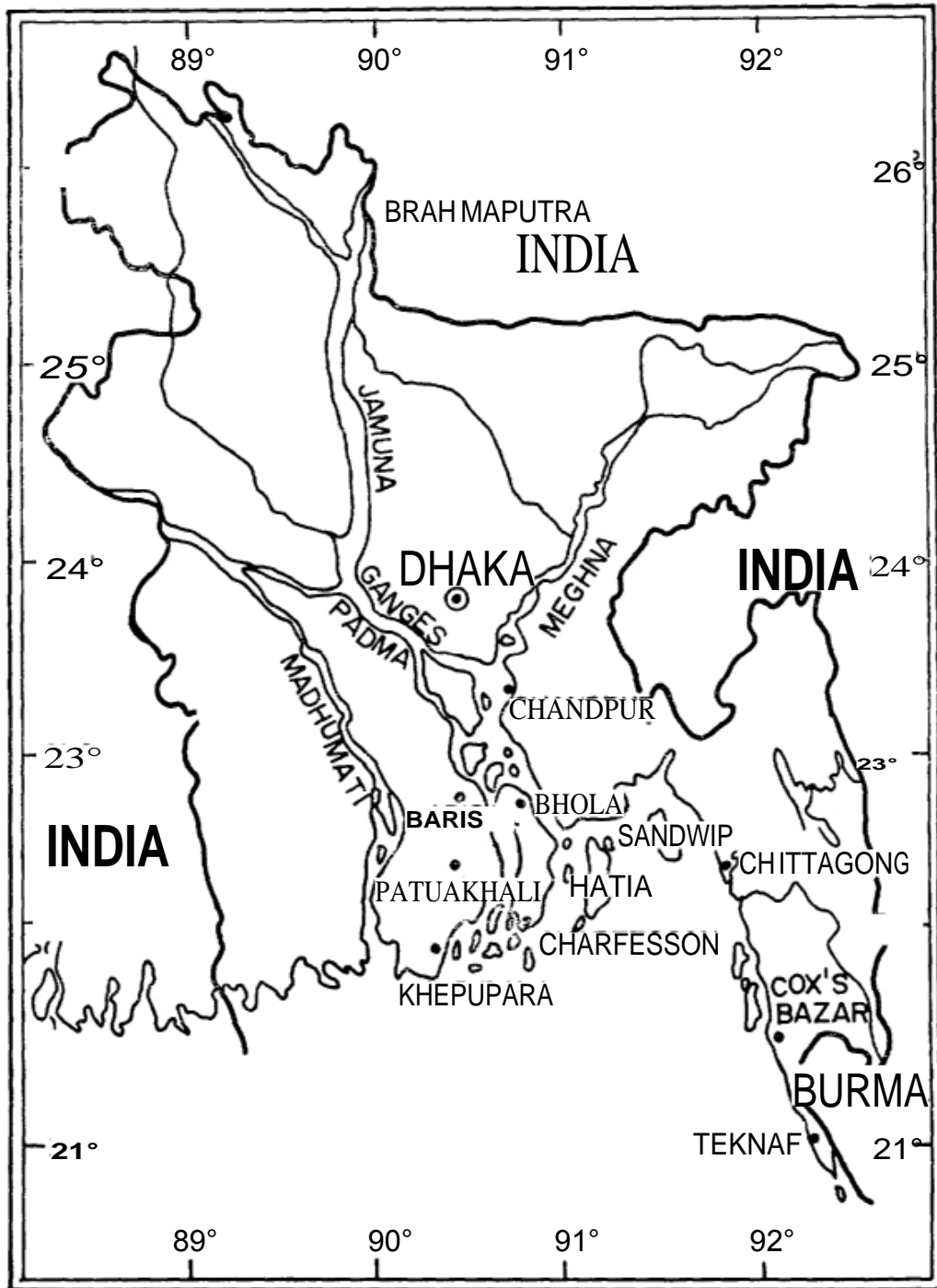


Appendix 1

HILSA SAMPLING STATIONS



## Appendix 2

### WORK CALENDAR

(Note: Figures here refer to dates of the month)

<i>Cox's Bazar:</i>	Catch and effort	: 1,3,5; 11,13,15; 17,19,21; 24,26,28.
	Length frequency	: 1, 2, 3; 17, 18, 19.
	Biological sample	: 3; 19.
	Experimental fishing	: 7, 8, 9.
<i>Chittagong:</i>	Catch and effort	: 1,3,5; 7,9,11; 18, 20, 22 ; 24, 26, 28.
	Length frequency	: 1, 2,3; 18, 19,20.
	Biological sample	: 3, 20.
	Experimental fishing	: 13,14,15.
<i>Khepupara:</i>	Catch and effort	: 1,3,5; 7,9,11; 13, 15, 17; 25, 27, 29.
	Length frequency	: 1,2,3; 15,16,17.
	Biological sample	: 3; 17.
<i>Charfesson:</i>	Experimental fishing	: 20, 21, 22.
<i>Chandpur:</i>	Catch and effort	: 1,3,5; 8,10,12; 15,17,19; 21,23,28.
	Length frequency	: 1,2, 3; 15, 16, 17.
	Biological sample	: 3; 17.
	Experimental fishing (gillnet)	: 24, 25, 26.
	(seine)	: 14, 29.

## Annexure 1

### HILSA FISHERY OF BANGLADESH IN 1985-1986

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#### 1. INTRODUCTION

*Hilsa ilisha*, the Hilsa Shad, constitutes the largest single species fishery in Bangladesh in almost all the river systems, estuaries and the sea, contributing perhaps to 30 per cent of the total fish production in the country. The country's population of 100 million people is heavily dependent on this fish, which is the most popular dietary fish in Bangladesh.

About 2 per cent of the total population is directly or indirectly employed in this single fishery. The fishery is exploited by some 18,000 fishing units, and provides employment to about 1.5 to 2 million people in the country (Sanullah, 1984). Historically, the location of major hilsa fishing grounds was restricted to the upper reaches of the main rivers. At present, the major fishing activities are confined to the lower reaches, estuaries and the coastal waters. However, past studies have been confined to the hilsa in the inland waters only. Since the catches were reported to be declining in the upper reaches of the rivers and were increasing rapidly in the marine environment, the Directorate of Fisheries, Government of Bangladesh, wanted to initiate a research programme to study the hilsa fishery in its totality. The FAO/UNDP project "Marine Fisheries Resources Management in Bay of Bengal" chalked out a programme to investigate the fishery for this species in all the three environments. This paper describes the results of investigations conducted from April 1985 to March 1986 on the commercial fishery for hilsa, from four selected sampling stations.

