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PRAWN NURSERY GROUND INVESTIGATION OF THE FENI RIVER ESTUARY (BANGLADESH) WITH REFERENCE TO IMPACTS OF THE IRRIGATION FLOOD CONTROL PROJECT

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ABSTRACT

Prawn samplings were conducted monthly from February 1978 to January 1979 in the Feni River Estuary located at the tip of the Bay of Bengal. The estuary was found to be utilized as nursery grounds by three species of marine prawns *Parapenaeopsis sculptilis*, *Metapenaeus monoceros* and *Metapenaeus brevicornis*, a species of estuarine prawn *Palaemon styliferus* and three species of freshwater prawns *Macrobrachium mirabilis*, *Macrobrachium malcolmsoni* and *Macrobrachium dayanus*. Construction of the proposed cross dam and regulator in the lower reach of the estuary will change the present brackishwater estuary into a freshwater lake during the dry season. This change will destroy the nursery grounds of *P. sculptilis* and *P. styliferus* whose juveniles require brackish water for nursing during the dry season, but not the other two species of marine prawns *M. monoceros* and *M. brevicornis* which require waters of very low salinity for nursing their juveniles during the monsoon season.

INTRODUCTION

THE FENI RIVER is one of the major rivers of Bangladesh. It flows into the Bay of Bengal, creating an extensive estuary in the northern reaches of the bay and the lower part of the

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river (Fig. 1). It is generally known that estuaries along the Bay of Bengal are utilized as nursery grounds for many species of marine prawns and breeding and hatching grounds for some freshwater prawns. These juvenile prawns in the estuaries are important for local fisheries (Jhingran and Gopalakrishnan, 1973). Some of them are the primary sources of seed for brackishwater prawn culture in that region (Bhanat, 1971; Gopalakrishnan *et al.*, 1975). In India such nursery grounds have been investigated for the estuaries of Kulti (Thakur, 1975), Hooghly-Matlah (Chandra, 1961; Rajyalakshmi, 1961; Gopalakrishnan, 1971, 1976;

Bhanat, 1971; Gopalakrishnan *et al.*, 1975), Lake Chilka (Kowtal, 1976), Godavari (Subrahmanyam, 1973, 1974), Lake Pulicat (Rao, 1973) and Cochin Backwater (George, 1959, 1962; Mohamed and Rao, 1971). No such biological investigation of estuaries has been conducted in Bangladesh.

Consequently, a concern exists about possible adverse impact of the proposed cross dam on the freshwater and marine prawn nursery grounds in the estuary. Such impact might damage the freshwater and marine fishery resources, particularly the marine shrimp fishery in the Bay of Bengal.

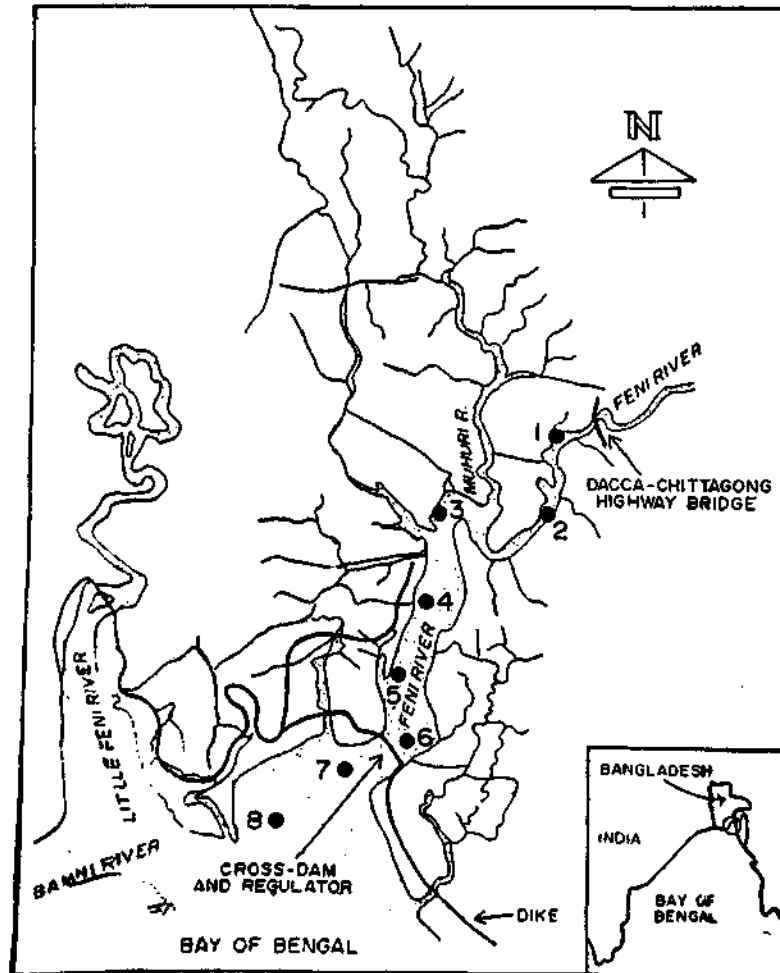


Fig. 1. Prawn sampling stations on the Feni River Estuary.

