

## EXPLOITATION OF THE LOWER ZONE OF THE HOOGHLY BY MIGRATORY FISHING UNITS\*

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### ABSTRACT

Fishery exploitation by migratory bag-net units is a typical feature of the lower zone of the Hooghly Estuary during winter seasons. It has been estimated that about 1,000 men with 300 nets migrate from the upper areas and set up fishing camps in the islands. The catch per unit for this migratory seasonal fishery is generally about 10 to 50 times that obtained in the upper zones and the total landings account for about 50% of the total annual bag-net catch from the whole estuary. The dominant species are *Harpodon nehereus*, *Trichiurus haumela* and *Trichiurus savala*, *Setipinna phasa* and *Setipinna taty* and different species of prawns. Most of the catch is sundried and boat-loads of dried fish are periodically sent to the marketing centres.

### INTRODUCTION

IN THE COURSE of its joining the sea, the river Ganges has given rise to an extensive estuarine system extending over the southern parts of West Bengal and Bangladesh which supports important commercial fisheries of a number of fish and prawn species. The part lying within southern West Bengal constituting the Hooghly Matlah estuarine system has, as its principal component the main channel known as the Hooghly river which extends landwards for about 180 miles from the confluence of the river in the Bay of Bengal.\*\* The lower part of the Hooghly-Matlah system comprise the estuarine network formed by the main channel and its distributaries alongwith their further subdivisions and cross-connections which flow into the sea giving rise to an extensive deltaic system in the process. The estuarine waters cutting through and adjoining this extensive deltaic region known as the Sunderbans support the richest fisheries in the whole estuary contributing about 80% of the total landings. Based on the gradual variation in salinity this estuarine system can be divided into three distinct zones as follows (Pantulu, 1961): (i) an upper zone having only traces of salinity during the year extending from Nabadwip to Khusigoli on the main channel, the two places being about 90 miles and 25 miles upstream respectively from Calcutta; (ii) a middle zone between Khusigoli and Diamond Harbour on the main channel where salinity ranges from traces to about 10‰; (iii) a third lower zone including the entire estuarine area of the Sunderbans and the tract below Diamond Harbour on the main channel, where salinity varies from 10‰ to nearly neritic values. Tidal effect in the Hooghly is practically absent above Nabadwip. Rupnarayan, a tributary of the Hooghly joining the

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\*\*It may be of interest to note that although generally described as such in official records, locally the river is not commonly called as the Hooghly but as 'the Ganga', the same name by it is known in its upper reaches outside West Bengal.

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latter about 12 miles above Diamond Harbour, has salinities similar to the middle zone and forms a part of the upper estuary (Fig. 1).

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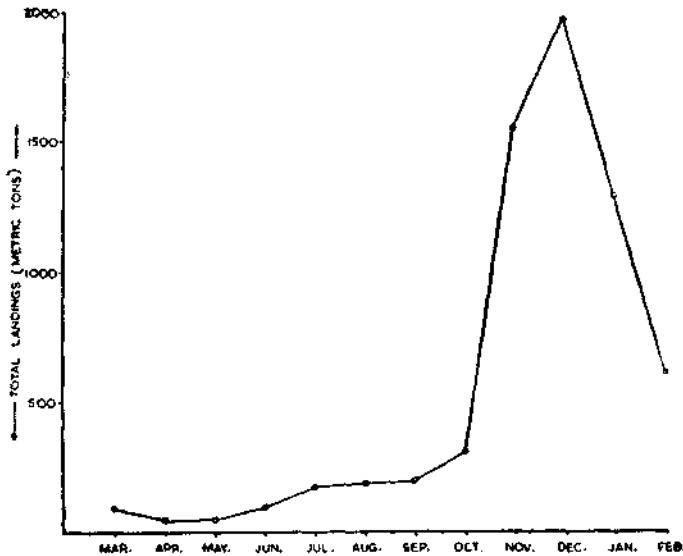


Fig. 1. Monthly total fish landing from the lower zone of the Hooghly-Matlah estuarine system 1964-65 to 1968-1969 (average).