#### 2. MATERIALS AND METHODS

The sampling centres selected for the study were Cox's Bazar, Chittagong (marine), Khepupara (estuarine) and Chandpur (riverine). At each of these places one biologist was assisted by a field assistant for collection of data.

At Cox's Bazar and Chittagong, estimates of catch rates and landings of hilsa were made by sampling the catches and operating mechanized boats. At Chandpur the bulk of the data was collected from non-mechanized carrier boats; the rest, from mechanized fishing boats. The latter, however, were not local boats but were from the coastal districts and used for fishing in the sea. At Khepupara, two sampling centres were selected, i.e., Nayahata (about 5 km southeast of Khepupara) and Mohipur (about 14 km south of Khepupara). At Nayahata, fishing is undertaken only by traditional, non-mechanized boats; at Mohipur, it is by both mechanized and non-mechanized boats. A set of pro forma was designed for collecting data on catch and effort (Appendix I and II). At each station, the catch and effort data were collected on alternate days, three times a week (12 days in a month). Data were collected by direct observation and also on the basis of interviews. The number of boats sampled was a certain percentage of the total number of fishing/carrier boats that unloaded their catches on the sampling day. It was about 100 per cent when the total number of boats unloading the catches was between 1 to 10; about 50, 35, 25, 20 and 10 per cent were sampled when the number of boats landing on a sampling day was 11 to 20, 21 to 30, 31 to 40, 41 to 50 and above 50, respectively. Any fraction of such percentage was rounded off to the nearest higher number.

At Chittagong three landing centres, namely, Chirmanghat, Bridgeghat and Fisheryghat (Patherghata) were chosen for collecting the data; each of these three ghats was covered every week on alternate days. At Khepupara, the two centres were usually observed on alternate weeks; sometimes both were covered during the same week. In either case, the total number of observation days was 12 every month.

Estimation of catch for the day and the month was done as follows. The day's observed total catch was raised on the basis of the ratio of the number of boats observed to the total number of boats landed. The month's estimated catch is the product of the average landing per day for the observed number of days and the total number of days in the month. The unit of effort is a fishing day.

The types and other specifications of fishing boats involved in catching and transporting hilsa in the rivers, in the estuaries and in the sea are listed in Table I. The different types of fishing gear used in catching hilsa in the sampling stations are listed in Table II. For a description of boats and gear, reference may be made to Anonymous (1985) and Raja (1985).

### 3. OBSERVATIONS

#### 3.1 Landings

Month-wise landings of all hilsa and the latter's percentage of the total fish landings are shown in Table III from which it may be seen that the total landings of hilsa at Chandpur peaked in April, June and October. The landings were very poor in December and January. The peak landings at Mohipur and Nayahata were in July and August respectively, while the lean season at both centres was in November (the marginally lower landings in January at Nayahata can be ignored).

Similarly, hilsa landings in Chittagong showed two peaks -a major one in September and a minor one in April. June and July in summer and December-January during winter can be considered a comparatively lean period for hilsa landings at Chittagong. In Cox's Bazar, the order of importance of peak landing seasons was April, October and February. Thus, while April and the September-October period were peak periods at both the marine stations, the month of February was a peak season for Cox's Bazar alone. The leanest month was July for both the stations, when weather conditions brought fishing operations at sea to a grinding halt. Thus, the common peak landings were in April and in September-October in the marine and riverine stations; in June-August in estuarine and riverine stations and to some extent in January-February at the Cox's Bazar and Khepupara areas.

The annual landings estimated for the sampling stations Chandpur, Mohipur, Nayahata, Chittagong and Cox's Bazar were 2678, 162, 33, 4430 and 8012 tonnes respectively (Table III). The poor landings at Khepupara area were attributed to the catches being collected and taken away by the carrier boats at the fishing grounds, low abundance of fish in the area and/or the very short duration of each fishing trip.

Railway's shipment data for 1985-86, at Chandpur, indicated that transshipment from the station was of the order of 4958 tonnes. This figure was arrived at after reducing the actual railway records by 31 per cent to account for the weight of ice (23%) and that of baskets (8%). The present estimate of 2,678 t may thus appear to be considerably less than the actual arrival. It may be remembered that the sampling was done only during day time (0700 to 1700 hrs) ; during the monsoon season (from May to October) the night landings were almost as much as the day landings. Hence if the corresponding figure of 1,870 t (to account for night landings) were to be added to the day's estimate, the total would be about 4,550 t, a figure reasonably close to the transshipment data.

#### 3.1.1. Species composition

From the catch statistics collected, an attempt was made to find out the relative importance of Hilsa spp with others. The percentage composition at different sampling stations is shown in Table IV. The dominance of *Hilsa ilisha* in the gillnet catches was as high as 85 to 97 per cent. *Hilsa toli* was available only at the marine stations, mostly close to Cox's Bazar.

Among the miscellaneous fishes, some species were predominant. There was a similarity in the identity of species landed in riverine and estuarine stations on the one hand and in marine stations on the other. In the former, the cat fishes *Silonia silondia* and *Mystus* sp, the sciaenid *Pama pama* and the anchovy *Setipinna phasa* were more common ; the Bombay duck (*Harpodon nehereus*) and small sharks and rays were also found in the estuaries. In the marine sector, the white pomfret (*Pampus argenteus*), the Indian mackerel (*Rastrelliger kanagurta*), cat fish (*Arius* spp.), croakers, Bombay duck, elasmobranchs and eastern little tuna (*futhynnus affinis*), were the important components in the miscellaneous catch.

### 3.2 Effort

The estimated number of boats landing the catches every month is given in Table V. It is apparent that at Chandpur the principal contributors were the non-mechanized carrier boats, the largest numbers operating from June to August and the lowest during December-January. While the latter period coincided with lean daily landings of hilsa (Fig. 1), such a relation could not be seen in respect of peak daily landings in May and in September. It was the mechanized carrier boats which appeared to have influenced the peak daily landings in September. The daily landings in May attained a peak in spite of the fewer non-mechanized carrier boats and the absence of any mechanized carrier boats.

