THE ESTUARINE SET BAGNET FISHERY

by

Md. S Islam
Md. G Khan
S A Quayum
Md. N Sada
Z A Chowdhury

Marine Fisheries Survey,
Management and Development Project,
Department of Fisheries, Chittagong

<<

<<

6. INTRODUCTION

According to the fish catch statistics of Bangladesh (Anon. 1988-89), the annual marine fish production is about 235,000 t. About 96 per cent of it, or 226,000 t, is reported to be contributed by artisanal fisheries. Of this, 63,000 t, or 28 per cent, is produced by set bagnets *(behundi jal).* About 46,000 t, or 73 per cent of the set bagnet production, has been reported to be from the estuarine set bagnet (ESBN) fishery, while the balance is from the seasonal, marine set bagnet (MSBN) fishery:

The ESBN fishery covers a vast coastal area. It embraces almost all the brackishwater bodies, channels, tributaries and also the open sea waters in some areas where there is a heavy outflow of freshwater from the major rivers of Bangladesh. Given the characteristics of the estuarine environment, the set bagnet makes an efficient gear for capturing a wide range of finfish and shellfish species. **But** it at the same time captures a wide size-range of these animals, including juveniles. Therefore, the operation of such a gear in the estuaries and the shallow waters of the sea, which are generally the nursery grounds for most marine finfish and shellfish, is considered harmful to the resources, except for a few estuarine species like Sergestid Shrimp *(Acetes indicus)* (Khan *et* al, 1988). Evidence of its destructive nature is also shown in the work of Ahmed (1979, 1981 and 1984), Islam (1987) and Chowdhury (1987).

In view of what many consider the destructive nature of the ESBN and the general concern for conservation of the marine fishery resources, the Bay of Bengal Programme was requested to assist in investigating this fishery to assess its destructiveness and identify what management steps should be taken,'if required. Consequently, a pilot survey was conducted in 1987, and the results proved the need for a more detailed investigation (Islam *et al,* 1988).

The set bagnet, a traditional fishing gear in the Bay of Bengal region, is still being operated by small-scale fisherfolk in Bangladesh, India, Indonesia, Malaysia, Myanmar and Thailand, with some regional variations in design and mode of operation. However, the gear is more dominant in Bangladesh (Figure 4) than in any of the other countries. This paper discusses the craft, gear, operation, fishing effort, production, seasonality in catch rates, species and size composition of catches in the ESBN fishery, as well as some biological characteristics and parameters of major penaeid shrimp and finfish, based on a study conducted in 1989/90.

Fig *4.* The set bagnet ol Bangladesh

<<

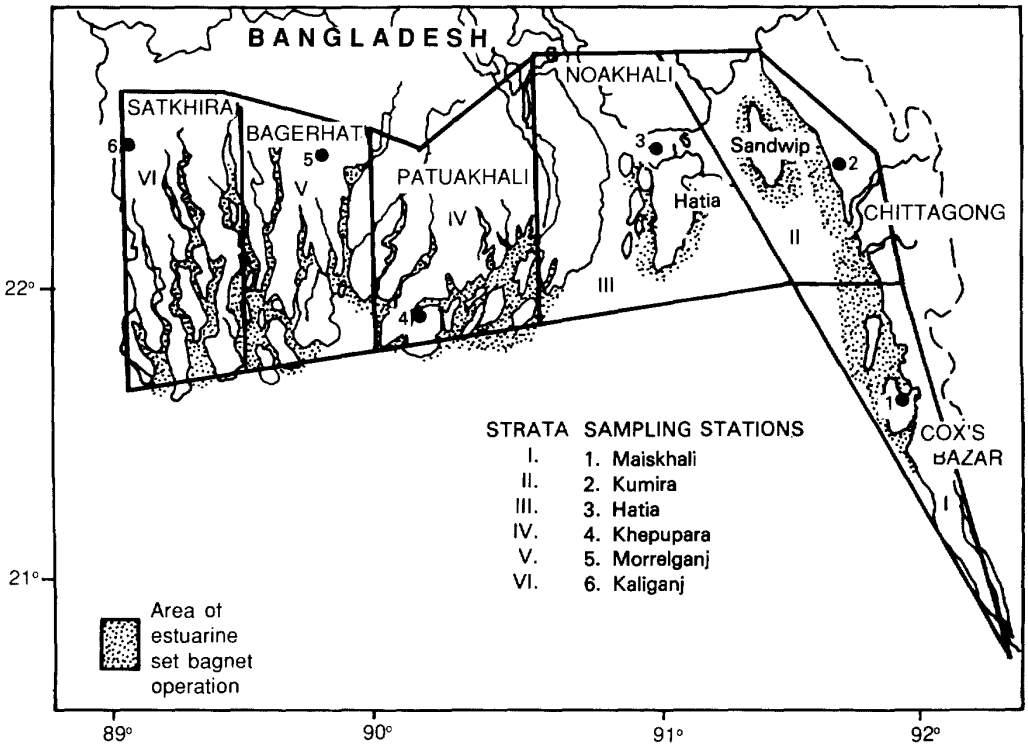
7. METHODOLOGY

7.1 *Sampling stations*

On the basis of the frame survey conducted in October and November 1989, six sampling stations were selected to represent the six areas covering the 650 km coastline of Bangladesh, as well as the estuarine tributaries (Figure 5). The selection of the stations was also influenced by their accessibility to the field staff conducting the investigations. The sampling stations identified for detailed data collection are listed alongside.

No.	*Area*	*Sampling village/station*
I	Cox's Bazar	I. Maiskhali (Ghorakghata base)
II	Chittagong	2. Kumira
III	Noakhali	3. Hatia (Harni base)
IV	Patuakhali	4. Khepupara
V	Bagerhat	5. Morrelganj
VI	Satkhira	6. Kaliganj

Fig 5. Areas of set bagnet (estuarine) operation in Bangladesh with sampling stations



7.2 *Classification of nets*

During the frame survey, an assessment was made of the total number of nets and craft engaged in the ESBN fishery at the selected stations. The differences in the lengths of the nets were used to identify four size categories. During the subsequent study, the classification was made on the basis of the area of the mouth opening, instead of the length of the net; it appeared that, besides the codend mesh etc., the area of the mouth would be of greater significance to performance. It also became evident from the preliminary study (Islam *et al,* 1987) that, among the nets used in Bangladesh, there was no significant correlation between the area of the mouth opening and the length of net. For sampling purposes, the nets were classified into four sizes based on the measurements of the mouth opening (see alongside).

Gear size cafegory	*Width of mouth (m)*	*Area of mouth (m^2)*
Gla	<6	<IS
GIb	6-10	15-50
GIc	10-15	50-90
GId	>15	>90

<<

The width of the mouth is the distance between the two poles at either end of the mouth. This measurement also determines the area of the mouth, since it is rectangular. The distance between the poles was convenient to measure when observing catches at fishing locations.

7.3 *Sampling programme*

The sampling programme was executed at the six stations by biologists of the Marine Fisheries Survey Management and Development Project based at Chittagong and Cox's Bazar, who formed six groups with two in each group. Regular sampling started in December 1989 and continued till November 1990, with data being collected every week, every month, at each station.

STRATIFIED SAMPLING OF CATCH AND EFFORT

Catch and effort data, with details of number of craft, number and types of nets, depths of water, number of hauls/day, starting time, ending time, soaking time, and total catch by craft were collected at the fishing ground. Data were collected for about 25 hauls, at each station. each month. Information on total landings for a number of boats and the number of hauls per day, estimated number of fishing days per month, species composition of catch (by weight), and value (Taka) for each species caught was collected at the landing sites.

STRATIFIED SAMPLING OF BIOLOGICAL DATA

Monthly length-frequency samples were taken for about twenty important species, stratified by gear. The sampling programme was aimed at measuring about 200 individuals of each species per month, though poor catches sometimes did not permit this. These samples were raised to the catch, and then to the monthly landings at the station and, finally, to the area level production of the species-catch at length. The catch at length for all areas were pooled for length-based analysis of the population. Length ranges and predominant sizes were noted for as many species as possible, apart from those for which length frequencies were measured. Sampling was done mainly on board, but there was also some sampling at the landing stations. In addition, sampling for sex ratio, length-weight relationship, stomach contents and gonad maturity was attempted, whenever possible, for about ten species.

For taxonomic work, Dall (1956), Day(1989). Fischer and Bianchi (1984). George (1969) and Shafi and Quddus (1982) were consulted.

COSTS AND EARNINGS

Data on costs and earnings were collected in the field, during catch and effort sampling, and interviews with fishermen provided information on variable costs such as crew share/fixed wage, food, fuel, lubricants, water, ice, repair and maintenance of craft/gear. and expenditure. Fixed cost included capital investments on craft, gear and equipment, average life, depreciation, interest payable on loans/credit, insurance etc. About 50 per cent of the owners of the gear units sampled for catch and effort were interviewed each month and at each station for costs and earnings information as well.

<<

ENVIRONMENTAL DATA

Salinity, temperature, turbidity, depth etc. were recorded monthly at each station.

During the sampling programme, the lunar phase, which influences tidal amplitude, was taken into consideration. It was found that the tides considerably influenced the catch rate and the species composition. The sampling of catch and effort was, therefore, executed according to the lunar months, from spring tide to neap tide, to obtain a good average catch rate. The sampling schedule followed is given in Table 10 (see facing page).

7.4 Data processing and analysis

Each group of biologists returning from a field sampling visit processed the collected data, which were subsequently refined through intergroup discussions every month. According to the sampling plan, two out of the six groups were always in the field. This was particularly done to ensure good briefing of the groups scheduled to visit the stations the following month and also to ensure regular processing of the data collected. All processing of data and basic analysis was done manually. Computers were used only for more advanced analysis of growth parameters and fish population dynamics.

ANALYSIS OF CATCH RATE AND PRODUCTION

Catch rate (kg/haul) and catch composition were analyzed separately for each station on a monthly basis, stratified according to gear class. For production estimation, the monthly mean catch rates were multiplied by the average number of fishing days for each month, the average number of hauls per fishing day each month and the estimated number of Units of each class of the set bagnets at each station. This monthly production estimate for each station was then raised to the area level using the estimated number of nets in each area. The composition of the different size-classes of nets at each station was applied to the number of units at the area level.

COST AND EARNINGS ANALYSIS

Most fishermen gave their annual costs and these were averaged and computed as monthly estimates for the cost and earnings analysis. Monthly depreciation for the gear and craft (by size categories) was calculated simply by dividing the average of the original cost by the average life span (in months) of the respective gear and craft.

The monthly gross revenue for each species or group of shrimp or finfish caught by a unit was obtained by multiplying the monthly mean catch rate of that species. or group, by the average price of that species/group. the number of fishing days and the average number of hauls per day for that month.

ANALYSIS OF LENGTH-FREQUENCY AND BIOLOGICAL DATA

Length-frequency data was analyzed for growth, mortality, recruitment and selectivity patterns. using ELEFAN and LFSA programmes with an IBM-compatible microcomputer.

<<

Table 10: Schedule of sampling at the six stations

First Quarter

Lunar Month	*Maiskhali* *Hatia*	*Kumira* *Morrelganj*	*Khepupara* *Kaliganj*	
	4th	1st	2nd	3rd
1.	C+F 22.11.89	B+E 01.12.89	A+D 07.12.89	—
2.	B+E 22.12.89	A+D 31.12.89	C+F 05.01.90	—
3.	A+D 20.01.90	C+F 28.01.90	B+E 04.02.90	—

Second Quarter

		Maiskhali *Hatia*	*Kumira* *Morrelganj*	*Khepupara* *Kaliganj*
22	4th	1st	2nd	3rd
4.	—	F÷C 20.02.90	E+B 05.03.90	D+A 12.03.90
5.	—	E+B 28,03.90	D+A 04.04.90	F+C 11.04.90
		D+A 26.04.90	F+C 03.05.90	E+B 10.05.90

Third Quarter

	Khepupara *Kaliganj*		*Maiskhali* *Hatia*	*Kurnira* *Morrelganj*
22	4th	1st	2nd	3rd
7.	A+D 17.05.90	—	C+F 03.06.90	B+E 10.06.90
8.	C+F 16.06.90	—	B+E 02.07.90	A+D 09.07.90
9.	B+E 10.07.90	—	A+D 31.07.90	C+F 07.08.90

Fourth Quarter

	Kumira *Morrelganj*	*Khepupara* *Ka/iganj*		*Maiskhali* *Hatia*
22	4th	1st	2nd	3rd
10.	E+B 14.08.90	D+A 23.08.90	—	F+C 06.09.90
11	D+A 13.09.90	F+C 21.09.90	—	E+B 05.10.90
12.	F+C 12.10.90	E+B 21.10.90	—	D+A 04.11.90
13.	B +E/C+F 11.11.90	D+A 17.11.90	—	—

Note: Alphabets (A to F) indicate the six groups of biologists who did the field work.

<<

8. *RESULTS*

8.1 *Characteristics and operation of the set bagnet*

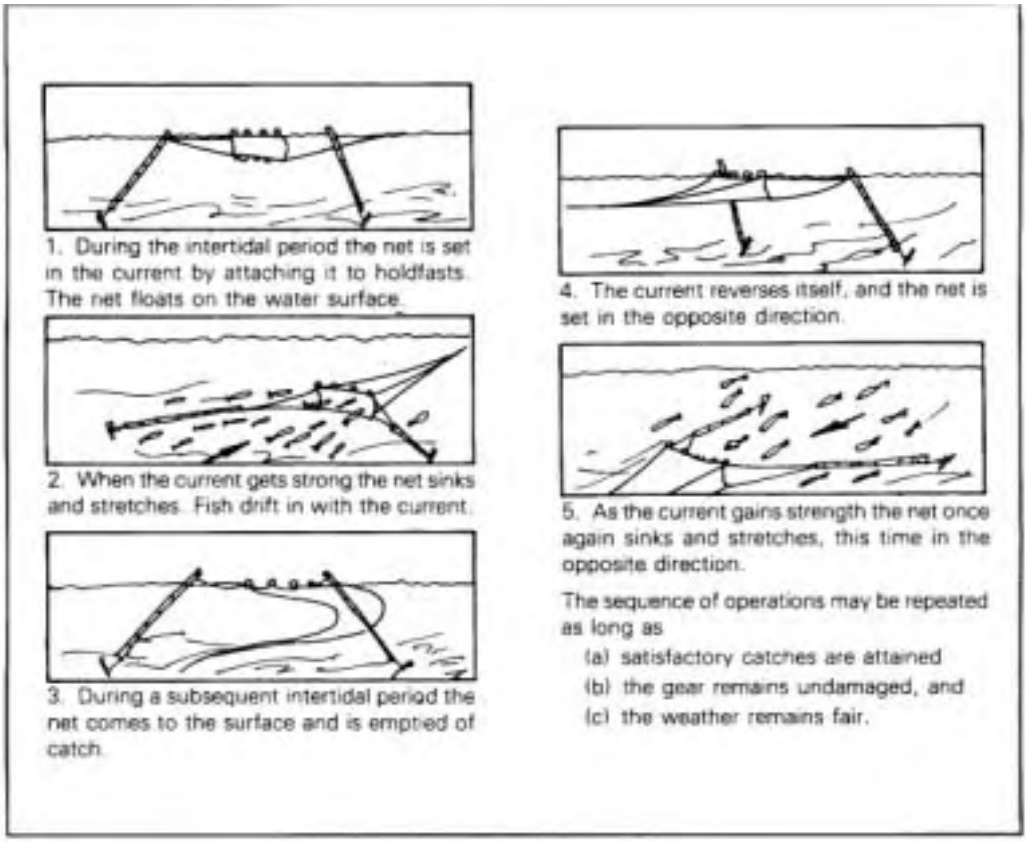
THE NET

The set bagnet is a fixed, tapering net, resembling a trawlnet, set in the tidal stream by attaching it to holdfasts. It has a rectangular mouth which is kept open by two vertical bamboo poles. The net is held in position, against the current, by linking the extended sides of the net (wings) to holdfasts by means of long bamboo poles or hollow drums and steel wires. The holdfasts are two wooden stakes embedded some distance apart in the seabed, so that the net is parallel to the direction of the tidal current (Figure 6).