According to the plans of the Muhuri Irrigation and Flood Control Project of Bangladesh under sponsorship of the World Bank, a cross dam and regulator (sluice gate) will be constructed in the lower reach of the Feni Estuary at a site between Bashkali and Char Mukhta (Fig. 1).

This study was designed (1) to determine the species of prawns which utilize the Feni River Estuary as their nursery grounds, (2) to determine their nursery periods, (3) to assess their significance for fisheries in the estuary and its adjacent waters and (4) to predict the

possible impacts of the cross dam on the prawn nursery grounds and their fisheries.

STUDY AREA AND SAMPLING STATIONS

The study area extended from the Dacca-Chittagong Highway bridge to the mouth of the Feni River, a distance of 22.9 km. This area of the river is named as the Feni River Estuary in this study. Eight sampling stations were established in the area (Fig. 1). Station 1 was at a site about 455 m downstream from the Dacca-Chittagong Highway bridge. Station 2 was near the village of Langalmora. Station 3 was near the village of Mobarakghona. Station 4 was near the village of Char Lamse. Station 5 was near the village of Bashkali about 1 km upstream from the proposed cross dam. Station 7 was near the village of Char Mukhta about 1.8 km downstream from the proposed site of the cross dam. Station 8 was near the village Nilakki Chae about 3.6 km downstream from the proposed site of the cross dam.

At low tide the width of the water channel in the estuary was about 30 to 50 m at Stations 1 and 2, about 180 to 360 m at Stations 3, 4, and 5, about 360 m at Station 6 and about 650 m at Stations 7 and 8. Water depth was about 0.5 to 1 m. Most of the estuarine area was flat sandbars, occupying about 70 to 98 per cent of the area. In the upstream Stations 1 and 2, water was clear and filamentous algae were common. Water at the six downstream stations was always muddy as the result of continuous agitation of sediments by tidal currents. Bottom sediments were mud near the shores and sand in the middle of the river.

SAMPLING METHODS

At each station water temperature was measured and a water sample was taken for salinity analysis by the silver nitrate titration method. Prawns were sampled with a 6.5 m long, 3 mm mesh beach seine. Each sampling

area was about 6.5 m × 150 m. The samples were preserved in 15% formalin. They were later sorted and identified as to species in the laboratory. Their number was counted and their length and weight were taken. Sampling was conducted monthly from February 1978 to January 1979.

RESULTS

Water Temperature and Salinity

Water temperature of the Feni River Estuary varied seasonally (Fig. 2). The lowest was 22°C in February and the highest was 33°C in May. During the monsoon season (June to October), the temperature remained fairly stable at 30 - 31°C.

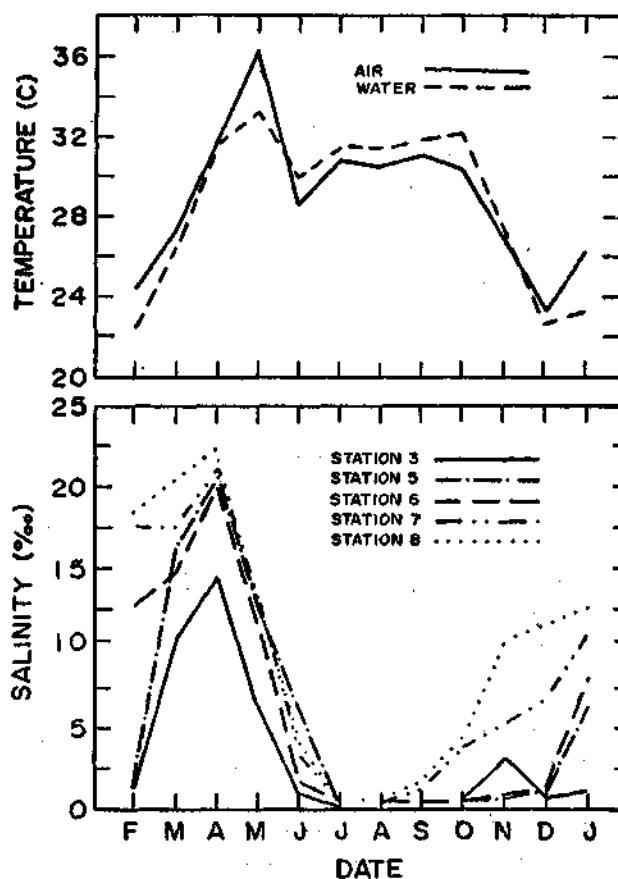


Fig. 2. Temperature and Salinity of the Feni River Estuary, February 1978-January 1979.