Exploitation in varying degrees continues in the lower zone, all the year round. However, generally there is a gradual increase in fishing and landing from the start of monsoon (June/July) upto December/January and a gradual decrease therefrom till the onset of monsoon. The notable fisheries of this region are constituted by stationary bag-nets, seines, gill-nets, and various forms of barrier-nets. The seasonal pattern of landing will be evident from Fig. 2 which shows the average monthly landings from the lower zone during the five year period March 1964 to February 1969. It will be seen that the bulk of the catch (82%) is made during the winter months - November to February. The relative contributions by the different types of gears to the total harvest from this zone are presented in Table 1. On the average 54% of the landings in this zone is contributed by bag-nets, seines and gill-nets contributing 23% and 7% respectively.

Of special importance is the migratory fishery of winter consisting of stationary bag-nets locally called been-jals described by Hornell (1922, 29), Naidu (1952), Mitra (1952), Pillay and Ghosh (1962) and others. Fish which are caught by the

bag-nets are usually those which are carried into these nets by the tidal flow and cannot escape out of the net. This no doubt, is one of the reasons why bag-net catches generally comprise of comparatively small-sized fish. One complete operation usually consists of the effective part of 1 full-tide. Being essentially a gear depending on tidal action, it is operated in all parts of the

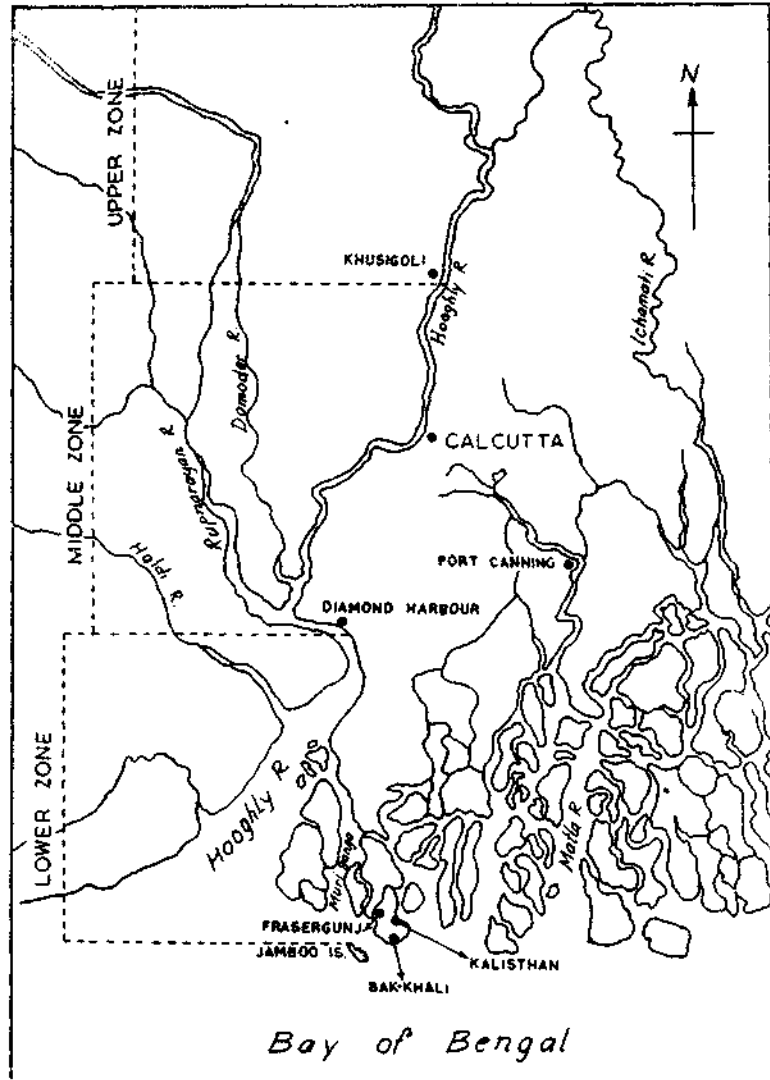


Fig. 2. Hooghly-Matlah estuarine system.