The set bagnet catches those species of fish which drift with the current or do not swim fast enough to stem the current and, thus, maintain a fixed position in relation to the seabed. During each slack-period, the net rises to the surface (because of the bamboo poles used for opening of the net and the bamboos serving as sweeplines) and is emptied: it is then turned over to face the opposite direction and made ready for fishing again (Figure 6). Due to the difficulties in embedding the wooden stakes in the sea bed, this method of fishing is restricted to a maximum water depth of about *25m* (Akerman, 1986).

The net is made up of four panels. The mesh size decreases from 140-20mm at the mouth to 22-5mm at the codend. The length of the net varies from 8.5m to 41m and the height of the mouth opening is 2-7m. Particulars on size, material and costs of different nets found in different stations during the present study are given in Table 11 (see facing page).

Fig **6. Operation of set bagnet *(behundi jal)***



<<

Table 11: Characteristics of the estuarine set bagnets operated in different stations

	Station	Gear size category (Code)	Mouth opening width (pole to pole) in	Mouth opening height (m)	Length of net (m)	Cod-end mesh si:e (mm)	Material	Arg. life (vrs)	Ori ginal cost (Tk)	Replacement cost (Ti)
I	Maiskhali	GIb	8.3-10.0	5.0-6.2	22.8-36.6	12	Nylon	6-7	5000 - 11000	5000 - 25000
		GIc	10.6-12.3	6.0-6.8	35.5-41.1	12.13	Tyrecord	6-7	3500 - 35000	20000 - 35000
11	Kumira	Gla	3.6-6.0	2.6-3.5	13.0-20.0	10.15	PA & PE	8-12	7500 - 14000	0000 - 6000
		GIb	8.5	3.0-3.5	18.2-20.0	10-IS	..	10-15	10000 - 14000	14000 - 17000
III	Hatia	Gla	5.1-5.9	3.0-6.1	12.3-18.0	12-22	Nylon	5-7	5000 - 15000	8000 - 20000
		GIb	6.2-10.0	3.6-5.5	5.3-22.9	11-16	..	5-7	7000 - 15000	9000 - 25000
IV	Khepupara	Gla	5.4-5.5	1.8-2.7	11.4-11.6	10-12	PA & PE	3-5	2250 - 3000	4000 - 6000
		GIb	6.9-9.1	3.2-3.7	23.3-32.0	8-12	lyre cord	4-6	4000 - 12000	4500 - 15000
		GIc	11.4	4.6	34.3	10		5-6	4500 - 8000	5500 - 85000
V	Morrelganj	GIb	7.5-9.0	2.0-3.0	11.5-16.5	8-IS	Nylon	4.12	4000 - 7000	8000 - 12000
		Glc	ll.0-I5.0	3.0-5.5	17.5-30.0	10-IS	Tyrecord	7-10	9000- 5000	18000- 20000
		GId	20.0	5.0	40.0	10-IS	..	10	20000 - 25000	25000 - 35000
VI	Kaliganj	GIa	5.4-5.8	2.7-5.4	12.6-27.0	10	Nylon	7-IS	2000 - 8000	3500 - 8000
		GIb	6.3-7.2	2.7-5.4	13.5-27.0	8-14	..	6-20	3000 - 10000	5000 - 5000

NB: Length of a single wing is more or less equal to pole-to-pole width of the mouth opening of the estuarine SBN.

About 12.560 set bagnets were estimated to be operating in the estuarine areas of Bangladesh, out of which more than half were in Cox's Bazar and Chittagong. Details are given in Table 12. Of the gear size categories. Gla and GIb were the dominant ones (37 per cent each), followed by GIc (24 per cent). The Glc and Gid categories were operated mainly in the seasonal MSBN fishery, but some of these nets were also operated in the estuarine sector during the rest of the year. The Gla nets were dominant in Chittagong and Noakhali, GIb in Cox's Bazar, Chittagong and Patuakhali and Gic in Cox's Bazar.

Table 12: Distribution of set bagnets of different sizes in the six strata (percentages in parenthesis)

Number of unit.c of gear by size tategory

No.	Stratum	Gla	Glh	Gic	Gid	Total	Percentage distri-bution by area
I	Cox's Bazar	—	958	2274		3232	26
			(30)	(70)		(100)	
II	Chittagong	1994	1087	—	—	3081	25
		(65)	(35)			(100)	
III	Noakhali	1420	609	—	—	2029	16
		(70)	(30)			(100)	
IV	Paluakhali	613	1533	613	—	2759	22
		(22)	(56)	22)		(100)	
V	Bagerhat	—	183	167	63	413	3
			(44)	(41)	(15)	(100)	
VI	Salkhira	592	455	—	—	1047	8
		(57)	(43)	—	—	(100)	
	Total	**4619**	**4825**	**3054**	**63**	**12561**	100
		(37)	**(38)**	**(24)**	**(1)**	**(100)**	

<<

CRAFT IN THE ESTUARINE SET BAGNET FISHERY

The majority of the craft used in the ESBN fishery were nonmotorized. But in Kumira, as in the MSBN fishery. some motorized boats are also used as carrier boats.

In this study, the fishing craft were grouped into four classes, based on their overall length: Class I = up to Sm. Class 2= 5-8m, Class 3 = 8-12 m and Class 4 = above 12 m. Particulars of the different types and classes of craft and the minimum number that operated at different stations are given in Table 13.

Table 13: Characteristics and numbers of fishing craft used in estuarine SBN fishery at different stations

No.	*Stations*	*Type*	*CODE*	*Length range (m)*	*Engine (lip)*	*Minimum number used in the fishery*	*Crewi Craft (no)*	*Gear Craft (no)*	Ar. *Life (yr.)*	*Original cost (Th)*	*Replacement cost (Tk)*
1	Maiskhali	Dugout	1C2	5.1-8	—	323	2-3	05-1.0	7-10	5000-8000	10000.20000
		..	1C3	8.1-12	—	540	2-3	..	8-12	6000-15000	18000-20000
		SBN craft	4C2	5.1-8	—	753	2-3	..	5-7	3000-12000	5000-16000
		..	4C3	8.1-12	—	1616	2-3	..	5-8	2500-10000	7000-15000
2	Kumira	Row	3C2	5.1-8	—	36	34	5.7	20	25000	35000
		..	3C3	8.1-12	—	104	4	5-7	20	30000	40000
		Dugout	1C2	5.1-8	—	16	3-4	5-7	25	40000	50000
		..	1C3	8.1-12	—	232	4	5-7	25	50000	70000
		Motorized country craft	6C3	8.1-12	12	12	4	—	15	60000	70000
		Motorized boat	7C3	8.1.12	24	40	4-S	—	10	40000	40000-50000
3.	Hatia	Dugout	1C3	8.1.12	—	48	2-3	2-4	30-70	1500.7000	20000-21000
		SBN craft	4C2	5.1-8	—	48	2	2-4	12	3000	8000
		..	4C3	8.1-12	—	194	3	2-4	8-12	4000-12000	9000-21000
4.	Khepupara	SBN craft	4C2	5.1-8	—	1104	2	1.2	2-5	800-7000	1000-7500
		..	4C3	8.1-12	—	276	2.3	1-2	3-4	3000-7000	5000-8000
S.	Morrelganj	SBN craft	4C2	5.1-8	—	It	1	1-2	6-7	3000-7000	10000-13000
		..	4C3	8.1-12	—	143	1-3	1-2	4-20	2000-20000	4000.35000
			4C4	>12.1	—	53	2-3	1-2	5-20	6000-33000	8000-35000
6	Kaliganj	SBN craft	4C3	8.1-12	—	363	2	1-2	7-30	1000-16000	4000-16000
		..	4C4	>12.1	—	161	2	1-2	15-40	5000-9000	10000.20000

The cost of the craft of the same class/type varied by station, probably due to differences in the price of timber which depends on type and quality. The average life of a craft also varied. Since the cost mainly depends on the quality of timber used, dugouts always cost more and last longer than others.

8.2 *Species composition*

A total of about 185 species or groups of species of finfish and shellfish were identified in the ESBN catches. These included 15 penaeid shrimp, 3 nonpenaeid shrimp, 9 freshwater prawn, 3 crab, 3 molluscs, 90 pelagics and 62 demersal finfish. The annual average species composition by area and gear size class is given in Table 14 (facing page).

<<

Table 14: Annual percentage composition of species (by weight) at different stations

S. No.	Species	Maiskhali		Kumira		Hatia		Khepupara			Morrelganj			Kaliganj	
		Glb	Glr	Gla	Glb	Gla	Glb	Gla	Glb	Glc	Glb	Glc	Gld	Gla	Glb
A.	SHRIMP														
I.	*Penaeidae* (Shrimp)														
	P. monodon (Tiger Shrimp)	1.2	0.9	-	-	0.0	-	0.1	0.2	0.8	0.0	0.0	0.0	0.2	0.3
	P. indicus (White Shrimp)	0.1	0.!	-	-	1.4	-	0.5	2.1	2.2	0.0	-	-	-	-
	M. monoceros (Brown/Speckled Shrimp)	1.0	1.4	0.1	0.0	3.2	1.5	1.9	2.2	1.3	2.2	0.2	0.0	1.2	0.9
	M. brevicornis (Yellow Shrimp)	3.4	4.7	0.3	0.2	0.2	2.3	7.2	8.7	10.4	15.4	.4	0.4	5.2	6.2
	M. spinulatus (Spinulated Shrimp)	0.0	0.1	0.4	0.5	2.1	0.3	-	0.1	0.1	-	0.0	0.0	0.0	0.2
	P. sculptilis (Rainbow Shrimp)	1.4	0.8	1.2	1.0	0.1	2.1	0.5	2.1	2.1	0.5	0.1	0.1	3.5	2.2
	P srylifera (Kiddi Shrimpl	8.6	4.9	0.4	0.9	-	0.1	1.9	1.9	1.9	0.5	0.0	0.0	2.6	2.3
	Other penaeids	2.7	1.3	0.0	-	-	-	0.8	0.3	0.0	-	-	-	0.5	1.1
	Subtotal	8.5	14.3	2.3	2.7	6.9	6.3	12.6	17.5	18.8	18.6	1.8	0.5	13.3	13.2
2.	***Palaemon)dae*** (prawn)														
	M, rosenbergit (Giant River Prawn)	0.0	0.7	0.0	-	0.4	0.3	0.9	0.2	-	1.3	0.1	0.1	0.2	0.1
	P. styliferus (Roshana Prawn)	.4	t.6	2.8	2.6	10.7	14.1	2.8	2.6	2.4	1.6	0.2	0.0	4.9	4.3
	Other Palacmonides	0.7	0.5	0.3	6.5	13.4	11.3	7.2	6.1	5.0	15.1	1.1	0.5	7.4	8.9
	Subtotal	2.1	2.8	3.1	9.0	24.6	25.7	10.9	8.9	7.4	8.0	.4	0.6	2.5	13.3
3.	*Acetes indicus* (Sergestid Shrimp)	8.5	6.8	16.7	10.9	0.6	0.3	13.1	5.7	9.2	3.4	0.3	0.1	1.5	0.5
B.	**CRAB**	3.1	3.0	3.0	7.6	2.3	1.7	2.6	2.5	1.5	2.0	91.8	94.8	23.7	31.4
C.	FISH														
1.	***Ariidae*** (catfish)	0.1	0.1	3.7	3.8	1.2	1.7	0.4	0.6	2.0	0.1	0.0	-	0.3	0.2
2.	*Engraulidae* (Anchovies)														
	S.tri (Anchovy)	76	5.9	0.1	0.1	0.1	0.2	7.6	8.5	7.4	.5	0.1	-	0.1	0.0
	S taty (Hairfin anchovy)	0.5	0.2	0.3	0.2	0.6	2.3	1.3	0.9	-	0.3	0.0	0.2	0.1	0.1
	C. dussumieri (Grenadier Anchovy)	2.!	1.8	1.5	2.0	1.4	1.4	9.6	13.6	13.4	1.1	0.5	0.0	19.6	12.4
	Thryssa spp. (Anchovy)	1.1	2.8	-	-	0.4	0.3	0.1	0.!	0.0	0.3	0.0	.0	0.0	0.7
	Subtotal	11.3	10.6	1.9	2.2	2.5	4.2	18.6	23.1	20.8	3.1	0.6	1.2	19.8	13.2
3.	***Carangidae*** (Trevallies)	1.7	0.4	-	-	-	-	-	-	-	-	-	-	-	-
4	***Clupeidae*** (Shad/Herrings)														
	H. ilisha (Hilsa Shad)	0.3	0.1	1.0	1.6	-	-	0.2	0.3	0.0	0.2	0.0	0.0	-	-
	Other clupeids	12.5	9.3	0.7	1.0	0.7	0.5	1.2	4.4	4.4	6.0	0.5	0.3	0.2	0.2
	Subtotal	12.8	9.3	1.7	2.6	0.7	0.5	1.4	4.7	4.4	6.2	0.5	0.3	0.2	0.2
5.	***Gobiidae*** (Goby)	0.7	1.0	31.0	26.9	36.2	33.1	28.6	15.1	15.1	16.8	1.0	0.1	8.7	8.2
6.	***H. nehereus*** (Bombay Duck)	7.8	6.3	20.5	18.5	4.2	3.6	0.0	0.2	0.0	0.0	0.0	-	2.3	2.4
7.	*Magilidae* (Mullet)	4.1	3.1	0.0	0.0	0.6	0.2	1.6	1.4	.4	4.1	• 0.4	0.1	0.2	0.3
8.	*P. hasta* (Javelin Grunter)	0.1	0.1	-	0.0	-	-	-	0.1	0.1	0.0	-	-	-	-
9.	*Polynemidae*)Threadfinl														
	P. paradiseus (Paradise Threadfin)	-	-	1.3	1.1	1.5	4.7	0.1	0.4	0.5	0.4	0.1	0.3	0.1	0.1
	H, tetradactylum (Four Finger Threadfin)	0.9	0.5	0.1	0.0	0.1	0.3	0.1	0.1	0.0	0.5	0.0	-	0.1	0.3
	Subtotal	0.9	0.5	1.4	1.1	1.7	4.9	0.2	0.5	0.5	0.9	0.1	0.3	0.2	0.4
10.	*Sillaginidae* (Sillago)														
	S. domina (Gangetic Whiting)	0.2	0.2	0.1	2.5	1.0	2.6	-	0.5	0.7	0.3	0.0	0.1	-	00
	S. sihama (Silver Whiting)	0.2	0.3	0.1	0.0	-	-	-	0.1	0.0	-	-	0.0	-	0.0
	Subtotal	0.3	0.5	0.2	2.5	.0	2.6	0.0	0.6	0.7	0.3	0.0	0.1	0.0	0.0
11	***Sciaenidae*** (Croaker)	5.8	7.4	3.0	2.8	7.3	7.6	3.2	5.6	11.0	8.3	1.0	0.7	3.9	3.6
12.	*P. **argenteus*** (Pomfret-silver)	0.0	0.1	0.1	0.7	-	-	-	-	-	-	-			-
13.	*L. savala* (Hairtail)	2.4	1.8	0.6	0.9	0.3	0.2	1.0	0.6	-	-	-	-	0.1	0.0
14.	Other finfish	11.6	25.3	10.9	7.7	10.0	7.4	5.9	11.8	6.8	17.8	1.0	1.3	9.0	8.0
15.	Other invertebrates	8.1	6.5	0.0	0.0	0.1	-	0.0	1.1	0.1	0.3	-	-	4.3	5.1
	Grand total	**100.0**	100.0	100.0	100.0	**100.0**	**100.0**	**100.0**	100.0	100.0	100.0	100.0	100.0	100.0	100.0