Salinity of the estuary showed an obvious seasonal cycle, strongly affected by monsoon floodwater runoff (Fig. 2). In the months of July and August, the estuary became a freshwater lake. At the end of the monsoon season (September and October), saltwater started to intrude into the river, but only reached as far as Station 6. Salinity was 4.5 ppt at river mouth Station 8. At the beginning of the dry season (November), the saltwater intrusion reached as far as Station 3, the upstream limit of the saltwater intrusion in the Feni River. As the dry season progressed, the salinity of the estuary increased rapidly and reached a peak of 22.8 ppt at Station 8 and 11.0 ppt at Station 3 at the end of the dry season (April). In May and June, floodwater runoff started and the salinity in the estuary decreased rapidly. Water at Stations 1 and 2 was fresh year round. On the basis of salinity characteristics, the Feni River Estuary was divided into two zones: a freshwater zone (Stations 1 and 2) and a brackish water zone (Stations 3-8). The latter is equivalent to the gradient zone (Chandra, 1961) or the true estuarine zone (Gopalakrishnan, 1971) in the Hooghly Estuarine system of India.

MARINE PRAWNS

Three species of penaeid prawns *Parapenaeopsis sculptilis* (Heller), *Metapenaeus monoceros* (Fabricius) and *Metapenaeus brevicornis* (Milne-Edwards) utilized the Feni River Estuary as nursery grounds. *Acetes indicus* Milne-Edwards was rare and occasionally found only at the mouth of the estuary (Station 1) in October-January.

Juveniles of *P. sculptilis* started intruding into the mouth of the Feni Estuary in late October in the beginning of the dry season (Table 1). As the salinity in the estuary increased and saltwater moved upstream, their upstream range also expanded and reached to Station 3 in March. They were most

abundant during the months of December-April and absent in the estuary at the peak of the monsoon freshwater runoff in the months of July to September. Juveniles of *P. sculptilis* apparently require brackish water for nursing. They never occurred at the freshwater zone of the estuary (Stations 1 and 2).

In contrast to *P. sculptilis*, the dry season species in the estuary *M. monoceros* and *M. brevicornis* are the monsoon season species. Juveniles of these two species were fairly abundant or nearly so in the estuary when it became freshwater (Table 1). In April, the juveniles suddenly occurred in abundance in the freshwater zone. Very few were taken at the upper portion of the brackishwater zone (Stations 3 and 4). During the peak of the monsoon season, they occupied the entire estuary. Juveniles of about 30 mm apparently require freshwater for nursing. They left the estuary in November and December.

In India, times of occurrence of post larval and juvenile *M. monoceros* and *M. brevicornis* varied greatly in different estuaries. *M. monoceros* was found in the lower reaches of the Godavari Estuary in October to February (Subrahmanyam, 1973) and November to June (Subrahmanyam and Ganapati, 1971), January to April and July to October in the Pulicat Lake (Rao, 1973), and May to December in the Chilka Lake (Kowtal, 1976). *M. brevicornis* occurred in July to December in the Hooghly Estuary (Gopalakrishnan, 1973; Rajyalakshmi, 1961) and February and March in the Matlah stretch (Gopalakrishnan *et al.*, 1975; Bhanat, 1971). These two species of *Metapenaeus* shrimps spend their first year of life in estuaries (Subrahmanyam, 1973; George, 1959; Mohamed and Rao, 1971). As they grow, they move toward high salinity offshore water (Subrahmanyam, 1974) for breeding (George, 1959, 1962; George and George, 1964; Mohamed and Rao, 1971). It seems that a great disparity in times of occurrence of the juveniles of these two species in the

PRAWN NURSERY GROUND OF FENI RIVER ESTUARY

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TABLE 1. Number and length of three species of marine prawns taken from the Feni River Estuary, February 1978—January 1979