estuary where sufficient tidal force is present. Of the annual catches of 7 to 10 thousand tonnes from the whole estuary during 1964-65 to 1968-69, 4 to 5 thousand tonnes were by bag-nets which accounted for 41 to 63% of the total catches by all gears during these years. It will be seen from Table 1 that of the

TABLE 1. Gear-wise distribution of the total fish yield from the lower zone

Type of gear	1964-65		1965-66		1966-67		1967-68		1968-69		Average	%
	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%		
Bag	3699584	38.98	3257960	61.59	2817180	53.07	4003352	62.43	3762443	60.02	3508104	(53.52)
Seine	2091668	22.04	1091323	20.63	1630885	30.73	1311533	20.45	1371464	21.88	1499375	(22.88)
Gill	451104	4.75	188099	3.56	299220	5.64	677877	10.57	720513	11.50	467362	(7.13)
Others	3249095	34.23	752501	14.22	560746	10.56	420147	6.55	413986	6.60	1079295	(16.47)
Total	9491451		5289883		5308031		6412909		6268406		6554136	

TABLE 2. Number of migrant fishermen, 'Khutis' (fishing camps) and centre-wise concentration of bag-nets around Frasergunj in winter

Centre	Year				
	1964-65	65-66	66-67	67-68	1968-69
bag-nets					
Bok-khali	44	75	73	83	104
Kalisthan	55	42	27	8	7
Frasergunj	94	110	68	59	33
Jamboodwip	96	102	104	123	190
Total:					
net	289	329	272	273	334
men	894	1295	955	1100	1354
'khutis'	82	75	68	68	73

total catches in the lower zone varying between 5 to 9 thousand tonnes during the five years, 3 to 4 thousand tonnes were landed by bag-nets, forming 39 to 62% of the annual totals.

A special feature of the Hooghly Estuary is the migration from upper areas of a large number of bag-net fishing parties during winter to suitable spots on the sea-face in the lower zone, where they set up fishing camps and remain engaged in bag-net fishing during the 4 winter months. The two main concentrations of such migratory fishing parties are on Sagar Island, at the mouth of Hooghly Estuary and around Frasersgunj Island, at Bok-khali, Kalisthan, Frasersgunj and Jamboodwip Island. The characteristics of the fishery relating to the last mentioned concentration have been studied for the years 1964-65 through 1968-69 and information based on direct enumeration on a sampling basis have been obtained on various aspects such as total catch, catch-per-unit-effort, and species composition of landings. The sampling frequency was generally 3 days per fortnight for any centre although, particularly in later years, when concentration of fishing gears at one of the centres diminished significantly, observations at that centre were reduced to 1-2 days per fortnight and the available days were utilized in intensifying observation at the other centres. Preparation of a full inventory of the numbers of migrant men and bag-nets by camp-to-camp visit at each of the sites was done at the start of the season. Effort input and catch-per-unit-effort for the observed days were noted for all camps at a site while for ascertaining composition, catches of 2 to 3 'Khuti's (fishing camps) were examined in detail. The analytical information based on the data collected and the important characteristics of the fishery revealed by it are embodied in this paper.

The location of Frasersgunj at the western flank of deltaic Sunderbans facing the sea is shown in Fig. 1. It is close to the main channel of the Hooghly, being separated from it by Sagar Island and Muriganga River, the latter being an arm of the main channel. Salinity at Frasersgunj varies during the year between 10‰ in October to 34‰ in May. During winter the salinity values are relatively low, varying between 19‰ in November to 23‰ in February. The migration of bag-net fishing parties, mostly from the upper reaches of the estuary, starts towards the end of October and is usually complete before the first week of November. The immigrants set up fishing camps on the spots known as 'Khuti's, each of which consists of a fair amount of enclosed space with a small hutment portion within it which is utilised for shelter and for stacking the dried fish. The open space and the enclosure are both utilised for drying the catch. The number of men migrating to the different bag-net fishing centres around Frasersgunj along with their numbers of nets and the numbers of 'Khuti's (fishing camps) set up by them in the different years between 1964-65 to 1968-69 are shown in Table 2. It will be seen that yearly on an average about 1100 men with 300 units take part in this migratory fishing activity around Frasersgunj Island. The men have to incur relatively heavy expenditure for sustaining themselves in these remote places. However, several factors which make this migratory fishing economical. During winter, a calm weather prevails in the extreme lower reaches of the estuary at the sea-face favourable for the operation of stationary bag-nets. This condition prevails till the onset of south wind which starts about the middle or end of February making the sea rough and the operation of these nets difficult or impossible. Secondly, the availability of fish vulnerable to bag-nets ranges at these fishing centres during November to January from about 11 to 50 times the average availability at the upper and middle zones during the whole year (Table 3). In the upper and middle zones the average catch-per-unit-effort remains about 2.6 Kg during the year, whereas in the winter fishing centres