<<

The proportion of shrimp in the catches were high in Maiskhali, Khepupara and Kaliganj, and in the Glb net in Morrelganj. The Yellow Shrimp *(M. brevicornis)* was the dominant species in Khepupara, Morrelganj and Khaliganj and the Kiddi Shrimp ***(P. styIifera)*** in Maiskhali.

The contribution of freshwater prawn, mainly the Caridean Roshana Prawn, was highest in Hatia (25 per cent) and lowest in Maiskhali and Kumira. The different gear classes had more or less similar contributions within each area.

Abnormally high catches of swimming crabs in one month in Morrelganj (for GIc and Gid classes) and, to a lesser extent, in Kaliganj have given this group a very high value in the total percentage composition, particularly in Morrelganj.

Among the finfish, the Anchovy *(Engraulidae)* showed high contributions in Khepupara (19-23 per cent), Kaliganj (13-20 per cent) and Maiskhali (11 per cent). The dominant species were ***C.*** *dussurnieri* in Khepupara and Kaliganj and S. *fri* in Maiskhali.

Catches of shad/herrings *(Clupeidae)* were relatively significant (11 per cent) in Maiskhali only.

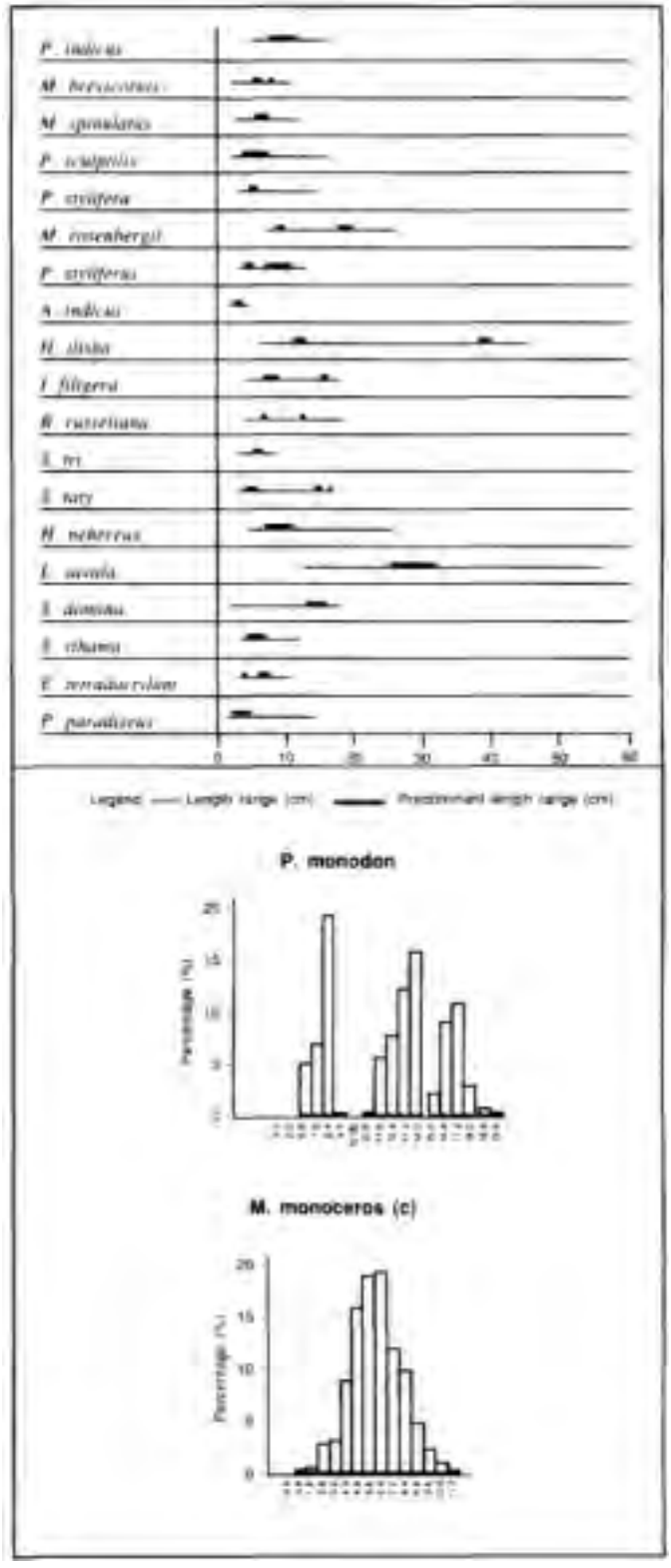
Goby *(Gohiidae)* catches were prominent in Kumira, Hatia and Khepupara.

Bombay Duck catches were high in Kumira (20 per cent), followed by Maiskhali (7 per cent).

8.3 *Size composition of major species*

The sizes of major shrimp and finfish caught in the ESBN are shown in Figure 7.

Fig 7. Length range (cm) of major shrimp and finfish caught by estuarine SBN and frequencies of annual production in size classes of *P. monodon* and *M. monoceros*



<<

The penaeid shrimp were mostly in the 2-15 cm range. except for the Tiger Shrimp *(P. monodon)* which were 5-20 cm. Annual length frequency for the whole area (pooled data) showed two peaks, one at 8 cm and the other at 11-15 cm. which indicated that they were mostly juveniles and immature. The predominant length of Brown Shrimp was 5-7 cm but there were several of smaller sizes, some even as small as 1 cm. They included a large proportion of juveniles and immature ones. Based on field observations during trawl surveys, Tiger Shrimp and Brown Shrimp are considered to mature when they are about 18 cm and 9 cm respectively.

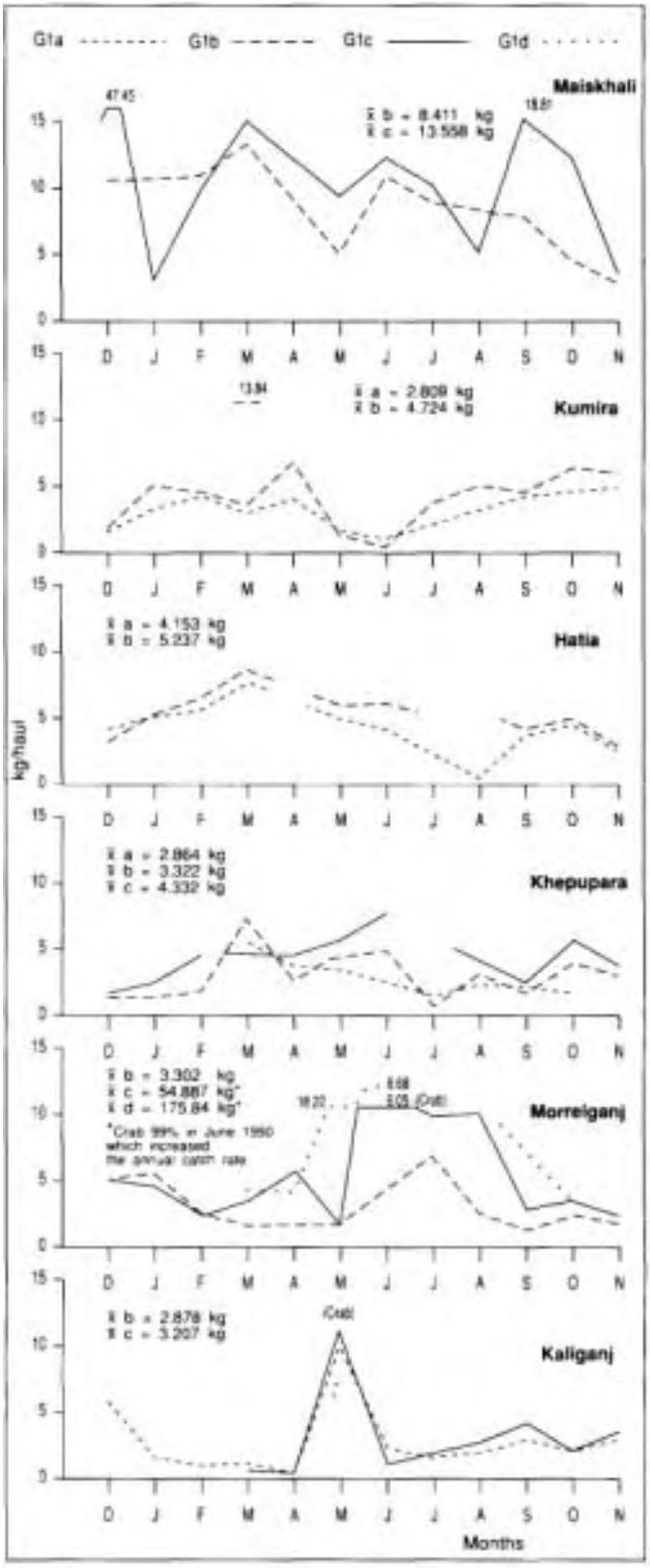
The size range of the Freshwater Giant Prawn ***(M. rosenhergii)*** caught in the set bagnet in the estuarine waters was 6-26 cm. This included juveniles and adults. The predominant sizes were 8-9cm and 16-18cm. Unusually, egg-bearing females were found at stations in the western part of Bangladesh.

A comparison of the size ranges of most of the finfish caught, with the maximum sizes recorded for these species in the region, indicated that the ESBN was mainly catching juveniles.

8.4 *Catch rates*

The monthly mean catch rate by different gear size classes in all areas (Figure 8a) exhibited numerous peaks in different months without any clear indication of any one peak being dominant. This could probably be due to the presence of numerous species catches which have peak catch rates in different months (Figures 8 b-k).

Fig 8a. Seasonal variations in the catch rates for ALL species caught at the six stations



<<

Student 't' test (Bishop, 1983 and Mustafa, 1984) was applied to the mean catch rates of different gear size classes in different areas but for the same months, to establish whether the efficiency of the net was influenced by the area of the mouth opening. The results of the analysis showed statistically significant differences. According to these results, the differences in the mean catch rate between the gear size classes Gla, GIb, Gic and Gid were in the ratio of 1:1.5:3:3 respectively.

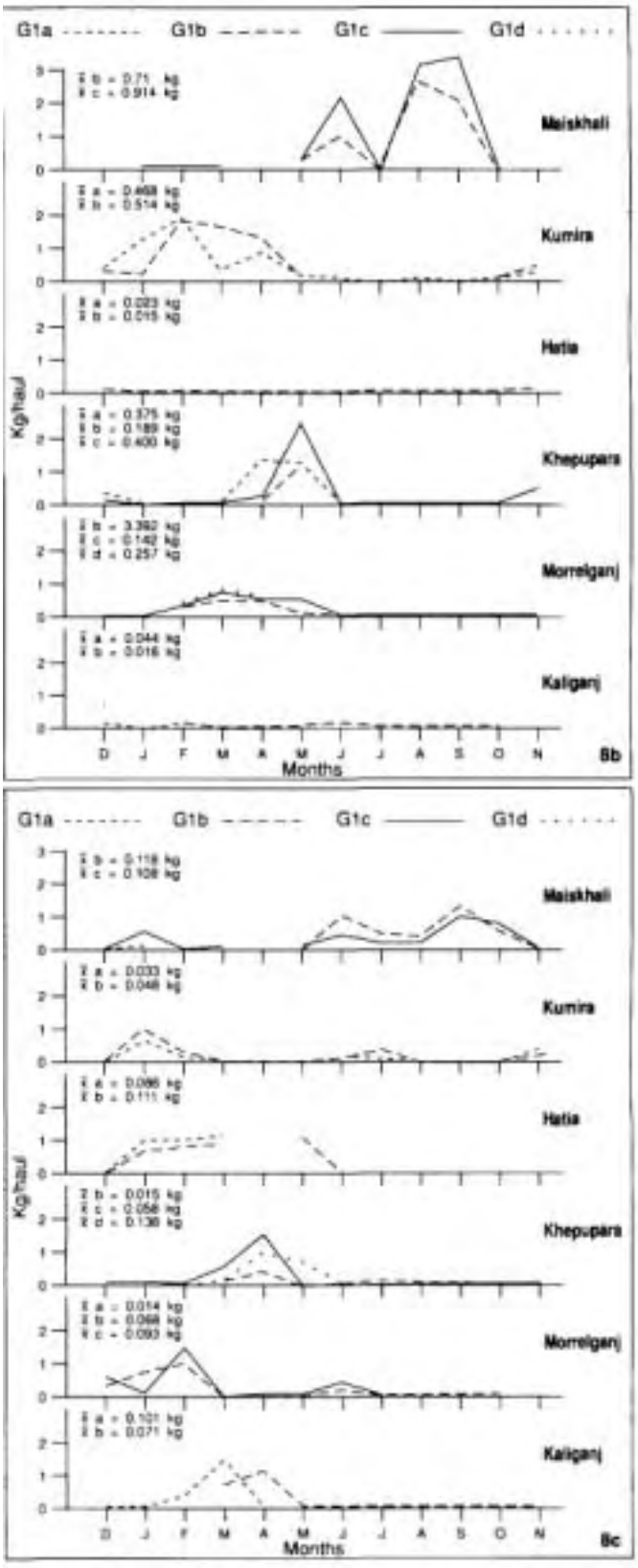
The highest mean annual catch rates (kg/haul) were recorded **in** Morrelganj for GIc *(54.9)* and GId (175.8). However, these high catch rates were due to unusually high catches of crab in June. If the crab rates were ignored, then the highest catch rates were in Maiskhali 6.4 in Glb and 13.6 in GIc.