Month	Station								Total Number	Length $\bar{X} \pm S.D.$ (mm)
	1	2	3	4	5	6	7	8		
<i>Parapenaeopsis sculptilis</i>										
Feb.	..			1		3	4	2	10	32.1 ± 5.8
Mar.	..		3	1		35		2	41	30.9 ± 3.3
Apr.	..			1	24	2	47	135	190	35.8 ± 13.5
May	..						17		17	22.9 ± 3.9
June	..						1		1	22.3
July	..									
Aug.	..									
Sep.	..									
Oct.	..							1	1	50.3
Nov.	..					5	23	6	34	49.4 ± 8.4
Dec.	..					21	56	9	86	24.9 ± 8.5
Jan.	..			1				1	2	27.7
<i>Metapenaeus brevicornis</i>										
Feb.	..			1	1				3	18.1 ± 2.2
Mar.	..									
Apr.	..	59	326	2	1				388	28.3 ± 6.7
May	..	8	51	81	44	59	10	25	294	31.5 ± 9.5
June	..	9	75	1	16	16	38	1	157	27.2 ± 9.1
July	..		1	78	10	2	2	8	110	27.6 ± 8.7
Aug.	..	5	18	200	42	22	3	46	351	29.9 ± 6.8
Sep.	..		2	2	306	22	38	11	382	30.9 ± 5.1
Oct.	..		6	11	1		9	1	28	30.6 ± 4.4
Nov.	..			18	1		3		1	27.5 ± 6.4
Dec.	..			72	1	3	2		78	35.6 ± 3.3
Jan.	..			2					2	16.5 ± 2.1
<i>Metapenaeus monoceros</i>										
Feb.	..									
Mar.	..									
Apr.	..	8	6	1					15	30.7 ± 6.4
May	..			82	2	1	2	1	90	42.0 ± 16.0
June	..									
July	..			27	3		1		31	23.4 ± 5.6
Aug.	..	4	36	6	1	2	1	2	58	31.0 ± 8.9
Sep.	..			1	27	7		7	44	33.6 ± 9.5
Oct.	..			26	2	1			29	23.3 ± 2.7
Nov.	..						3	1	4	24.7 ± 0.6
Dec.	..			1					1	25.1
Jan.	..					1			1	28.1

estuaries along the Bay of Bengal perhaps is due to the different salinities in different estuaries and to different salinity requirements of the different developmental stages of the juveniles.

ESTUARINE PRAWN

Palaemon styliferus Milne-Edwards was the only species of estuarine prawn in the Feni River Estuary. Like other estuaries in the Gangetic Delta in India (Kunju, 1955; Panikkar and Menon, 1955; Jhingran and

in the estuary. This suggests that *P. styliferus* seems to have a fairly high tolerance to freshwater, differing from the same species in the Hooghly Estuary which is reported to have a low freshwater tolerance (Kunju, 1955). However, this species were not found in the freshwater zone of the estuary during the dry season.

Most of *P. styliferus* taken were juveniles whose total lengths were less than 30 mm. Small juveniles of less than 15 mm appeared in great numbers in January and February. Larger specimens (40-60 mm) were found in

TABLE 2. Number and length of the estuarine prawn *Palaemon styliferus* taken in the Feni River Estuary, February 1978—January 1979

Month	Station								Total Number	Length $\bar{X} \pm S.D.$ (mm)
	1	2	3	4	5	6	7	8		
Feb.	..		23	1346	1718	693	163	431	4374	18.4 ± 5.7
Mar.	..		743	255	950	14	475	2225	4662	25.1 ± 6.7
Apr.	..		482	479	385	485	300	1210	3341	17.1 ± 9.2
May	..		2450	260	366	137	346	607	4166	19.7 ± 7.6
June	..		21	29	63	28	25	11	177	25.0 ± 5.9
July	..			26	3	55	15	114	213	26.0 ± 4.6
Aug.	..		26	125	9	7	3	13	183	27.8 ± 6.9
Sep.	..					48	1	12	61	22.5 ± 8.5
Oct.	..		43	9	8	187	163	7	417	27.2 ± 4.8
Nov.	..		475	435	215	146	307	323	1901	24.4 ± 8.1
Dec.	..		820	256	610	147	34	236	2103	21.0 ± 7.2
Jan.	..		896	1015	1270	2220	295	936	6632	18.7 ± 7.0

Gopalakrishnan, 1973), *P. styliferus* was the most dominant species of prawn in the brackish-water zone of the estuary. In the Feni Estuary, this species comprised 65 to 99.6 per cent of the total number of prawns in the various samples (Table 2). During the monsoon season when the flood water runoff was heavy from June to September, the upstream range moved downstream from Station 3 to Station 6. Apparently, many of these estuarine prawns migrated into the Bay of Bengal during the monsoon season. In the months of July and August, when the estuary became a freshwater lake, *P. styliferus* still remained in abundance

small numbers from April to August. Berried females which are known to migrate seaward (Panikkar and Menon, 1955; Kunju, 1955) were absent. Obviously, the brackishwater zone of the Feni Estuary is utilized as a nursery ground by *P. styliferus* year round.