At Khepupara, unfortunately, records were not maintained separately for the non-mechanized and mechanized boats at Mohipur centre. At Nayahata, the peak catch rate in September roughly coincides with the highest number of boats in August-September. It may however be remembered that in the Khepupara area, the catches of the fishing boats are largely taken over by the carrier boats; hence the shore landings do not truly reflect the catches.

At Chittagong, it is hard to explain why the boat landings were so low in June when the catch rates were high. This single phenomenon apart, there seems to be a correlation between the catch rates and the number of boats.

At Cox's Bazar, except for June-July when inclement weather and rough monsoon conditions hindered fishing activities, the number of boats fluctuated only between 450 and 700.

### 3.3 Catch rates

Catch per boat per fishing day has been taken as the catch rate in Chittagong, Cox's Bazar, Mohipur and Nayahata sampling stations. As it was not possible to collect information on the catch per boat per fishing day at Chandpur, the total amount of hilsa landed per day (almost exclusively by the non-mechanized carrier boats) was taken as an index of catch rate in the Meghna river (Fig. 1).

Catch rates of hilsa at Chittagong attained major peaks in June and October and one minor peak in February. Similarly catch rates at the other marine station (Cox's Bazar) attained two major peaks in April and October and a minor one in February. The minor peak value in February at Cox's Bazar was higher than the value at Chittagong. At both stations the catch rates showed low values in July and January. Thus the major difference between the two marine stations lay in the timing of the first peak-April in Cox's Bazar and June in Chittagong. This difference apart, the similarities in catch rates at both the stations could be because the fishing grounds covered by the crafts from both stations were more or less the same. The peak in April at Cox's Bazar was caused by the entry of a size group of 0-39 cm which subsequently dwindled. It is possible that these originated from the south (probably from Burmese waters), and that they returned south after a month or so.

In the estuarine region, the principal peak was observed in July at Mohipur, but in September at Nayahata. A second small peak also appeared in January-February in this area. It must be recalled that July and January were the leanest months at both the marine stations. While the contrasting of peak and lean months in the marine and estuarine environments in July and January may offer some evidence of hilsa migration from the sea to the estuaries during the respective periods, the secondary peak in September in Nayahata may have to be considered as a minor aberration in the records because there was not much difference in the catch rates

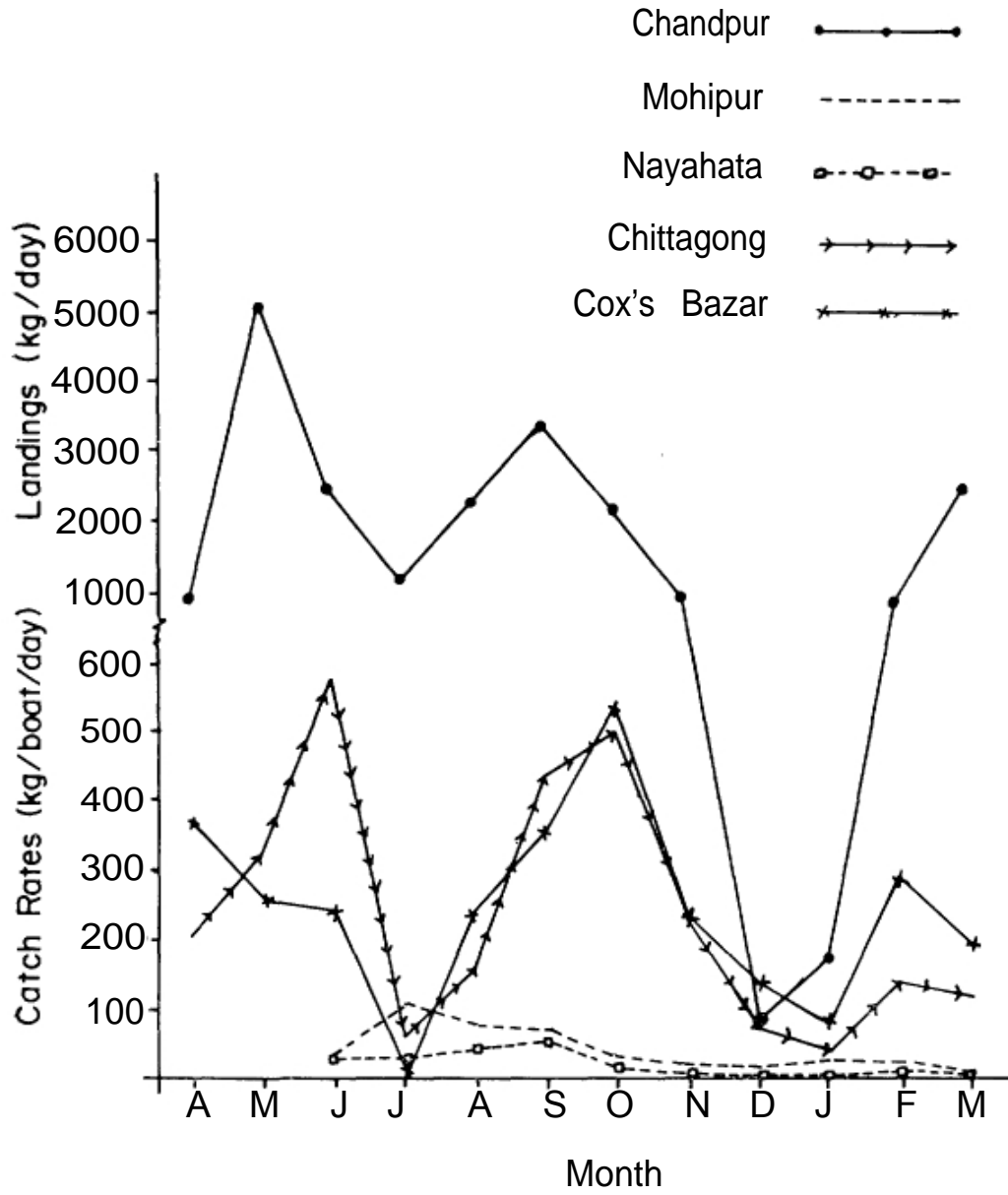


Fig. 1 Seasonal variation in the catch rates of *H/Isa ilisha* during 1985/86 at the different sampling stations. Note— Chandpur values show landings per day by non-mechanised carrier boats.