The catches of major shrimp and finfish species varied considerably by area, gear size and season. The following observations can be made:

Sergestid Shrimp ***(Acetes indicus)*** showed high catch rates (2-3 kg/haul) in three areas, but very low or negligible rates in the other three areas. The abundance is highly seasonal, with different seasons in different areas but limited to about five months of the year (Figure 8b).

Rainbow Shrimp *(P. scuiptilis)* showed peak catch rates of 1-1.5 kg/haul in practically all areas; the peaks were generally in the first half of the year. but a greater peak was also observed during the last quarter in Maiskhali. The seasonality is significant, because the catch rates during other months are negligible (Figure 8c).

Fig 8b & c. Seasonal variations in the ESBN catch rates for *Acetes indicus* (b), and *P.sculptilis* (C)

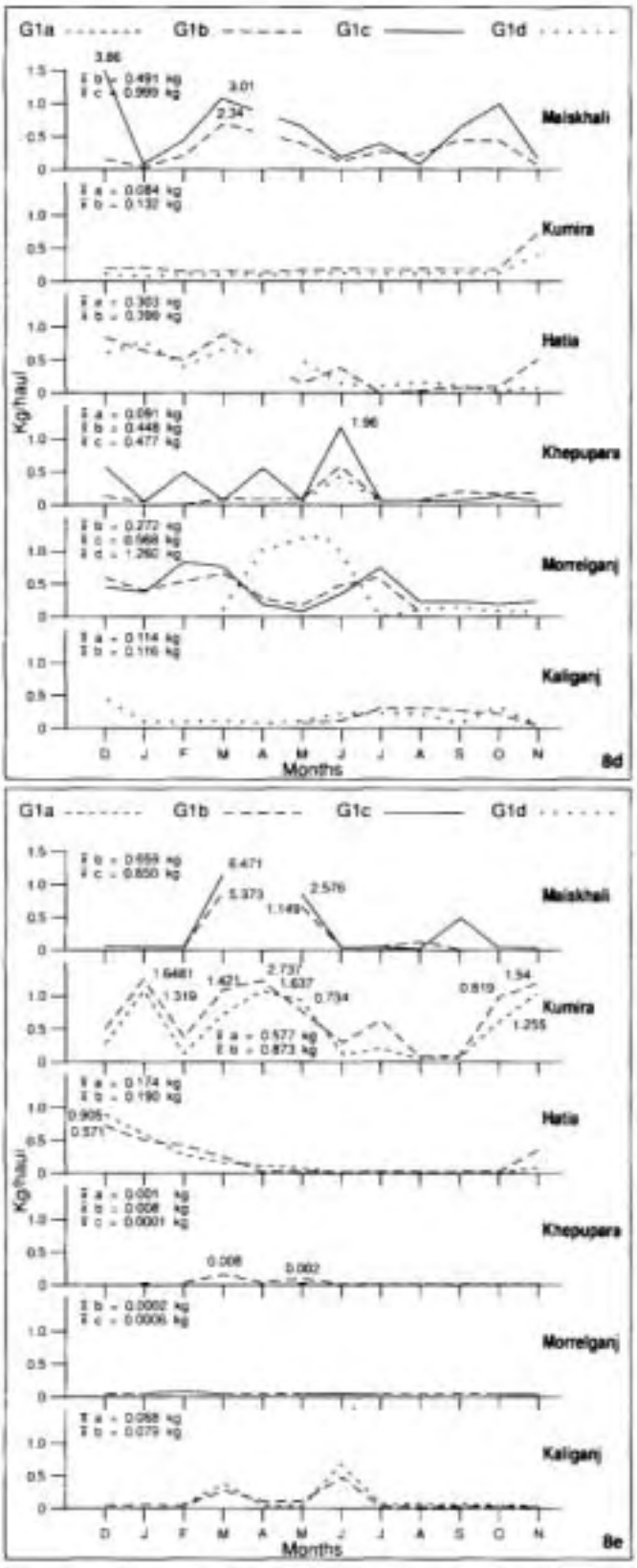


<<

Croakers were rather evenly distributed and caught year-round in all areas. The highest catches in Maiskhali, reaching peak of 2-4 kg/haul. The catch rates in the GId nets in Morrelganj deviate from the general picture (Figure 8d).

The Bombay Duck *(H. nehereus)* was mainly caught in the eastern areas during the first half of the year (Figure 8e).

Fig 8d & e. Seasonal variations in the ESBN catch rates for Croaker (d), and *H.nehereus* **(e)**

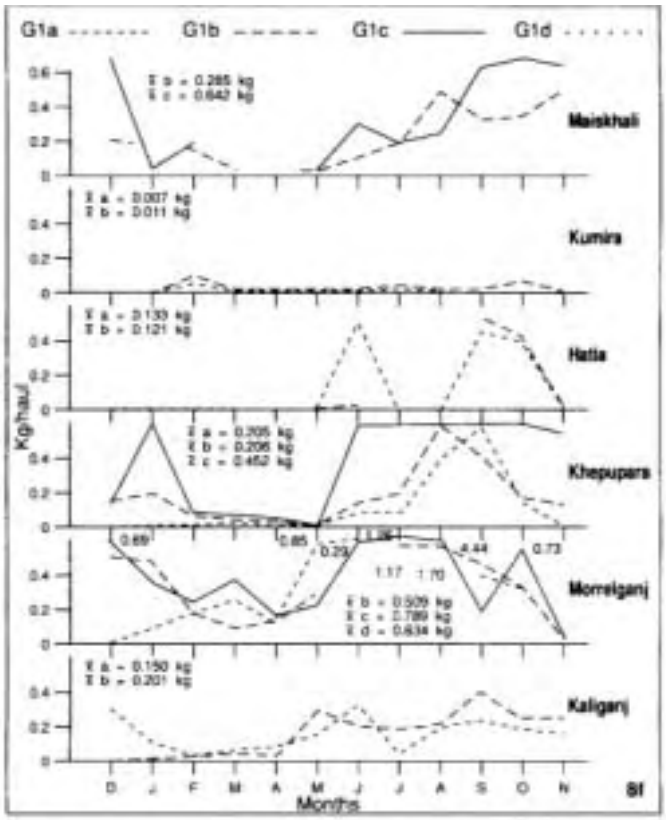


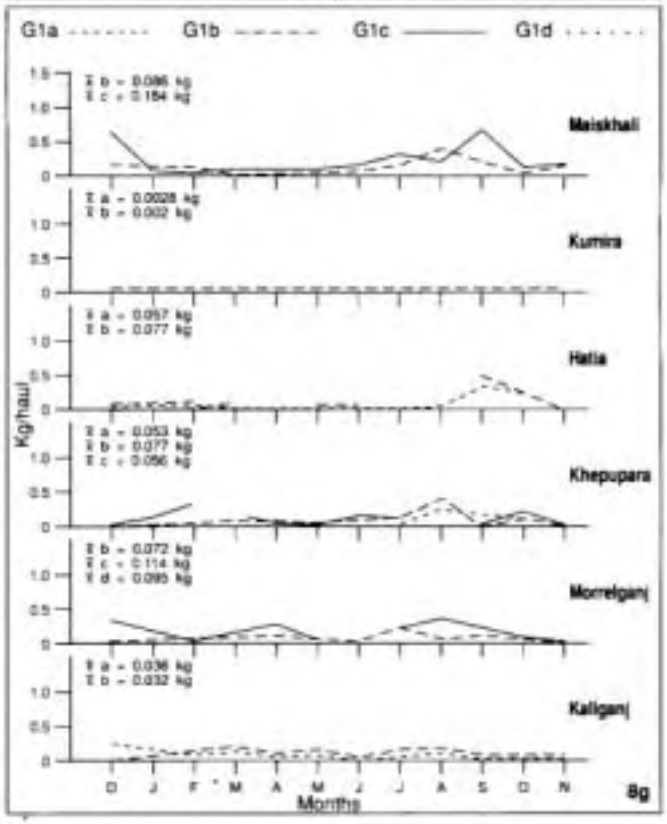
<<

– Yellow Shrimp *(M. brevicornis)* reached catch levels of 0.2-1 kg/haul at all stations except Kumira during peak season, which generally covered the second half of the year (Figure 8f).

– Brown Shrimp *(M. monoceros)* catches were generally very low, reading only 0.1-0.2 kg/haul during a short peak period in August-September (Figure 8g).

Fig 81 & g. Seasonal variations in the ESBN catch rates for *M.brevicomis* (f), and *M. monoceros* (g)



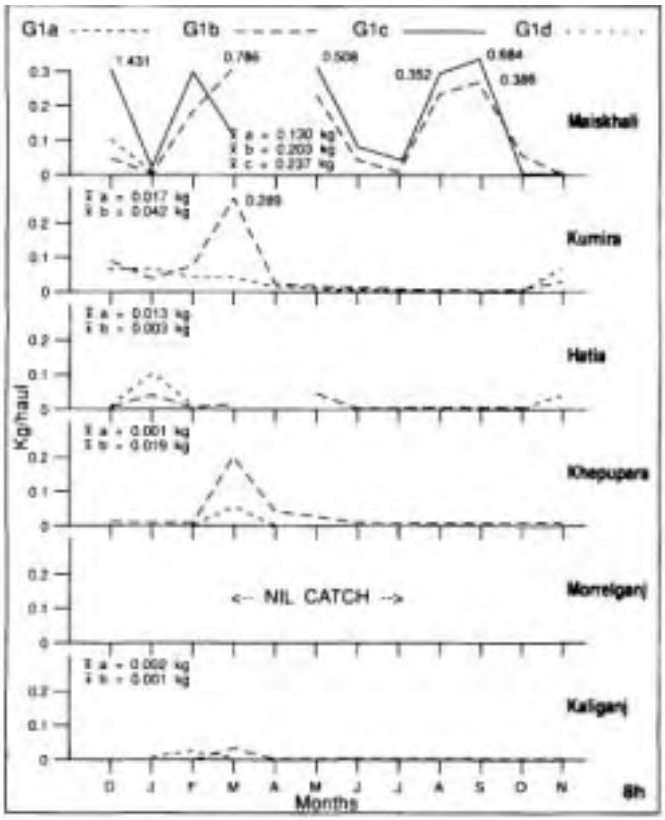


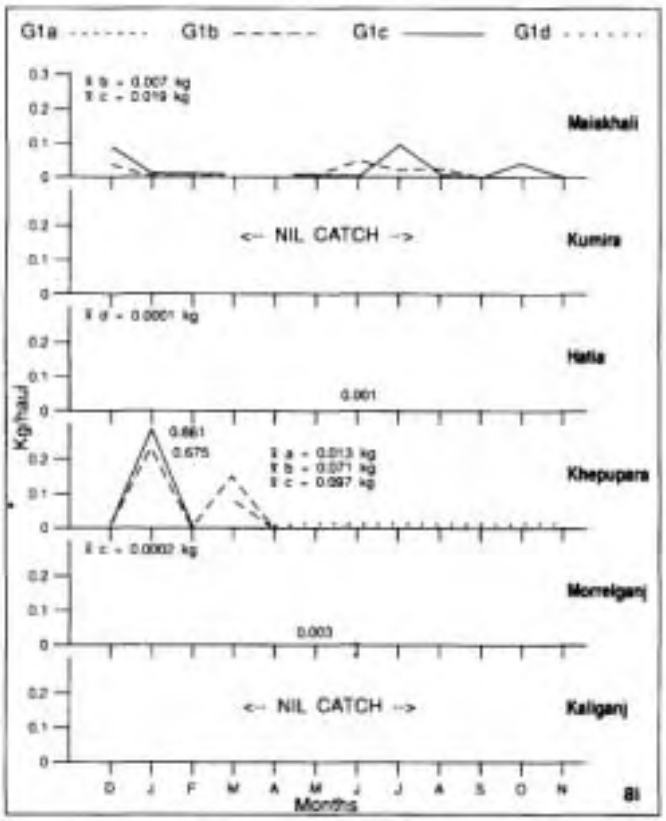
<<

— Hairtails and Ribbonfish *(L. savala)* were mainly caught in Maiskhali. There were fewer catches in Kumira and they gradually became less, going westwards, till there was almost nil catch in Morrelganj and Kaliganj. The catch in Maiskhali reached peaks of 0.5 to 0.8 kg/haul during several months of the year (Figure 8h).

— White Shrimp *(P. indicus)* was caught in significant amounts in Khepupara between December and April, with peaks around 1 kg/haul being reached in January. Elsewhere, the only significant catches were in Maiskhali — averaging about 0.05 kg/haul during the second half of the year. There was almost nil catch in the other areas (Figure 8i).

