (Table 3). This would suggest that spawning of these two species might take place round the year.

TABLE 3. LENGTH FREQUENCY DISTRIBUTION OF POSTLARVAE OF FOUR SPECIES OF PENAEID SHRIMPS, THEIR RECRUITMENT IN THE STUDIED AREA AND PROBABLE SPAWNING PERIOD.

Species	Length group (mm)	MONTH June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Peak recruitment month	Probable spawning period
	7.00 - 9.00	97	193	–	26	–	–	–	–	–	4	–	–		
	9.00 - 11.00	108	326	108	85	130	60	55	64	66	6	126	36		
Penaeus monodon	11.00 - 13.00	19	20	2	11	50	31	14	44	72	5	32	14	July	Contini-
	13.00 - 15.00	6	–	–	–	–	–	–	4	–	–	–	7		uous breeder
	15.00 17.00	–	–	–	–	–	–	–	–	–	–	4	–		
	7.00 - 9.00	6	–	–	–	–	–	–	–	–	–	–	1		
	9.00 - 11.00	16	13	–	–	–	3	1	4	–	1	2	3	June	March to
P.indicus	11.00 - 13.00	11	9	–	–	–	–	–	–	–	–	1	1		July and
	13.00 - 15.00	4	–	–	–	–	–	–	–	–	–	–	–		Nov. to
	15.00 - 17.00	–	–	–	–	–	–	–	–	–	–	–	–		Jan.
	3.00 - 3.50	2	28	20	10	25	9	–	–	–	–	–	34		
	3.50 - 4.00	600	1145	116	71	182	75	15	–	2	2	66	61	July	Contin-
Metapenaeus monoceros	4.00 - 4.50	687	1568	104	104	605	78	38	26	9	8	610	217		uous breaer
	4.50 - 5.00	33	148	49	42	50	–	2	4	4	–	78	15		
	5.00 - 5.50	–	2	–	–	–	–	2	–	–	–	–	–		
	3.25 - 3.50	–	–	2	4	49	4	–	–	–	–	–	1		
	3.50 - 3.75	–	6	43	38	112	18	–	–	–	–	–	3	Oct.	April to
M. brevicornis	3.75 - 4.00	10	12	5	26	77	2	5	–	–	–	–	–		Nov.
	4.00 - 4.25	–	–	–	–	–	–	–	–	–	–	–	–		

Discussion

From the analyses made earlier it is apparent that *Metapenaeus monoceros* is the major component of the postlarval penaeids of the studied area. The valuable *Penaeus monodon* is a continuous breeder in our water but postlarvae occur in a lesser densities when needed (March-April) for stocking in the costal aquaculture ponds.

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