Annexure 1

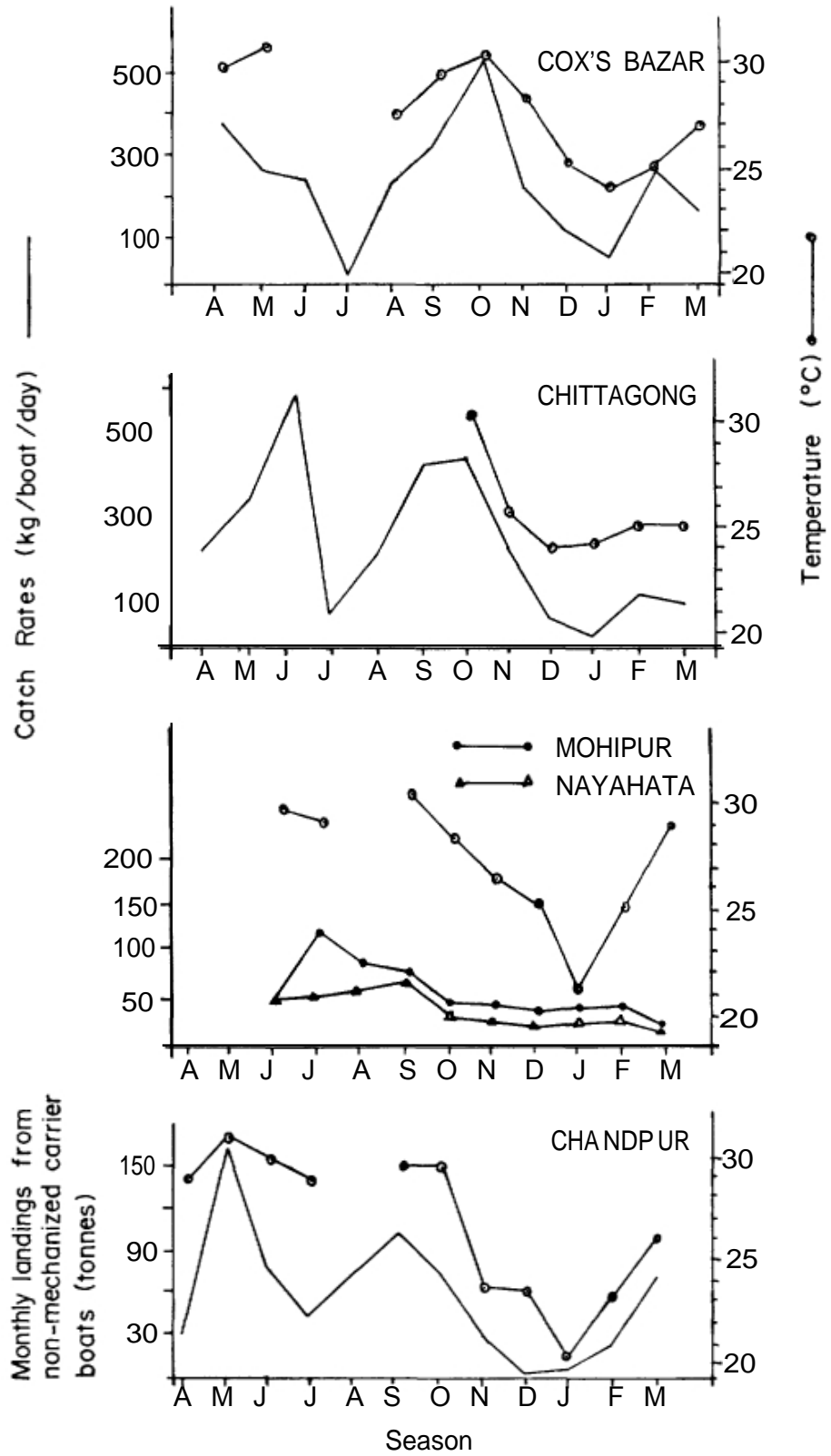


Fig. 2 Seasonal variations in surface temperature and catch rates of *Hilsa ilisha* at the four sampling stations.