Fig 8h & i. Seasonal variations in the ESBN catch rates for *L.savala* (h), and *P indicus* (i)



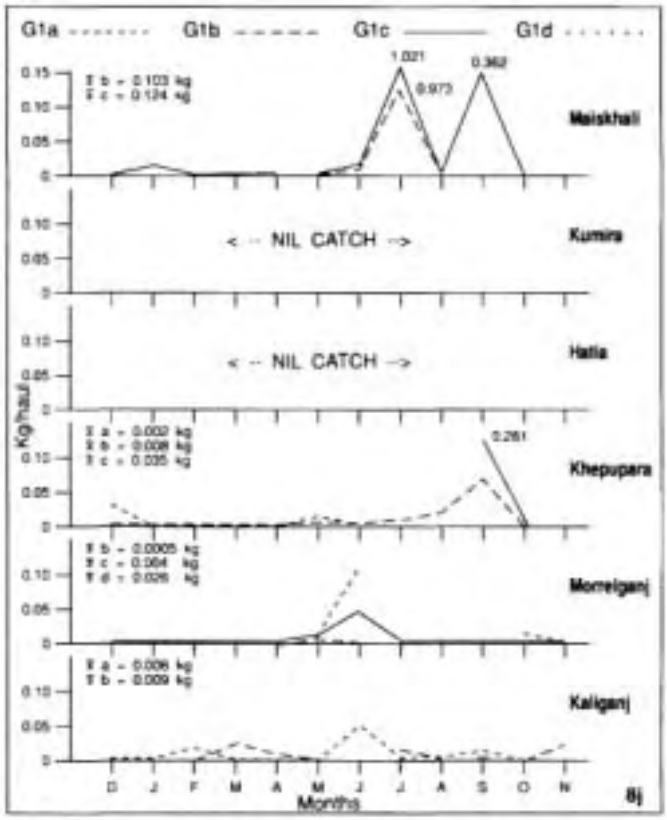


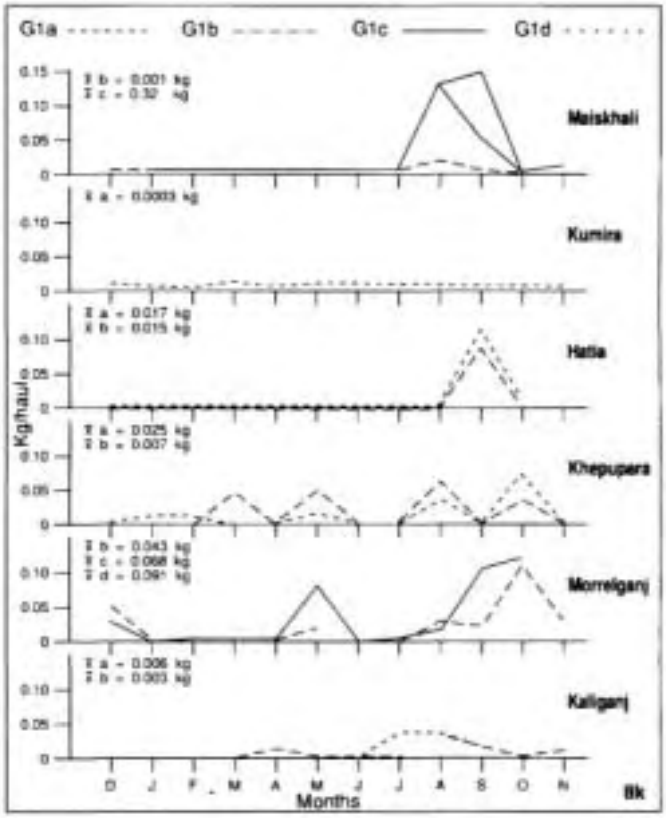
<<

– Tiger Shrimp *(P. monodon)* catches were made year-round in all areas of the estuarine set bagnet fishery, but they were in very small quantities. In almost all areas the catch was less than 0.1 kg/haul. The only exceptions were in Maiskhali, where catches between 0.5 and 1 kg/haul occurred between June and September, and in Khepupara where there was a catch of nearly 0.3 kg/haul in September (Figure 8j).

– Freshwater Prawn ***(M. rosenhergii)*** catches were also low, the only significant catches again being in Maiskhali between July and October with a peak of nearly 0.7 kg/haul **in September. This** was also the peak period in the other strata, where catches **were negligible.** (Figure 8k).

Fig 8j & k. Seasonal variations in the ESBN catch rates for *Pmonodon* (i), and *M.rosenbergii* (k)





<<

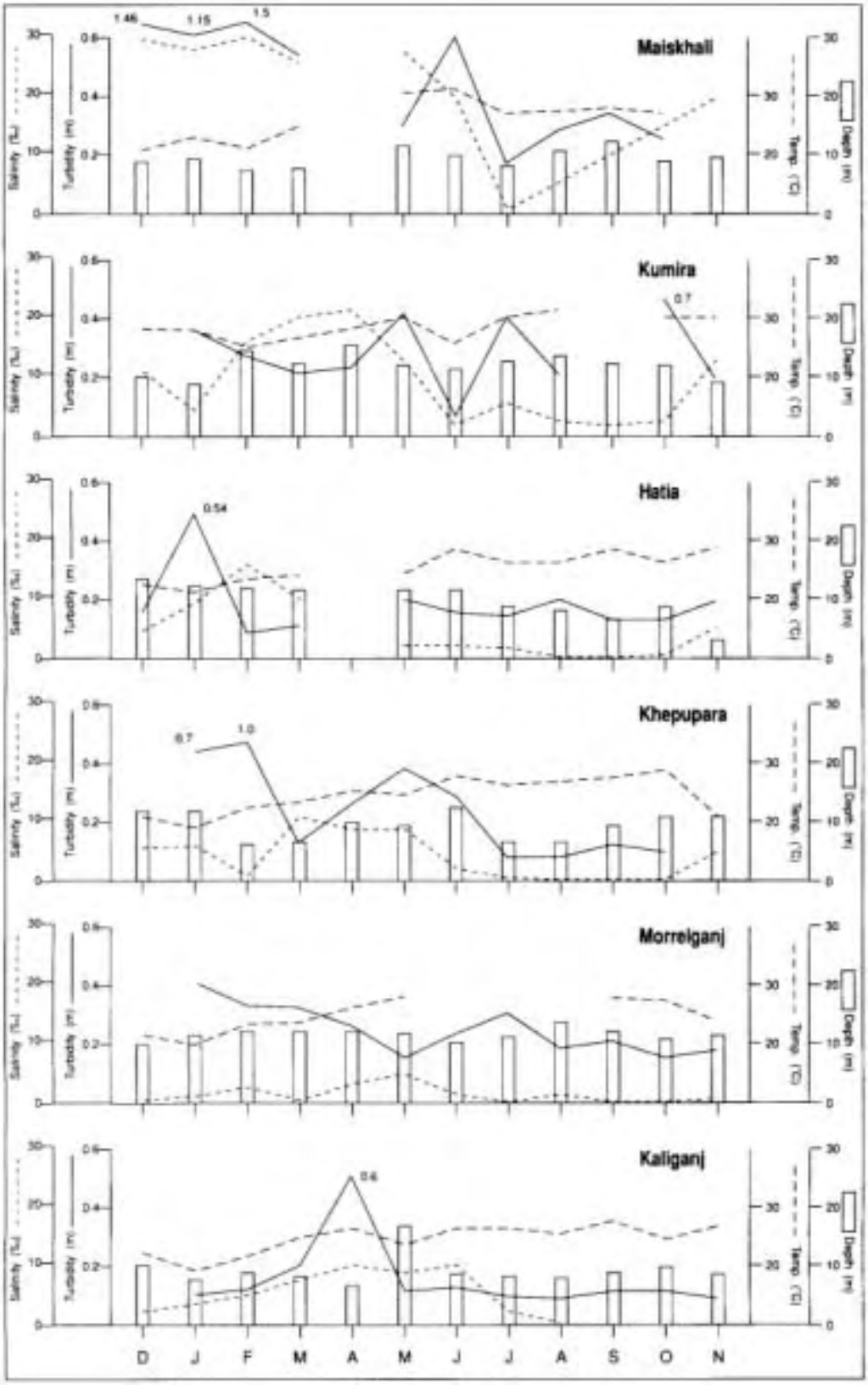
Catch rates of selected species by area and gear class are summarized in Table 15. Tiger Shrimp had highest abundance in Maiskhali (71.5 per cent) with a peak in July, White Shrimp in Khepupara (87.3 per cent) during December-May, Brown Shrimp evenly high in Maiskhali (30 per **cent),** Morrelganj *(25* per cent) and Khepupara (20.4 per cent) throughout the year and Yellow Shrimp in Morrelganj (44.5 per cent). Among finfish, Ribbonfish *(L. savala)* was highly abundant in Maiskhali (81.1 per cent) during December to May. Bombay Duck was equally highly abundant in Maiskhali (45 per cent) and Kumira (42 per cent) in November-April. Sergestid Shrimp was dominant in Maiskhali. From all information gathered, it would seem that Maiskhali is the area of highest abundance of many of the valuable species, including croakers, especially during December-March.

Table 15: Density of major species as catch rates (kg/haul) by gear and station

Species		Station/Gear													
		Maiskhali		Kumira		Hatia		Khepupara			Morrelganj			Kaliganj	
		Gib	Gle	Gla	Glb	Gla	Glb	Gla	Glb	Glc	Glb	Glc	Gld	Gla	Glb
P. monodon	CPUE	0.1	0.1	—	—	—	—	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
P. indicus	CPUE	0.1	0.1	—	—	0.0	0.0	0.0	0.1	0.1	—	0.0	—	—	—
M. monoceros	CPUE	0.1	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0
M. breycornis	CPUE	0.3	0.6	0.0	0.0	0.1	0.1	0.2	0.2	0.4	0.5	0.8	0.6	0.1	0.2
P. sculptilis	CPUE	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
M. rosenbergii	CPUE	0,1	0.1	0.0	—	0.0	0.0	0.0	0.0	—	0.0	0.1	0.1	0.0	0.0
Acetes	CPUE	0.7	0.9	0.5	0.S	0.0	0.0	0.4	0.2	0.4	0.1	0.1	0.3	0.0	0.0
H. nehereus	CPUE	0.7	0.8	0.6	0.9	0.2	0.2	0.0	0.0	0.0	0.0	0.0	—	0.1	0.1
Johnius spp.	CPUE	0.5	1.0	0,8	0.1	0.3	0.4	0.1	0.5	0.3	0.6	1.3	0.1	0.1	—
L. sarala	CPUE	0.2	0.2	0.0	0.0	0.0	0.0	0.0	—	—	—	—	0.0	0.0	0.0

<<

Fig 9. Monthly mean salinity (‰), temperature (°C),turbidity (m) and fishing depth (m) for ESBN



<<

8.5 Effects of environmental conditions

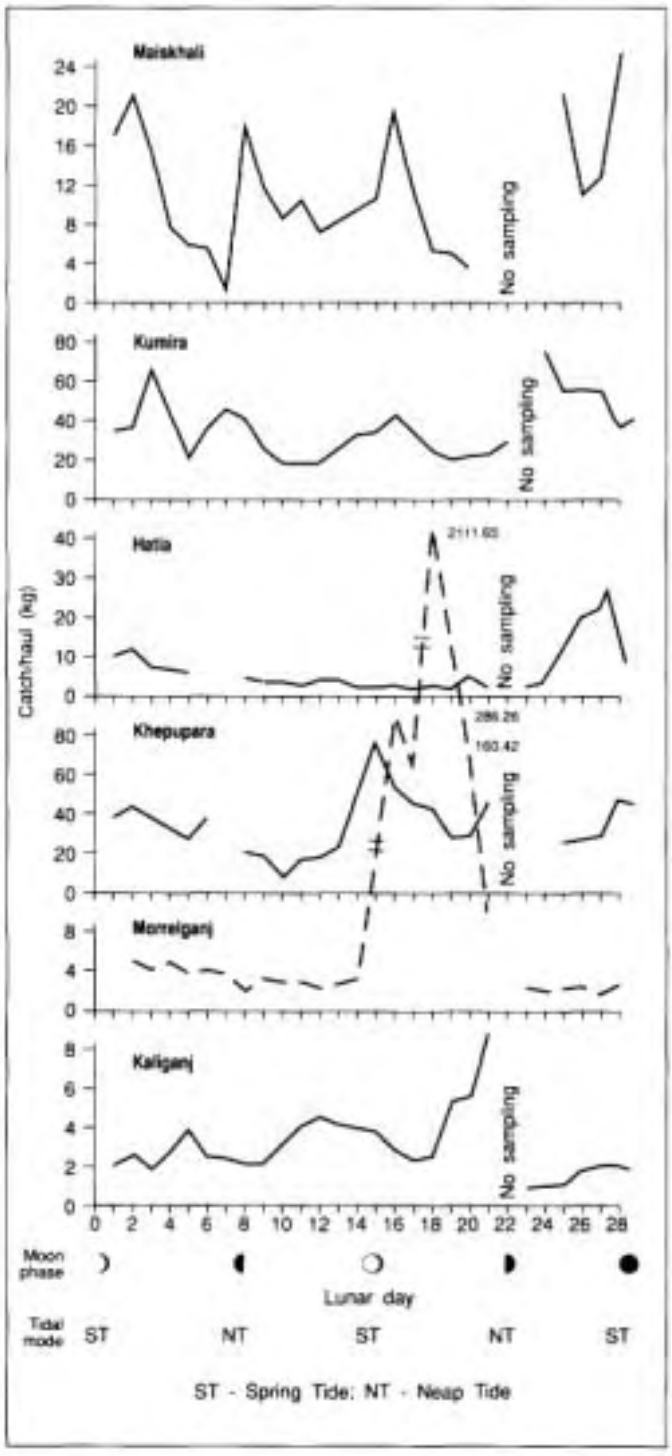
Data collected on the physico-chemical parameters of surface water and the fishing depth at the sampling stations are shown in Figure 9 (facing page) and reveal.

- The total catch rate increased with increase of salinity at Hatia and Khepupara stations. But no clear trend was visible in the other stations.
- No clear evidence of any effect of temperature on the catch rate was observed.

Waters of greater turbidity were found in the rainy season, but not in Maiskhali and Kumira. The catch rate decreased with increase of turbidity in all stations except Kaliganj, where such a trend was not clear. Perhaps, the salinity becomes too low for many of the animals in the estuary during the rainy season.

Fishing depth increased in the rainy season, but not in Maiskhali and Hatia. The fishermen may have been shifting their operations away from the relatively low saline shallow water areas. Any influence of fishing depth on catch rates was not clearly evident from the available data.

Fig 10. ESBN catch rate variation with lunar periodicity



The variations in the overall monthly catch rate with the lunar periodicity are shown in Figure 10 for the different areas. The catch rates were relatively higher during the spring tide when the high tide water moved from the sea into the estuary. However, differences in the magnitude of this effect were observed at different stations, probably due to significant differences in the distances of the stations from the coastline. The relationship was distinctly evident in Maiskhali and somewhat in Kumira, but not so in Morrelganj, Kaliganj, Khepupara or even Hatia. Consequently, partial correlation, rather than perfect correlation has been established from the results obtained.

<<

Another factor to be considered is that numerous species are involved and the lunar effect and influence of the tidal flow may be acting differently, both in kind and degree, on different species. Consequently, the resultant overall catch rate values may fail to exhibit good correlation. There may also be differences in the behaviour of the organisms, in relation to the ascending and descending phases of the spring tide, but this was not clearly evident in the results and, hence, the effects were assumed to be almost the same.

8.6 *Production*

The estimated monthly production, including finfish, penaeid shrimp and others, by different gear classes, in the different strata is presented in Table 16.