FRESHWATER PRAWNS

Of the six species of freshwater prawns, *Macrobrachium rosenbergii*, *M. villosimanus*, *M. dollichodactylus* and *M. rudis* were very rare. They occurred only at freshwater Stations 1 and 2. *M. mirabilis*, *M. malcolmsoni* and *M.*

water runoff started in May, juveniles of this species migrated downstream to reach Station 7 where salinity was still 13 ppt. At the peak of the monsoon season, they occurred throughout the entire estuary. They remained in the estuary until October.

M. dayanus also dwells in the upstream portion of the Feni River. They were extremely rare at the freshwater Station 1 and 2 during the dry season (Table 3). This species became common at Station 1 in March and at Station 2 in April. As the freshwater runoff increased and the estuary salinity decreased, *M. dayanus* distributed as far as Station 7 in May where salinity is 16 ppt. Most of the population remained in the freshwater Stations 1-3 during the monsoon season. They became absent from the estuary in November.

M. malcolmsoni also dwells in the upstream portion of the Feni River. This species rarely occurred at the freshwater Stations 1 and 2 during the dry season from November to February. It became common at these two stations in March. The numbers increased as the monsoon season progressed, and remained at these two stations until June. At the peak of the monsoon season when the freshwater runoff was heavy and the estuary became freshwater, juveniles of this species migrated downstream as far as Station 6 in September. Unlike *M. mirabilis* and *M. dayanus* which apparently tolerate a certain degree of salinity, *M. malcolmsoni* always remained in freshwater.

POSSIBLE IMPACTS

The Feni River Estuary is located in a flat coastal plain of sediment deposits at the tip of the Bay of Bengal. It is muddy and shallow. It has strong tides and currents. The flood tide carries sediments from the Bay of Bengal into the estuary and at the same time stirs up the deposits in the estuary. The ebb tide

generates a strong outgoing current, washing sediments out of the estuary. There is little freshwater runoff during the dry season, and most parts of the estuary became sandbars at low tide. Because of strong tidal currents, deeply deposited sediments and shallow water, the estuary is like a pan of muddy water continuously agitated by the tidal forces. Erosion and the formation of mud banks and sandbars are ceaseless phenomena. In addition to the above adverse environment, there is a wide range of seasonal variations in salinity of the estuarine water. At the mouth of the river, salinity decreased from 22.8 ppt in April to zero ppt in July and August. The estuary actually becomes a freshwater lake for at least two months during the monsoon season. As a result, the Feni River Estuary is unstable.

Because of the instability of the estuary, sessile flora and fauna were virtually absent. The benthic invertebrate community is also extremely poor. There are no mussels, clams and oysters which, normally, would indicate a rich estuary. *P. styliferus* is the only resident prawn in the estuary. It is evident that in such an adverse environment, resident communities are unable to develop to significant abundance and high diversity. The estuary is utilized as a nursery ground by many species of marine prawns and freshwater prawns.

Construction of the proposed cross dam and regulator at the mouth of the Feni River will change the estuary into a stable freshwater reservoir above the dam and a tidal seawater area below the dam. This means that during the post-construction period, the estuary in the Feni River will no longer exist during the dry season. Undoubtedly, the nursery ground of *P. sculptilis* which requires brackishwater for nursing their juveniles during the dry seasons will be destroyed. In contrast, during the monsoon season, the estuary of the Feni River becomes freshwater and will remain so both above and below the dam during the post-

construction period. Therefore, the nursery grounds of those prawns which require freshwater for nursing juveniles during the monsoon season will not be affected.

On the basis of the maximum salinity of 22.8 ppt at the mouth of the river, the estuary which is a mixing zone of freshwater and seawater undoubtedly extends farther southward into the upper portion of the Bay of Bengal during the dry season. During the monsoon season, because of floodwater runoff, the estuary moved farther southward into the Bay of Bengal. The so-called 'Ganges Estuary' may

cover the entire 'Mouth of Ganges', which extends from Calcutta in India to Cox's Bazaar in Bangladesh. It also extends many miles deep into the Bay of Bengal. That area of the estuary which was under investigation is merely an extremely small portion of the Ganges Estuary. Therefore, the nursery ground of marine prawns in the Feni River Estuary occupies a very insignificant portion of their nursery grounds in the Ganges Estuary. The destruction of such small nursery grounds in the Feni River Estuary probably will not have a significant effect on the fishery stocks of marine prawns in the Bay of Bengal.

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