Annexure 1

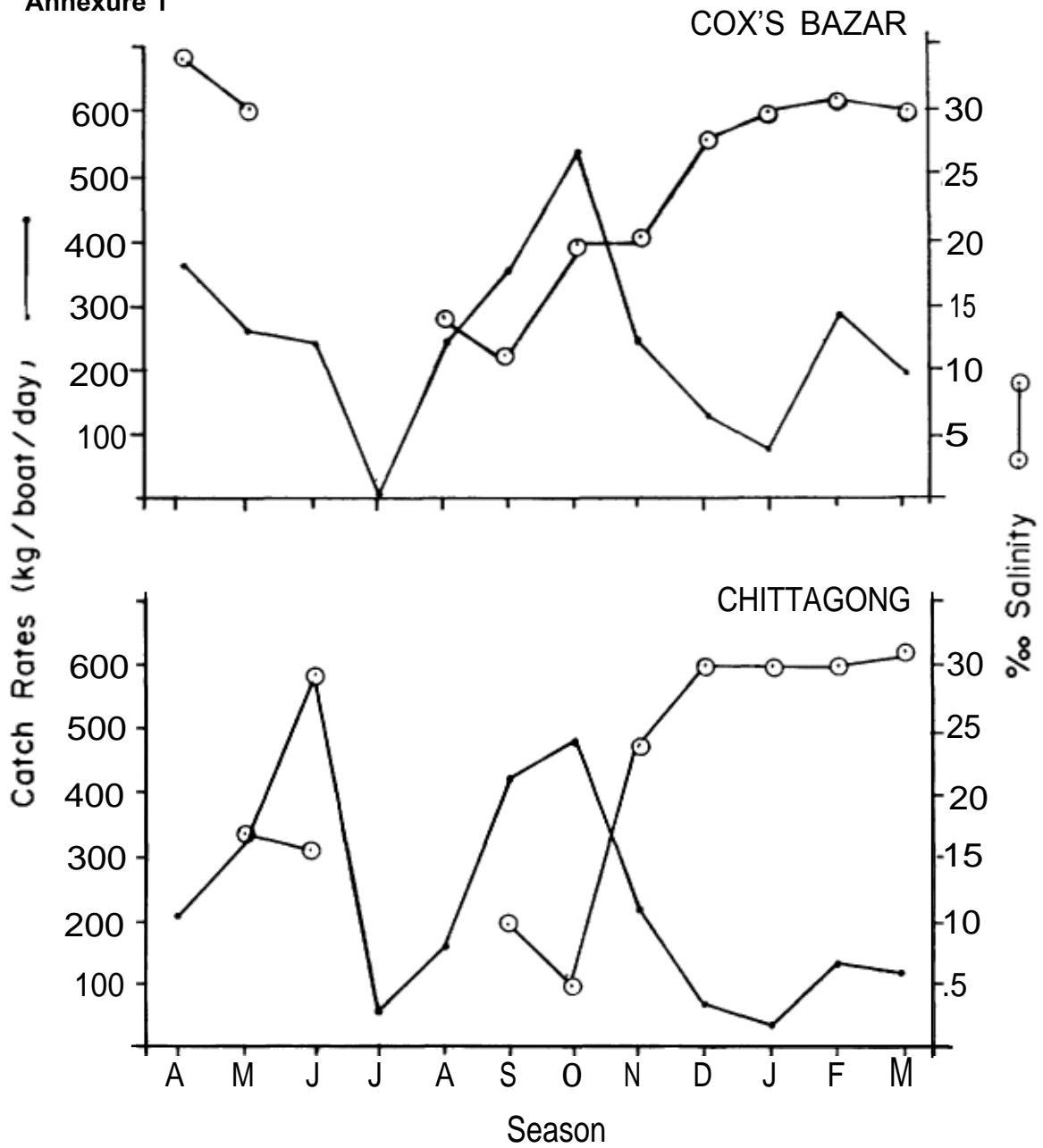


Fig. 3 Seasonal variations in the salinity and cattth rate of *Hilsa ilisha* at two sampling stations.



Annexure 1

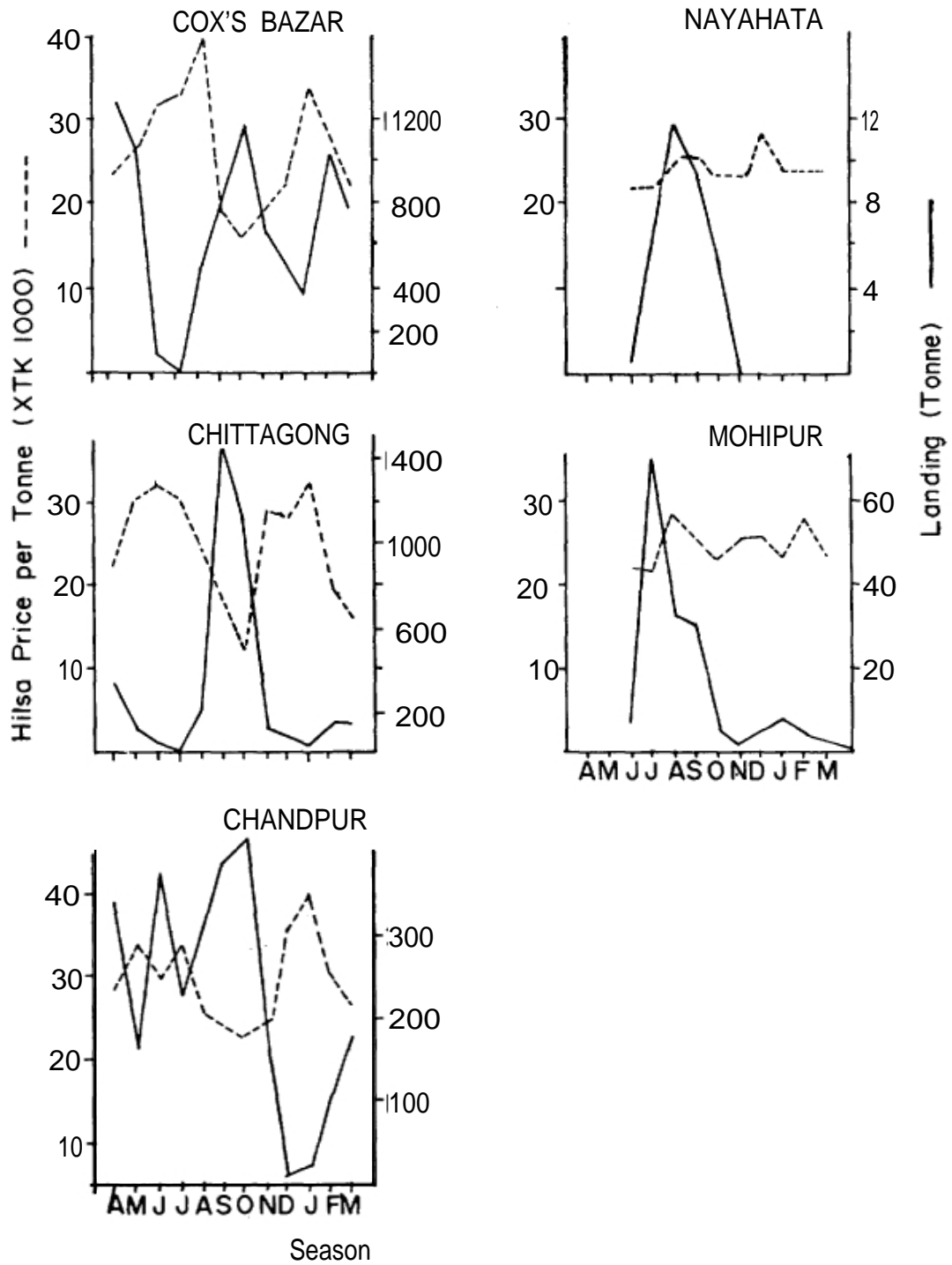


Fig. 4 Seasonal changes in the landings of *Hilsa ilisha* and the price per tonne at the sampling stations.

between Nayahata and Mohipur in September. At Chandpur (the riverine station) the peaks occurred in May and September, the latter somewhat less dominant than the former; in addition there was an indication of a rising trend in February-March and this may perhaps end in a peak in May. The lean period here is December-January.