Table 16: Monthly production of ESBN by **area and gear class (in tonnes)**

		Month												
Station	*Gear type*	*Dec. 89*	*Jan. 90*	*Feb. 90*	*Mar. 90*	*Apr. '90*	*Mar 90*	*June 90*	*July 90*	*Aug. '90*	*Sept. '90*	*Oct. '90*	*Nor. '90*	*Total*
Coxs Bazar	Gla	—	—	—	—	—	—	—	—	—	—	—	—	0.0
	GIb	239.4	—	653.6	662.8	421.5	180.3	538.4	315.0	296.3	301.0	859.4	121.0	4588.6
	GIc	2955.8	155.2	1479.0	2114.3	1517.8	921.3	1413.9	947.4	537.4	10904.7	6417.7	418.9	29783.3
Subtotal		3195.3	155.2	2132.6	2777.0	1939.3	1101.6	1952.3	1262.4	833.7	11205.8	7277.1	539.9	34372.0
Chittagong	Gla	58.7	68.3	62.0	62.4	98.9	57.6	47.7	110.6	31.9	40,0	360.0	87.8	1085.8
	GIb	34.7	65.4	42.0	96.2	85.1	28.5	24.4	122.4	26.9	24.8	314.2	64.4	929.0
Subtotal		93.4	133.7	104.1	158.6	184.0	86.1	72.1	233.0	58.8	64.7	674.1	152.2	2014.8
Noakhali	GIa	114.6	61.8	197.1	660.9	389.8	118.7	5.3	3.7	3.2	26.6	30.2	1.5	1613.4
	GIb	39.0	24.7	105.0	337.0	199.5	62.1	3.7	—	—	12.2	27.8	1.6	812.6
Subtotal		153.6	86.5	302.1	998.0	589.3	180.7	9.0	3.7	3.2	38.9	58.0	3.1	2426.0
Patuakhali	Gla	—	—	—	995.7	527.6	139.0	116.3	37.8	70.5	233.6	147.3	—	2067.8
	GIb	787.6	150.9	212.9	2540.6	160.7	463.9	604.1	171.7	284.3	497.8	625.3	203.1	6702.8
	GIc	327.7	565.0	117.4	—	239.8	190.7	396.4	—	—	271.6	419.7	116.0	2644.2
Subtotal		1115.3	716.0	330.2	3536.3	928.1	793.6	1116.8	209.5	354.8	1002.9	1192.3	319.2	11414.9
Bagerhat	Glb	13.3	9.3	3.5	3.3	7.8	5.4	—	28.6	12.3	4.9	4.5	5.8	98.5
	GIc	11.5	7.3	3.6	7.4	22.4	5.2	9666.8*	29.7	35.1	7.9	5.3	7.9	9810.0
	GId	—	—	—	2.3	6.6	18.3	13870.0*	—	—	—	2.1	—	13899.4
Subtotal		24.8	16.5	7.1	3.0	36.8	28.9	23536.8	58.3	47.4	12.8	11.9	13.7	23807.9
Satkhira	GIa	101.4	63.3	33.9	17.2	5.6	255.8	32.4	18.0	31.0	13.8	10.1	57.1	639.6
	Gb	—	—	—	18.4	6.7	294.9	23.9	28.0	56.4	129.4	8.8	71.2	637.8
Subtotal		101.4	63.3	33.9	35.7	12.3	550.8	56.3	46.0	87.4	143.1	18.9	128.3	1277.4
Total	Gla	274.7	193.3	293.1	1736.2	1021.9	571.2	201.7	170.2	136.6	314.0	547.5	146.3	5406.6
(1.6)	GIb	1113.9	250.3	1017.0	3658.4	881.3	1035.0	1194.5	665.7	676.2	970.0	1840.0	467.1	13769.3
	GIc	3295.1	727.4	1599.9	2121.7	1780.0	1117.1	11477.1	977.1	572.4	11184.2	6842.7	542.8	42237.6
	GId	0.0	0.0	0.0	2.3	6.6	18.3	13870.0	0.0	0.0	0.0	2.1	0.0	13899.4
Total		4683.7	**1171,1**	**2910.0**	**7518.6**	**3689.8**	**2741.6**	**26743.3**	**1812.9**	**1385.3**	**12468.2**	**9232.3**	**1156.3**	**75312.9**

*** Crabs were about 99% of the catch composition**

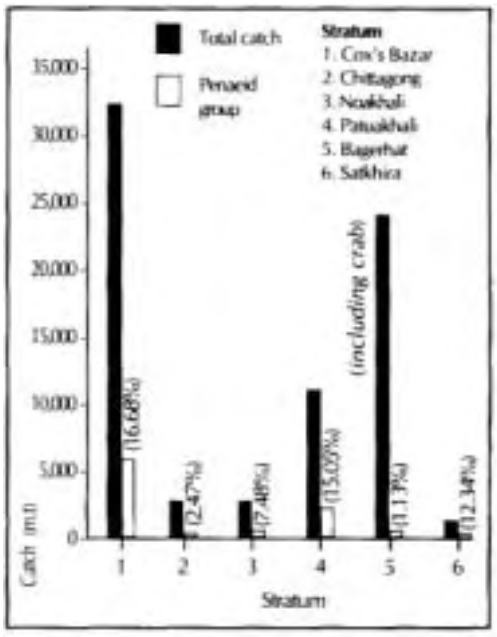
<<

The annual production of all the areas combined was about 54,000 t if the abnormally high catches of crab in Bagerhat in June are disregarded. Cox's Bazar accounted for as much as 65 per cent and Patuakhali 21 per cent (see Figure 11). The bulk of the catch was caught in the Glc nets (62 per cent) and GIb nets (26 per cent).

The peak catches (9-12,000 t) were in September and October with the bulk from the Cox's Bazar area. There was another peak in March, of 7500 t, to which Cox's Bazar and Patuakhali contributed almost equally. The lowest catches were in January, July, August and November.

The total production of penaeid shrimp in the ESBN fishery was estimated at 7,746t (see below). Gear class contributed most (68 per cent) of this production, especially in Cox's Bazar. Which contributed 87 per cent of the total penaeid catch.

Fig 11. **Annual production of ESBN in** Bangladesh (Dec. **'89 - Nov.** '90)



Gear class	Area/Coy's Ba:ar	Chittagong	Noakhali	Patuakhali	Bagerhat	Satkhira	TOTAL
Gla		24	85	261	—	72	442
GIb	776	25	53	954	18	86	1912
Glc	4638	—	—	502	178	—	5318
GId	—	—	—	—	74	—	74
TOTAL	5414	49	138	1717	270	158	7746

8.7 *Biology of major species*

GROWTH PARAMETERS

Growth parameters for major species, estimated using ICLARM'S (1989) ELEFAN I Program, version 1.11, are summarized in Table 17 (overleaf) and the length frequencies and growth curves are shown in Figures 12a-s (see pages 42, 43, 44, 45). For some species, such as Gangetic Whiting *(Sillago domina),* Silver Whiting *(Sillago sihama),* penaeid shrimp *(Metapenaeus spinularus),* Hairfin Anchovy *(Setipinna taty,* Russel 's Smoothback Herring *(Raconda russeliana),* and Fourfinger Threadfin *(Eleutheronema tetradactylum),* the availability of length frequency data was limited to less than six months of the year due to the highly seasonal occurrence or to the very small sample sizes due to low abundance and poor catch rates. In such cases, the parameters derived must be considered as very preliminary estimates. In the case of many other species, the size range in the catch was fairly wide, with sufficient modal groups, so that the analysis was more reliable (Figures 12a-s).

MORTALITY AND EXPLOITATION RATES

ICLARM'S ELEFAN II Program (1989) was used to estimate these values (Table 17). Abnormalities were observed in certain cases, in the estimates of mean length at which a species becomes fully recruited to the fishery and also in the plotting of points for a catch-curve, to estimate total mortality rate, probably due to limitations in length frequency data. Such cases are indicated in Table 17, by an asterisk. *(Text continued on p. 45.)*

<<

Table 17: Growth and mortality estimates of some species of shrimp and finfish exploited by ESBN

S/No.	Species	L_{∞}	K	Z	M	F	E	Lc
1	*P. monodon*	31.4	.72	9.8	1.42	8.38	.85	13.8
2	* *P. indicus*	22.8	.55	5.0	1.30	3.70	.74	5.9
3	*M. monoceros*	19.8	.44	4.8	1.17	3.65	.76	5.9
4	*M.hrericornis*	15.6	.31	5.2	.99	4.24	.81	4.8
5	*Metapenaeus* spinulalus	20.1	.39	6.9	1.08	5.90	.85	5.3
6	*P. stylifera*	14.4	1.67	6.!	3.06	3.0	.49	2.8
7	*P. sculptilis*	16.9	.76	5.9	1.75	4.15	.70	4.3
8	* *M. rosenbergii*	35.5	.34	2.8	.84	1.96	.70	7.3
9	*P. styliferus*	15.4	.63	4.8	1.59	3.2	.67	3.7
10	*Acetes indicus*	5.0	.73	3.5	2.40	1.10	.31	2.0
11	*H. nehereus*	34.9	.38	4.7	.9!	3.75	.81	6.3
12	*L. sara/a*	93.0	.29	3.2	.58	2.62	.82	22.6
3	*S. taty*	21.3	.53	2.!	1.28	.80	.28	4.6
14	* *S. sihama*	27.4	.39	3.9	.99	3.00	.75	5.1
15	*Raconda russeliana*	23.6	.43	3.2	1.09	2.10	.66	4.!
16	*Stolephorus tn*	16.8	.65	10.6	1.59	9.00	.85	3,4
17	* *Eleutheronema tetradactv/um*	38.1	.18	4.4	.85	3.50	.87	5.3
18	*Polynemous paradiseus*	21.6	.52	6.0	1.28	4.72	.79	2.7
19	*S. domina*	43.3	.38	3.6	.86	2.70	.76	8.5

* **Cases where abnormalities were noted.**

Fig 12a. Length frequency and growth curve of P. *monodon*

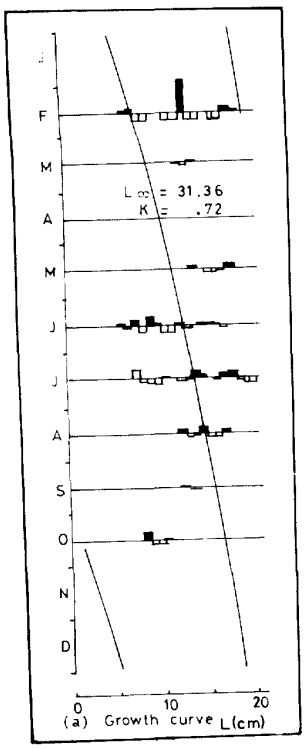


Fig 12b. Length frequency and growth curve of *P. indicus*

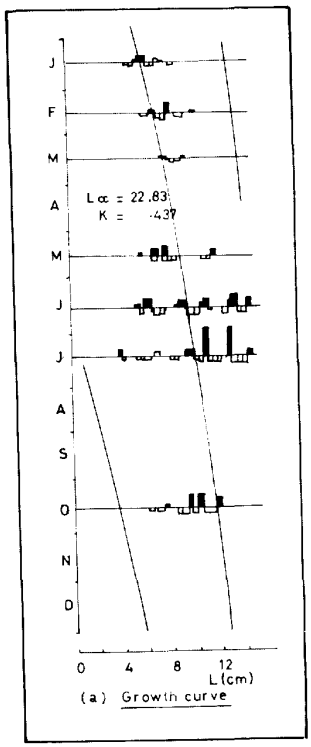
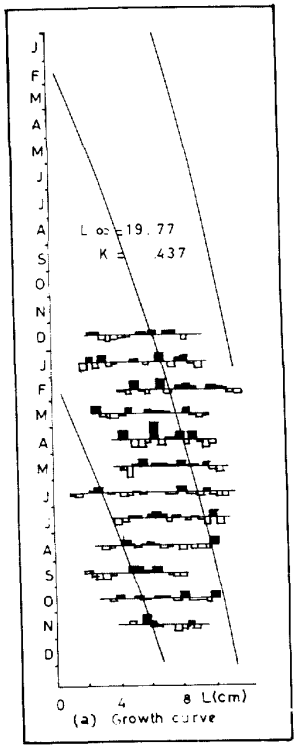


Fig **12c. Length frequency and growth curve of *M. monoceros***



<<

Fig 12d. Length frequency and growth curve of *M. brevicornis*

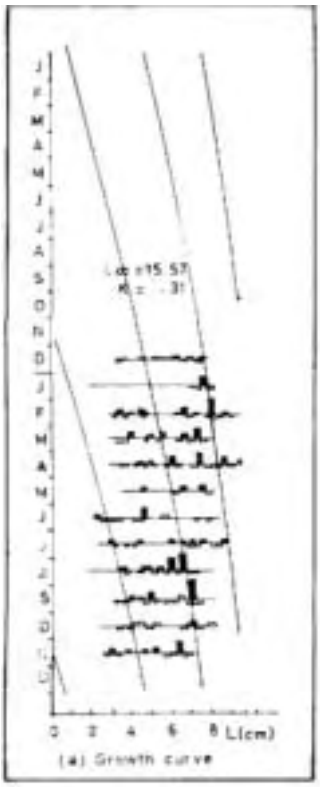


Fig 12e. Length frequency and growth curve of *P. stylifera*

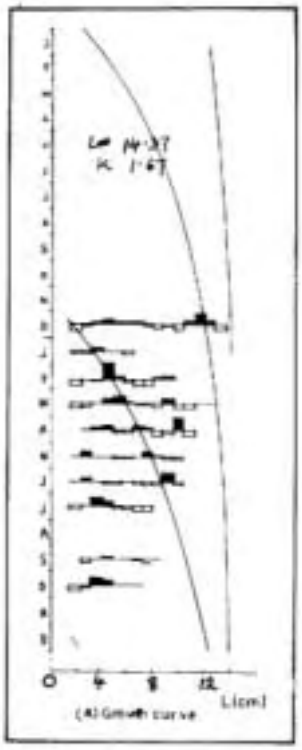


Fig 12f. Length frequency and growth curve of *P. sculptilis*

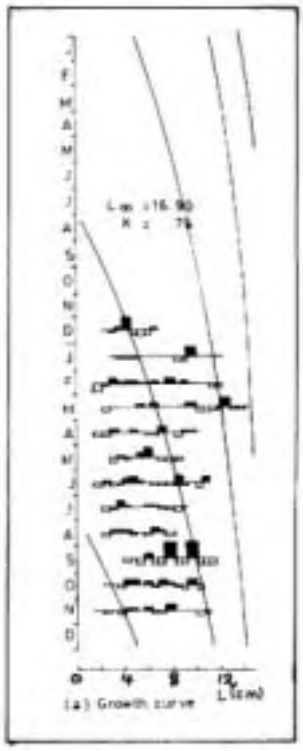


Fig 12g. Length frequency and growth curve of *M. rosenbergil*

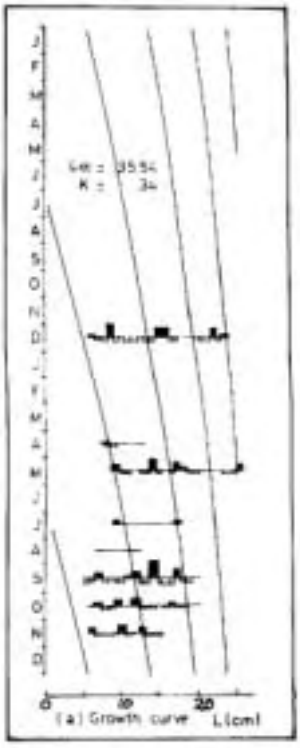


Fig 12h. Length frequency and growth curve of *P. styliferus*

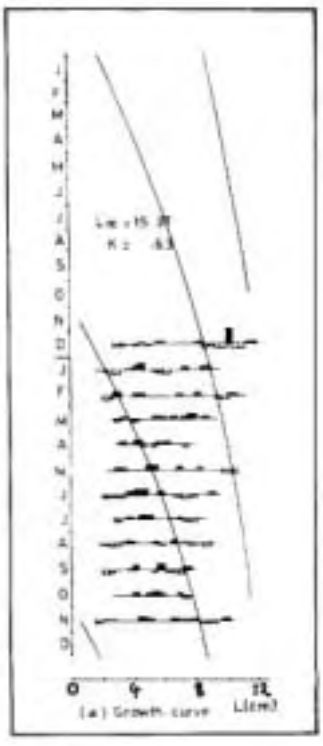
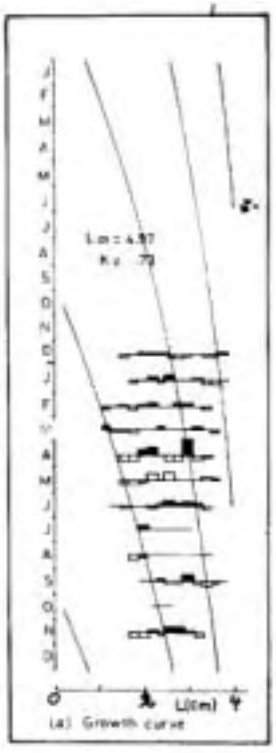


Fig 12i. Length frequency and growth curve of *A. indicus*



<<

Fig 12j. Length frequency and growth curve of *H. nehereus*

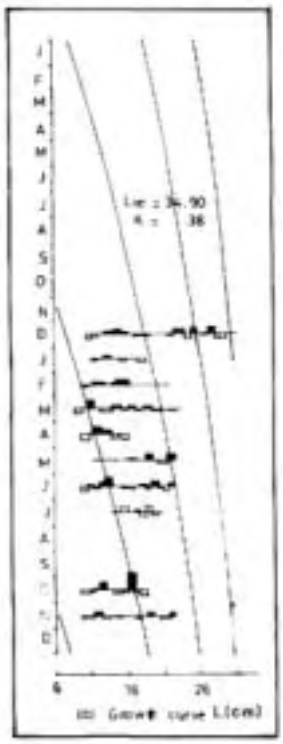


Fig 12k. Length frequency and growth curve of *L. savala*

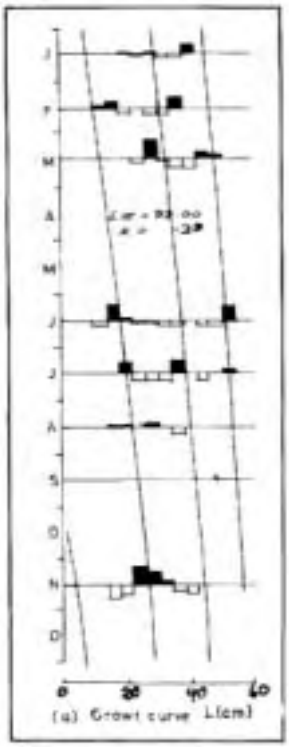


Fig 121. Length frequency and growth curve of *S. taty*

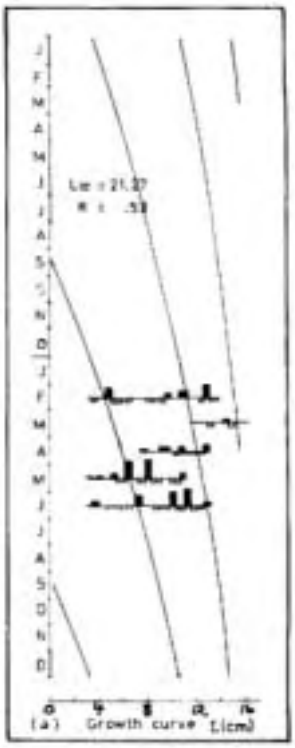


Fig 12m. Length frequency and growth curve of *S. sihama*

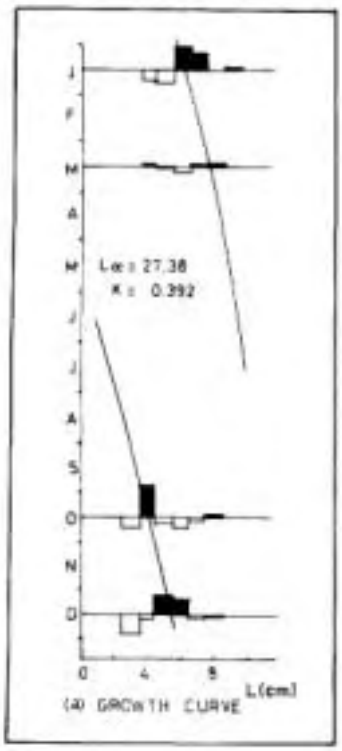


Fig 12n. Length frequency and growth curve of *M. spinulatus*

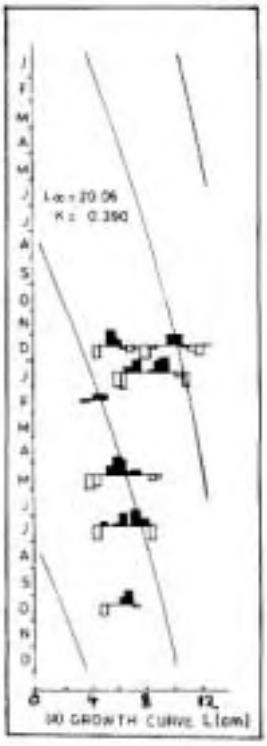
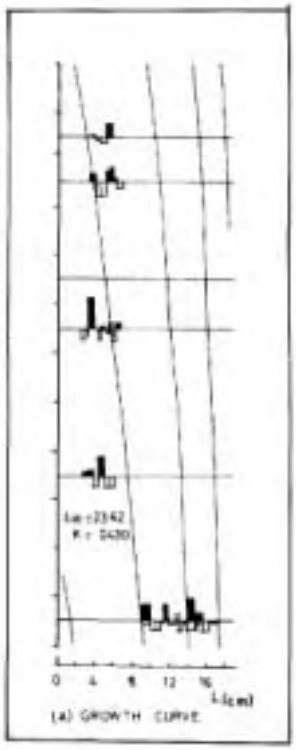


Fig 12o. Length frequency and growth curve of *R. russellana*



<<

Fig 12p. Length frequency and growth curve of S. *tri*

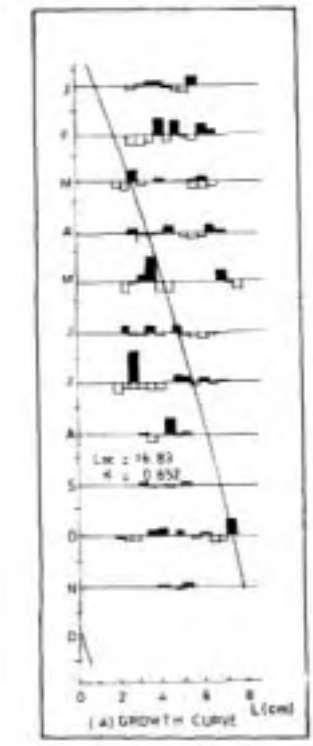


Fig 12q. Length frequency and growth curve of *E. tetnadactvlum*

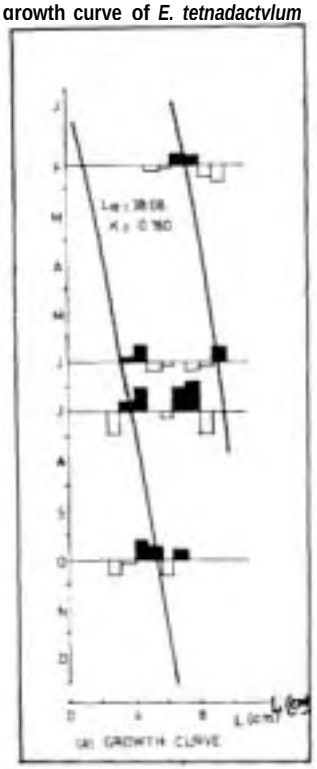
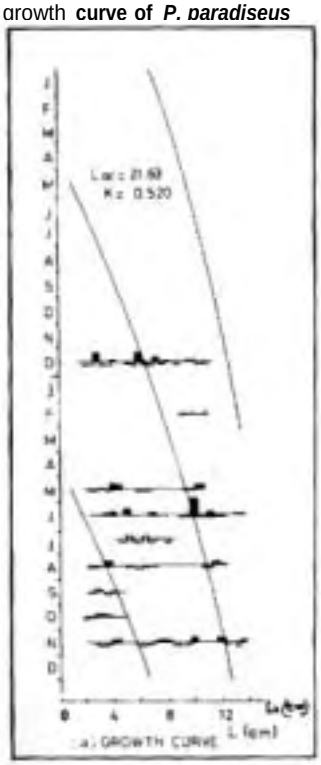
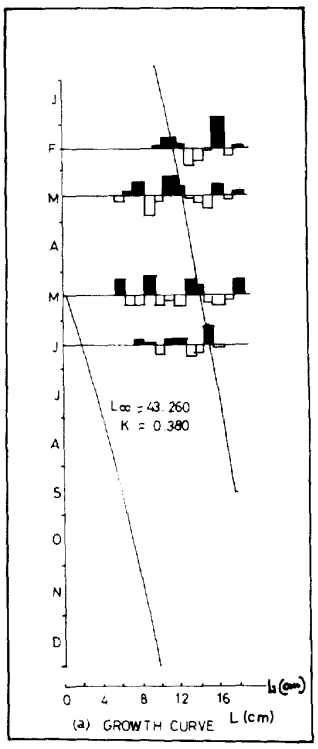


Fig 12r. Length frequency and growth curve of *P. paradiseus*



Exploitation rate was observed to be very high for most species. This may have been influenced by the predominance of very small sizes of animals caught by ESBN, compared to the asymptotic length (L_{∞}) estimated for the respective species as well as by the poor representation of larger sizes in the catch. Absence of larger sizes in the catch is not due to death but because the large sizes are in deeper waters and not 'available' to this estuarine fishery. The mean-length at first capture also clearly proves the preponderance of juvenile and immature fish and shrimp, except in the case of a few species like Sergestid Shrimp and Anchovy, whose adults are 'available' to the ESBN. In the latter cases the estimated exploitation rates indicate underexploitation of the resources.

Fig 12s. Length frequency and growth curve of ***S. domina***



RECRUITMENT PATTERN

Practically all the species studied exhibited two major recruitments each year. Though spawners were observed year round, there were two periods when there appeared to be significant increase in spawning activity — towards the end of the winter season (December-March) and at the end of the summer season (July-September).

Even though there were two recruitments, they were seldom of equal strength. Tiger Shrimp had a stronger recruitment in July and September, Brown Shrimp in May/June, Yellow Shrimp around May and Kiddi Shrimp mainly in January/February. Rainbow Shrimp and Freshwater Prawn came into the ESBN catches mainly around October. Bombay Duck and Ribbonfish were primarily recruited during August/September and April/May, respectively. Sizes at recruitment and size ranges 'available' to this fishery are also evident from Figures 12 a-s.

<<

8.8 *Economics of the fishery*

COST AND EARNINGS

Figure 13 illustrates the monthly variations in the costs and earnings at the six stations. Annual gross and net income, cost, income to crew and number of fishing months. by each size and class of set bagnet, in each station, are also presented in these figures.. The Gla class net used in five of the stations had an annual net profit ranging between Tk 24,969 and Tk 33,342, indicating relatively small differences among strata, but the highest net income was from Hatia, over 11 months of operation, and the lowest was from Kumira, over 12 months of operation. However, in Kumira, hired labour was used and the total cost was higher than in Hatia where the labour was mostly provided by members of the owner households.

GIb class net was operated in all six stations and the annual net income ranged from 1k 19,540 to Tk 95.739. Maiskhali recorded the highest income over ten months' operation and Kaliganj the lowest income over nine months of operation. All other stations fell between these two. Morrelganj, with Tk 37.814 net profit, appeared to have incurred the highest operational cost, using hired labour.

Glc class nets were operated only in three stations and, again, Maiskhali had the highest net annual income of Tk 179,159 over Il months of fishing, while Khepupara exhibited the lowest income of Tk 37,278 in 12 months. Gld class nets were used only in one estuarine station — Morrelganj — and the annual net profit was Tk 20,517 for four months' fishing in the estuary. The average net income, in each station for each class of gear per active fishing month, were as follows:

SBN Area / *gear class*	*1* *Mai skhali*	*2* *Kumira*	3 *Hatia*	4 *Khepupara*	*5* *Morrelganj*	*6* *Kahganj*
Gla	—	2.080	3.031	3.745	—	2.296
GIb	9.573	3.336	3.384	3.475	3,437	2,171
GIc	16.287	—	—	4.I42	4,560	—
GId	—	—	—	—	5,129	—

Except for extremely high values in Maiskhali, the others seem to fit into a pattern. Ratios of average net income from all classes of nets for all stations combined, excluding Maiskhali, was 1:1.1:1.5:1.8.

In most stations, there were two troughs in the income line — one in May/June and the other in November/December. These tend to correspond with the beginning of the SW. Monsoon and the N.E. Monsoon, respectively. In Maiskhali, whenever crew were engaged, they were paid Tk 400-600 per month and food provided free of cost. In Kumira and Khepupara, too, the crew were hired at a rate of 600-1000 and 250-600 Tk/rnonth, respectively. The food provided free of cost to the crew was valued at 450-500 Tk/month per ESBN unit. Other operational costs are minimal: most ofthe craft used in this fishery are nonmotorized and, generally, family members are engaged as labour.