In the absence of comparable statistics, it is not possible to state unequivocally that the catch rates in the marine sector are higher than those of the riverine area. But looking broadly at all the data, it is difficult to reject this inference. Although the fishery in the selected sampling station for the estuarine environment was on a low key, it is indicative of the connection between the fisheries in the marine and riverine sectors. It may also be stated that part of the catches landed in Chandpur came from estuarine areas around Patuakhali, Bhola, Natiya and Sandwip.

### **3.4 Relationship with environmental factors**

(i) *Surface water temperature and catch rates:* The seasonal variations in surface water temperature and catch rate (kg/boat/day) at different sampling stations are shown in Fig. 2. In Chandpur, there seems to be a direct relationship between temperature and the landings -the rise and fall in temperature coinciding with the rise and fall in the landings. At Cox's Bazar and Chittagong, the peak value of temperature in October coincides with the peak catch rate in that month but such a situation does not obtain for the other temperature peak in May.

(ii) *Salinity and catch rates:* Salinity and catch rate dates are plotted in Fig. 3. In Chittagong a significant inverse relationship ( $r=-0.90$ ) was observed between salinity and catch rate. In October, salinity was low while the catch rate was high. During winter high salinity was recorded when the catches were low. However, Cox's Bazar data do not show such a trend.

No comparison could be attempted for the Khepupara area because the salinity records relate to the adjacent Charfession area. As the temperature and salinity appear to be dependent variables, it is not possible to state whether either or both environmental parameters influence the seasonal changes in the distribution of this species in Bangladesh waters.

### **3.5 Fish price**

The wholesale price of hilsa at different sampling stations in relation to the respective total landings is shown in Fig. 4. The price ranged from Tk. 12,860 to Tk. 43,000 per tonne. The average price for the year was around Tk. 25,000 in the marine stations and Tk. 30,000 in the riverine station. It was noticed that prices of hilsa had declined during September-October when landings were at their highest while the prices tended to rise when the landings declined. The highest prices were generally in the June-August period and again in January. The only exception to this general inverse relationship is the situation obtained in Khepupara, where the prices did not fluctuate much, irrespective of the amount of landings. In fact when the catches were high the price also went up probably because of increased competition from buyers during the peak period-from both the carrier boats and those engaged in the dry fish trade. The prices also ruled high when the catches were low, because of local market demand.

#### 4. DISCUSSION

One of the objectives of the present investigation was to estimate, at least for the marine sector, the total hilsa production, because there was no well designed sampling programme for estimating the catches; also because almost all the mechanized boats of the Chittagong — Cox's Bazar coastal belt were primarily directed towards gillnetting for hilsa.

Table VI lists the estimated monthly production of total catch and hilsa catch per boat at Chittagong and Cox's Bazar. The annual hilsa production per boat was estimated to be 43.4 t and 50.2 t respectively at the two centres. The Fisheries Resources Survey System Project of the Government of Bangladesh has carried out a census survey of mechanized boats engaged in the hilsa fishery. It was learnt from that project that for Cox's Bazar and Chittagong districts, the boats numbered 1,822 and 1,128 respectively, totalling 2,950 boats. If there are 2,950 boats engaged in hilsa fishing, then their hilsa returns totalled about 140,000 t, on the basis of an average catch of 47.1 t per boat. Shahidullah (1986) has indicated that there are 3,000 mechanized boats in the gillnet fishery and from the data collected by him at Chittagong, an estimate of hilsa production can be made. His latest figure for catch per boat per trip is 1.96 t, of which 76.2 per cent consist of hilsa — 1.5 t of hilsa. He has assumed three trips a month and 8 months of fishery. On this basis, the average annual catch per boat is 36 t (as against 47 t estimated during the present study). Projected for 3,000 boats, the total hilsa production is about 108,000 t, about 32,000 t less than the present estimate. This appears to be an underestimate, because even according to his data there is only one lean month in the fishery. On the other hand, McNeilly (1985) has estimated a production of 200,000 t assuming that each boat produces an average of 100 t per annum and the fleet consists of 2,000 boats. It is difficult to test the accuracy of his estimate.

Ali (1985) has mentioned that hilsa production in the riverine and estuarine sectors is 40.4 per cent of 207,786 t, i.e., about 90,000 t. With the present estimate of 140,000 t from the marine sector, the total hilsa production in Bangladesh appears to be in the vicinity of 230,000 t. Assuming that the total fish production from all sources is of the order of 780,000 t, consisting of 580,000 t from inland waters (Ali, 1985) and 200,000 t from the marine sector (Shahidullah, 1986), the contribution from the hilsa fishery is nearly 30 per cent of total fish production of the country.

The erstwhile Freshwater Fisheries Research Station at Chandpur (the present Riverine Fisheries Research Station of FRI) had been collecting the landings records at Cox's Bazar from the mechanized boats. Their records show (Raja, 1985) that during the five-year period ending 1982-83, the average catch was only about 1,000 t. The present estimate in this study is about 8,000 t. Even allowing for growth of the fleet, it is very obvious that the catches at Cox's Bazar have been grossly underestimated in the earlier years. Perhaps the underestimation may be due to the simple reason that, as per existing government orders, there is a landing cess of 6% of the value of landings to be paid by the boat owners to the Bangladesh Fisheries Development Corporation.

Even after allowing for underestimation and reconciling with the railway transshipment records at Chandpur, it will be seen that, as compared to past records (Dunn 1982, Melvin, 1984), the present level of landings is the second lowest for the last 14-15 years and is only about one half of the landings in 1982 and 1983. If this is the situation at the most important riverine landing stations, it would be extremely difficult to make any projections for other landing stations. Is it possible that catches are larger further down in Meghna river?

In the case of Chittagong, the railway transshipment records (Dunn, 1982, Melvin, 1984) have been showing a rapid increase since the beginning of the eighties, the last figure being about 13,000 t for 1983. On the other hand, the present estimate of 44,000 t represents a big departure from earlier records. Had the railway records been compiled (as it was in Chandpur), it would

have been possible to have a little more light thrown on this subject. Unfortunately the data for the comparison could not be collected. Hence it can only be stated that (as with Chandpur), it is possible that the landings during the night time may have been missed. There is also yet another factor—two other landing centres at Chittagong were not covered during the present investigation. During peak seasons, the boats land their catches at the non-sampled centres also. No weightage was given to such landings in the present estimation.