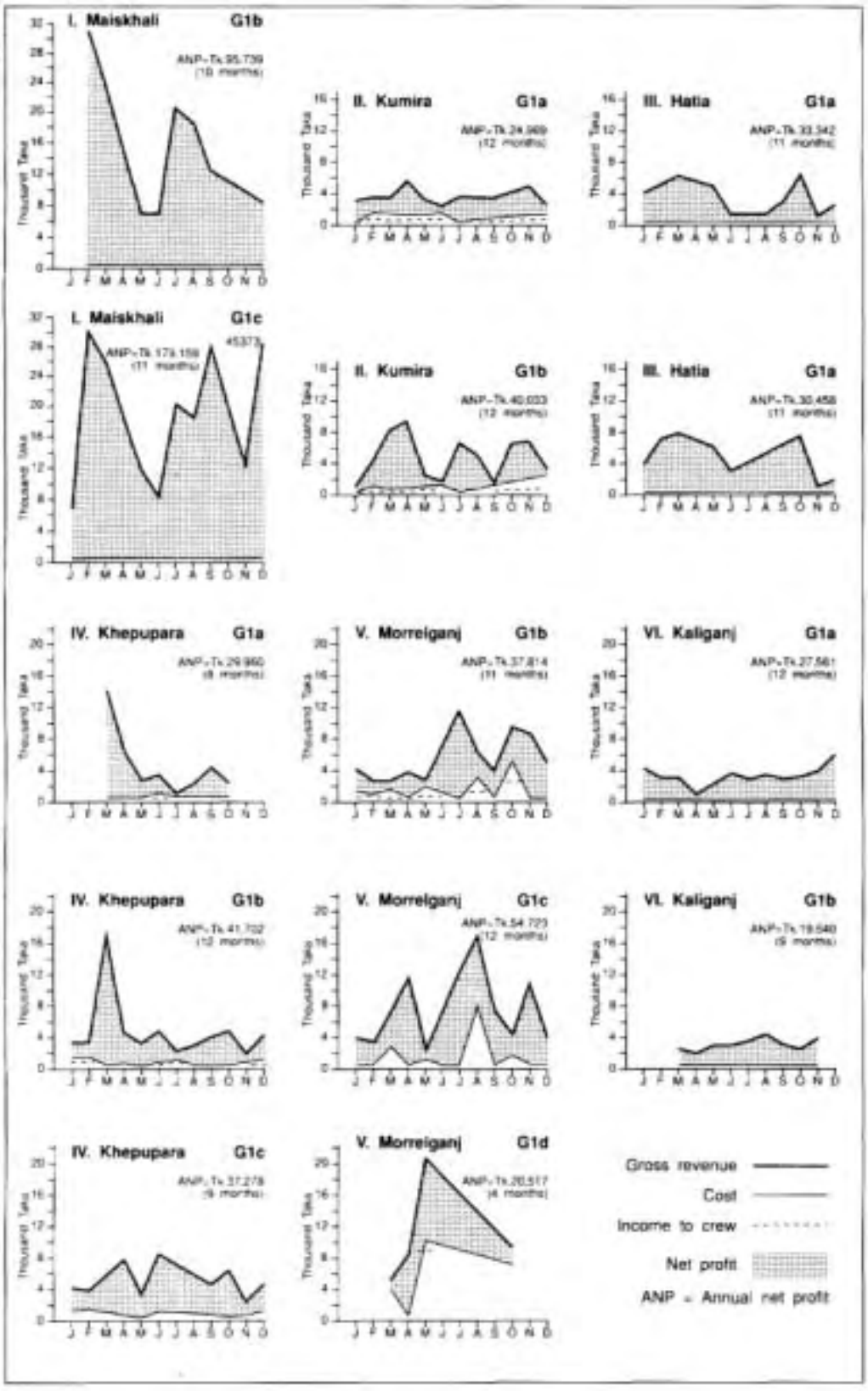
VARIATION OF UNIT VALUE OF SPECIES

The price of mixed species of finfish and shrimp range from 1k. 11 to 40 with some variation between stations (see Table 18 p. 48). In each station, price varied by 30-40 per cent, but this variation by season was not the same in all stations. When valuable species were sold, the prices differed more significantly between stations. They were probably influenced by a mixture of factors, such as size of the animal, quantity landed, marketing facilities at the station and seasonal demand for fish.

Prices were high in Maiskhali. In this station, marketing, transportation and communication systems are relatively better developed. The socioeconomic condition of the fisherfolk is also better. In

<<

Fig 13. Monthly cost-benefit analysis of ESBN at different stations **per gear size category**



<<

Kaliganj, due to low catch rate and higher demand, the fishermen got good prices for mixed shrimp. The finfish price was also about that in Maiskhali. In Kumira, values were moderately high. A reasonable landing, marketing and transportation system exists there too. On Hatia island, fishermen got relatively lower prices because the marketing. transportation and communication. systems were poor. Power supply was also only for a few hours at night, with the help of a generator. Large shrimp and prawn also got relatively low prices. In Khepupara. also, fish was sold at a low price. In Morrelganj, mixed shrimp and fish were sold at low prices, somewhat similar to those in Hatia:

Table 18: Average monthly price (Tk/kg) of species groups in different stations for ESBN catches

Species name	*Station*	*Jan*	*Feb.*	*March*	*April*	*Mar*	*June*	*July*	*Aug.*	*Sept,*	*Oct*	*Nov.*	*Dec.*
Mixed shrimp and fish	Maiskhali	30	30	25	20	—	IS	30	27	27	30	30	30
	Kumira	24	22	25	25	25	35	27	18	20	15	17	26
	Hatia	17	19	18	18	—	2!	25	23	21	28	24	IS
	Khepupara	20	25	23	20	15	22	23	14	20	12	IS	18
	Morrelganj	IS	20	25	24	9	18	22	30	24	18	30	11
	Kaliganj	30	22	30	40	30	20	25	23	20	30	25	26
Penaeus monodon	Maiskhali	—	—	—	—	—	200	250	—	38	80	—	—
	Kumira	—.	—	—	—	—	—	—	—	—	—	—	—
	Hatia	—	—	—	—	—	—	—	—	—	—	—	—
	Khepupara	—	25	—	—	210	22	140	—	—	—	—	—
	Morrelganj	—	—	—	—	250	175	—	—	—	250	—	230
	Kaliganj	—	220	210	230	230	—	60	200	260	—	—	40
Macrobrachium rosenbergii	Maiskhali	—	—	—	—	—	—	—	270	50	150	150	—
	Kumira	—	—	200	—	—	—	—	—	—	—	—	
	Hatia	—	—	—	—	—	—	—	—	120	130	—	
	Khepupara	60	50	—	—	60	—	—	60	—	140	—	—
	Morrelganj	—	—	—	—	280	282	—	—	220	220	124	138
	Kaliganj	—	—	—	160	—	—	150	ISO	150	—	30	60
Metapenaeus monoc eros	Maiskhali	—	40	—	—	—	—	—	40	—	—	—	—
	Kumira	—	—	—	—	—	—	—	—	—	—	—	—
	Halis	—	—	35	—	30	—	—	—	—	—	—	—
	Khepupara	—	—	—	—	—	—	—	—	-..	—	—	—
	Morrelganj	—	—	—	—	80	—	—	—	50	—	—	—
	Kaliganj	—	—	—	—	—	—	—	—	—	—	—	—
M. *brevicornis*	Maiskhali	—	40	—	—	—	—	—	—	—	—	—	
	Kumira	—	—	—	—	—	—	—	—	—	—	—	
	Hatia	—	—	—	25	—	25	—	—	—	—.	—	—
	Khepupara	—	—	—	—	—	—	—	—	—	—	—	—
	Morrelganj	—	—	—	—	—	—	—	—	—	—	—	—
	Kaliganj	—	—	—	—	—	—	—	—	—	—	—	—
Acetes spp.	Maiskhali	7	—	—	—	7	8	—	6	7	8	7	—
	Kumira	6	7	7	8	8	7	—	5	S	6	6	6
	Hatis	3	5	—	—	—	—	—	—	—	—	—	4
	Khepupara	—	—	—	7	4	—	—	—	—	—	4	4
	Morrelganj	—	4	4	8	4	—	—	—	—	—	—	—
	Kaliganj	6	4	5		4	4	—	4	4	—	—	4

<<

9. DISCUSSION

The extensive use of set hagnets in the estuaries of Bangladesh niay not have a parallel in any other country in the Bay of Bengal region using this gear. The large number of species caught by ESBN in Bangladesh is also very significant. when compared **to** the number of species caught by other marine fisheries. According to Pillay and Ghose (1962). freshwater prawn were more dominant in the set bagriet catches in India than the marine penaeid shrimp, but this was not the case in Bangladesh. Even among the penaeid shrimp, only the presence of the Brown Shrimp was reported in India and there was no record of either the Tiger Shrimp or the White Shrimp, as in Bangladesh. This was probably due to differences in the environmental conditions in which the gear is operated

Observations made on species caught in ESBN during the present study are supported by Chowdhury 1987), Islam (1987) and Islam *et al.,* (1987). Observations made on the relative abundance of mature and immature shrimp and finfish are also in agreement with those of Ahmed (1979) and Islam *et al* (1 987).

The total production by ESBN estimated in this study. excluding the crab catches, is 11 per cent higher than the available statistics of the Department of Fisheries. This may be due to the fact that, in the present sludy. production was estimated on the basis of stratified sampling according to sizes of gear based on area of the mouth opening and on sampling spread throughout the year in six strata across the entire coastline.

The present study has shown that all estuarine set bagnet fisheries in Bangladesh do not generate similar earnings. They (lifter not only according to the area of fishing even for the same size and class of net used. but also according to the different size classes of the nets operating in the same area. The variations in the monthly earnings appear to he even more significant than variations in the earnings among different size and classes of the gear or strata.

In the marine sector. an increase in mesh size may be considered helpful in reducing the catch ot uveniles without affecting the income from the opertation (Akerman 1986). However. in the estuarine areas, with the predominance of juveniles. it may be difficult to realize the same revenue or better revenue if the mesh size is increased. On the other hand, a seasonal reduction in the fishing effort of thk gear in selected estuarine areas and **during** months when juveniles of valuable species of shrimp and finfish are predominant, would reduce destruction of juveniles, help to conserve the resources and increase the yield from them.

10. *REFERENCES*

AHMED, M.K., 1979. *On catches and relative abundance of prejuveniles and juveniles of penaeid prawn in the Chakaria Sundarbans and the Bathkhali river estuary of Cox's Bazar during November, 1978–October, 1979.* Research Report no.2 Freshwater Fisheries Research Station, Chandpur, Comilla, Bangladesh. 35pp.

_____, 1981. *Behundi set Fishery in the Brackishwater area of Satkhira with emphasis on biometrics and mortalities of shrimps.* Research Report No.3. Freshwater Fisheries Research Station, Chandpur, Comilla, Bangladesh. 42pp.

_____, 1984. *Behundi set fishery in the brackishwater area of Patuakhali with emphasis on biometrics and mortalities of shrimps.* Research Report No.8, Freshwater Fisheries Research Station, Chandpur, Bangladesh. 36pp.

AKERMAN, S.E., 1986. *The coastal set bagnet fishery of Bangladesh fishing trials and investigations.* BOBP/REP/34, FAO, Rome. 25pp.

ANON (1988/89). *Fish Catch Statistics of Bangladesh.* Dept. of Fisheries, Bangladesh.

BISHOP, O.N., 1983. *Statistics for Biology* (Microcomputer editions). Longman Group Limited, Harlow, England. 232pp.

CHOWDHURY, Z.A., 1987. *Catch composition in the Moheshkhali Channel* (Dec.1984-Nov.1985). Marine Fisheries Survey Management & Development Project,Cox'Bazar. Mimeo. 5pp.

DUTTA, K.K. and DAN, S.S. 1988. Comparative efficiency of different type of set bagnet (*Behundi jal*) units of West Bengal. *Sea Food Export Journal*, August, 1988 issue, pp.5-14.

DALL, W., 1956. A revision of the Australian species of penaeid (Crustacea:Decapoda : Penaeidae).

<<

DAY, F. 1989. *The Fauna of British India including Ceylon and Burma.* Fishes **vol.1.** and **II. Taylor and Francis. London.**

DEPT. OF FISHERIES, 1987-88, *Fish catch statistics of* Bangladesh.36pp

FISCHER, W. and BIANCHI. G. 1984. ***FAO*** *species identification sheets for* fishery *purposes.* **Western Indian Ocean** (Fishing Area 5), VoI.I.IV. FAO. Rome. Italy

GEORGE, M.J. 1969. Prawn Fisheries of India. Systematic taxonomic consideration and general distribution. *Bull. Cent Fish Rcs. Inst.* **pp5-48.**

HOLTHUIS. LB. 980. *FAG Species Catalogue, Vol. Shrimps and Prawn of* the *World.* **An annotated catalogue of** species of interest to fisheries. FAO Fish.Symop.(125) VoI.l:126pp.

ISLAM, **M.S.S.M.. BRUYIAN. I. and SIVASUBRAMANIAM.** K. 1987. *A preliminary survey* of the **set** bagnet fishery *and its interaction with tither marine fisheries in Bangladesh. Chittagong.* 987. Mimeo i8pp.

ISLAM, M.S.S.M 1987. *Study* of e*atch composition of* **behundi net** *(Set bagnet in relation to some ecological parameters in the Naf river estuary.* Marine Fisheries Survey, **Management** & Dev.Projeci. Con's **Bazar. Bangladesh.Mimeo.4pp**

ISLAM, S.. **BHUIYAN. I., IQBAL. Q..** HUDA, S.M.S., RAZZAK. A. **and GUPTA. KS. 1988. No easy solutions for set hagnct** fisherfolk. *Bar of* ***Bengal*** *News,* **Issue No.29. March. 4pp.**

KASHEM, A. and IQBAL. I. **1985.** *Pilot survey of set bagnet fishery* of *Bangladesh.* **BOBP/WP/34. Rome, 26pp.**

KHAN, MG., ISLAM, MS., CHOWDHURY, Z.A. and PAUL, S.C. 1988. *Shrmp Resources of Bangladesh - four stages of its exploitation and their comparative effect on the stock.* **(In Bangla). Marine Fisheries Survey. Management & Dev. Project, Chinagong. Mimeo l lpp.**

MUSTAFA, MG. 1984. ***Methods*** *of statistics.* **Karim press and publications, Dhaka. 284pp.**

PILLAY, T.V.R. and GHOSH, K.K. 1962. The set bagnet fishery of the Hoogly-Matlah estuarinc **system (West Bengal).** *Indian Journal of* ***Fishery*** vol.9 (Part A) p **71-98.**

SHAFI, M. and QUDDUS, M.M.A. 1982. *Fisheries Resources of Bangladesh* **(In Bangla).** Bangla Academy. **Dhaka, Bangladesh. 444 pp.**