A comparative picture of the peak catch rate seasons (both major and minor, in the order of importance) at different stations is indicated below:

<i>Stations</i>	<i>Months of peak catch rates</i>
Chandpur	May, September, March
Khepupara (Mohipur) (Nayahata)	July, January September, February
Chittagong	June, October, February
Cox's Bazar	April, October, February

A close look at the records of size groups and maturity stages indicates that the stock which contributed to the April peak in Cox's Bazar appears to be a stock that came from elsewhere. It most probably came from the south and returned south, since this peak could not be traced into the peak fishery anywhere further north. If this is the case, then there is room for suspicion that the hilsa caught off and south of Cox's Bazar is an intermingling of the components from the north of Cox's Bazar and also from the Burmese waters in the south.

The other possibility is a migration of a segment of population within and in between the riverine and estuarine environment — a situation not uncommon and already reported for Indian waters in the Hooghly river system (Pillay 1957 and 1958). One such migration may take place in the winter between January and March, the other in the summer between July and September. Probably this may be limited to the fish till they attain first maturity at about 30 cm ; after spawning, they move down to the sea, and re-enter the rivers next year for spawning. Thus, it is suggested that some future studies may focus on the possibilities of:

- (i) a stock of Cox's Bazar consisting of races from south and north;
- (ii) a segment of population which migrates within the inland waters till the first spawning;
- (iii) an anadromous component, especially of age 1 and above, migrating between the sea and the river.

It may be very rightly questioned how and why such segmentation should be suspected. It is difficult to answer such a question without acceptable evidence. The attempt here is to pose the question to others who are involved in interpreting data for growth, maturity and spawning and in the analysis of biometric data.

Other biologists concentrating on the above aspects could not throw much light on the question posed except to state that fish less than 30 cm, i.e., till first spawning, seldom appear in the commercial fishery in any environment and that the migration between sea and river is evident only for the size groups 30 cm and above. These may partially answer the questions (ii) and (iii) raised above.

## 5. SUMMARY

Systematic random sampling of hilsa landings were carried out at four stations — Cox's Bazar and Chittagong (marine), Khepupara (estuarine) and Chandpur (riverine) -for a period of one year (1985-86) with collection of statistics on catches and effort for 12 days a month. The observed landings were raised to the total landings of the day, on the basis of the ratio between observed number of boats and the total number of boats landing that day. The average daily catch of 12 days was raised to the monthly catch.

The estimated landings were 4,550 t, 4,330 t and 8,012 t for Chandpur, Chittagong and Cox's Bazar respectively. At Khepupara the estimated catches were poor because most of the catches were taken away from the fishing ground by the carrier boats.

For the marine sector, it has been estimated that if there were 3,000 mechanized gillnetters engaged in hilsa fishing, then the total annual hilsa production from the marine sector would be 140,000 t. Add to this, the reported production of 90,000 t from riverine and estuarine sectors; however the total production of 230,000 t may be an over-estimate because the number of mechanized gillnetters actively operating in the marine sector may be less than those registered, and the estimated figures for riverine/estuarine areas are likely to comprise marine catch also, as brought by carrier boats.

The common peak landings were in April and September-October respectively in marine and riverine stations and also in June-August in estuarine and riverine stations. There were indications of a minor peak at Cox's Bazar and Khepupara in January-February. The leanest period is June-July in the marine sector, because of rough monsoon conditions, and during December-January in the riverine side, probably because no spawning run takes place at that time.

With regard to effort, the principal contributors at Chandpur were the non-mechanized carrier boats, the largest number of which landed in June-August, the lowest during December-January. However, the peak landings in September appear to have been contributed by the mechanized carrier boats.

In the Khepupara area the peak catch rates roughly coincided with the higher number of boats in August-September.

At Chittagong, except for one month, the catch rates and the number of boats appear to be directly related to each other. Such a situation is not observed in Cox's Bazar, where a fairly large number of boats varying between 450 and 700 operate all through the year, except in June-July, irrespective of catch rates.

Taking catch rates as the index of abundance, it is seen that the peak periods at the two marine stations are either in April or June and the next in October; a minor peak was seen in February at both the places. In the estuarine station the principal peak was observed in July in Mohipur and in September at Nayahata. A secondary small peak appeared in January-February. At Chandpur, the peaks occurred in May and September.

No firm relationship could be established between temperature or salinity and catch rates, though indications of a correlation were evident.

The wholesale prices of hilsa varied between Tk 12,860 and Tk 48,000 per tonne; the average price was around Tk 25,000 in the marine sector and Tk 30,000 in the riverine station. Usually the prices tended to dip low during peak seasons and shoot up during the lean period. The exception to this was in Khepupara where the fluctuation in prices was small irrespective of the seasons.

The results are discussed in the light of past records on the subject. On the basis of present data, certain suggestions have been posed on the question of identity of stocks and their movement.

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**Table I**

**Characteristics of the fishing craft and duration of trips and fishing time at the sampling stations**

(MB=Mechanized fishing boat; MCB-Mechanized carrier boat; NMC=Non-mechanized carrier boat; NMB=Non-mechanized fishing boat)

Parameter	Chandpur			Mohipur Nayahata		Chitta-gong	Cox's Bazar
	MB	MCB	NMC	MB	NMB	MB	MB
Types of fishing craft	MB	MCB	NMC	MB	NMB	MB	MB
Size of the boat (m)	6-9	10-13	3-5	12-13	11-14	13-15	13-15
Horse power	21-23	22-49	—	22-24	—	32-35	29-33
Crew size	4-12	4-12	3-5	8-9	5-10	10-11	12-13
Period of absence from port	1-11 days	1-7 days	—	9-18 hrs.	10-12 hrs.	3-11 days	2-7 days
Period of fishing	1-9 days	—	4-12 hrs.	5-14 hrs.	5-10 hrs.	2-9 days	2-5 days

**Table II**

**Types of fishing gear used in the hilsa fishery at the sampling stations**

Gear	Chandpur	Mohipur	Nayahata	Chittagong	Cox's Bazar
1. Types	1. Drift gillnet without pocket (Chandi) 2. Bottom set gillnet 3. Clap net 4. Drift gillnet with pocket (Gulti)	Drift gillnet	Drift gillnet  Bottom set gillnet	Drift gillnet	Drift gillnet
2. Size of drift gillnet (m) (length x depth)	400 to 1300 x 6 to 13	1100 to 1400 x 8 to 11	900 to 1300 x 6 to 13	1500 to 1800 x 18 to 21	1700 to 2000 x 19 to 22
3. Mesh size (cm)	7.5 to 12.0	7.4 to 12.0	8.0 to 12.0	8.5 to 12.0	8.5 to 12.0

**Table III**  
**Monthly hilsa landings and their percentage in the total fish landings at the sampling stations**

Months	Chandpur			Mohipur			Nayahata			Chittagong			Cox's Bazar		
	Total landing	Hilsa landing	Per cent Hilsa	Total landing	Hilsa landing	Per cent Hilsa	Total landing	Hilsa landing	Per cent Hilsa	Total landing	Hilsa landing	Per cent Hilsa	Total landing	Hilsa landing	Per cent Hilsa
April	328.08	—	—	—	—	—	—	—	558.79	339.55	60.8	1507.26	1275.59	84.6	
May	159.05	—	—	—	—	—	—	—	140.52	122.28	87.0	1201.92	1060.22	88.2	
June	372.29	6.90	6.90	100.0	0.54	0.54	100.0	52.70	50.06	94.9	133.66	99.70	74.5		
July	232.08	69.44	66.96	96.4	5.58	5.58	100.0	7.72	5.05	65.4	2.20	0.51	23.1		
August	308.66	32.42	32.47	100.0	11.48	11.48	100.0	244.61	205.98	84.2	608.95	499.34	82.0		
September	385.24	29.52	29.52	100.0	9.18	9.18	100.0	2084.41	2032.0	97.4	867.81	814.57	93.8		
October	410.58	5.51	5.51	100.0	5.18	5.18	100.0	1218.09	1112.43	91.3	1168.04	1151.66	98.6		
November	155.69	2.08	2.08	100.0	0.10	0.10	100.0	157.26	127.77	81.2	742.55	650.88	87.6		
December	12.81	13.89	5.95	42.8	0.62	0.16	25.0	163.64	91.38	55.8	781.37	483.44	61.8		
January	25.94	14.11	8.06	57.1	0.19	0.09	48.9	103.22	30.71	29.7	527.46	375.06	71.1		
February	109.30	12.01	4.37	36.4	0.56	0.28	50.0	235.83	148.43	62.9	1289.65	1043.37	80.9		
March	178.68	2.39	0.68	28.5	0.31	0.16	50.0	270.65	164.79	60.8	646.84	557.03	86.1		
Total(t)	2678.40	188.27	162.50	86.3	33.74	32.75	97.0	5237.24	4430.43	84.6	9477.71	8012.37	84.5		



**Table IV**  
**Percentage of Hilsa spp. and miscellaneous varieties in the gillnet catches at the sampling stations**

Species	Chandpur	Mohipur	Nayahata	Chittagong	Cox's Bazar
<i>Hilsa ilisha</i>	<b>90.0</b>	86.30	97.06	84.60	84.54
<i>Hilsa toli</i>	—	—	—	0.08	6.01
Miscellaneous	10.0	13.70	2.94	15.32	9.45

**Table V**  
**Estimated number of boats landing at the sampling centres**  
(NMB=Non-mechanized boats; MB=Mechanized boats)

Month	Chandpur				Mohipur	Nayahata	Chittagong	Cox's Bazar
	Carrier boat	Fishing boat	Carrier boat	Fishing boat	NMB	NMB	MB	MB
	<i>Mechanized</i>		<i>Non-mechanized</i>					
April 1985	15	3	622	4	—	—	227	692
May	—	—	720	4	—	—	73	710
June	10	—	1325	—	690	60	4 5	167
July	13	—	1227	—	2480	930	26	44
August	96	—	1003	—	2494	1276	314	457
September	180	—	778	—	2460	1020	967	522
October	126	—	576	—	1377	864	409	648
November	217	<b>10</b>	407	—	416	104	79	532
December	46	5	137	—	1984	155	133	695
January 1986	56	11	162	—	2015	93	92	478
February	105	5	537	—	1092	140	152	657
March	119	1	602	—	341	155	167	560
Average	89	6	675	4	1535	480	224	514

**Table VI**

**Monthly and annual production of all species and hilsa species  
from a gillnet fishing craft at the two marine sampling stations**

Months	Chittagong		Cox's Bazar	
	Total catch (t)	Hilsa catch (t)	Total catch (t)	Hilsa catch (t)
April 1985	7.4	4.5	7.4	6.4
May	5.6	4.9	4.9	4.3
June	5.6	5.3	5.6	4.2
July	1.1	0.7	0.8	0.1
August	2.8	2.3	5.7	4.6
September	6.9	6.7	6.4	6.0
October	8.6	7.8	7.7	7.0
November	5.0	4.16	4.8	4.2
December	2.7	1.5	3.9	2.9
January 1986	2.7	0.8	2.5	1.8
February	3.4	2.1	6.2	3.0
March	4.4	2.7	4.3	3.7
<b>Total percentage of hilsa</b>	<b>56.2</b>	<b>43.4</b> <b>(93)</b>	<b>60.2</b>	<b>50.2</b> <b>(83)</b>

**Appendix I**

**RECORDS OF CATCH AND EFFORT ON HILSA (FISHING BOATS)**

Landing centre :  
Biologist:

Date of observation :  
Time : From.....To.....

Total no. of fishing  
boats landed :  
No. of boats observed :  
Price per tonne :

Sl. No. Name of boat	Length of boat HP of engine	Name of gear	Details of gear			Time absent from port (days)	No. of fishing days/hrs.	No. of fishermen	Particulars about fishing ground	Total catch (kg)	Hilsa catch (kg)			Remarks
			Total length (m)	Depth (cm)	Mesh size (cm)						<i>ilisha</i>	<i>toli</i>	<i>kelee</i>	

Appendix II

RECORD OF CATCH AND EFFORT ON HILSA (CARRIER BOATS)

Landing centre :  
Biologist:

Date of observation :  
Time: From..... To.....

Total no. of carrier boats landed :  
No. of carrier boats observed :  
Price per tonne :

Sl. No. and Name of carrier boat	Absence from port (Date & Time) From To		Details of the fishing boats from which collections were made							Area of Collection	Remark	
			No. of fishing boats	Name of gear & length depth & mesh size	Size of boat and HP of engine	Weight of fish						
						ilisha	toli	kelee	Others			Total