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it ranges from 29 to 131 Kg during November to January, decreasing to 12 Kg during February. In upper areas fishing at all the tides is not a regular feature, whereas in the migratory fishery it is the general rule increasing the frequency of operation of nets. Thirdly, there is a good market demand within and outside the country for the dry fish of the varieties caught in appreciable quantities.

The major importance of the migratory bag-net fishery of winter lies in its high share in the total landings from the lower zone and from the whole estuary (Table 4). The yields from the migratory fishery of four months duration formed in the different years 42 to 58% and 53 to 78% of the total bag-net landings in the whole estuary and the lower zone respectively. The high rate of removal is due in the main to the high seasonal abundance as measured by the C.P.U.E. (catch per unit effort) figures indicated earlier. The effectiveness of the effort put in is particularly high for *Harpodon nehereus*, two species of *Trichiurus*, two species of *Setipinna* and some species of prawns. This seasonal rise in abundance is due in a large measure to the feeding migration of species feeding on plankton which in turn induces migration of their predators as well. It has been found that plankton production, particularly phytoplankton production, reaches a peak in the lower zone in the winter months (Shetty *et al.*, 1961). The large amount of detritus and other washed off materials, rich in nutrient contents, that are deposited below the mouth of the estuary during monsoon by the heavy inflow which characterises the stream during that period, set up major food chains by inducing a rich growth of phytoplankton during winter, particularly in the shallow regions of the bay where the migratory fishery operates.

TABLE 3. Average monthly catch per unit effort in kg (total of all species) in the migratory fishing centres

Centre	November	December	January	February	Average
Frasergunj	42.07	50.47	29.33	21.52	35.85
Bok-khali	131.38	97.70	67.18	45.66	85.48
Jamboodwip	44.10	41.08	28.86	12.07	31.53
Kalasthan	67.16	72.53	40.52	45.19	56.35
Average	71.18	65.44	41.47	31.11	52.30

The pattern of concentration of the nets at the different centres in the various years (Table 2) shows some notable variations. There has been a gradual decline in the number of units migrating to Frasergunj and Kalasthan and an increase in the number of units migrating to Bok-khali and Jamboodwip\*.

The marked decline in migration to Kalasthan in the recent years is noteworthy. Preference for a spot appears to be based on several considerations like higher availability of fish, space for camping and drying, facility of landing close to camping spot, general safety, proximity to the market for purchase of essential commodities and to the source of drinking water, some of which may be conflicting in demand. It will be seen from the results of catch-per-unit effort studies presented later that availability at Kalasthan is not poor relative to the other centres. Hence the reason

\*Two parts of Jamboodwip, known as upper Jamboo and lower Jamboo, are usually distinguished due to the division made by a canal cutting inwards on the island for a fair length. Figures which respecting Jamboo are the composite figures for the two parts.

for lower preference for the centre is to be looked in some other factor or factors other than fish availability. Some variation in the size-composition of the nets is also seen at the different centres. The largeness in size of a bag-net is generally indicated by the number of meshes at the periphery of the mouth. The nets of the migratory fishery belong to the medium and large groups characterised by '800 to 1000' and 'above 1000' meshes at the mouth respectively, a higher percentage being of the medium group (Table 5). A few smaller nets with less than 800 meshes at mouth were also encountered. Nets of the large group (i.e. no. of mesh above 1000) are operated in more numbers at Bok-khali.

TABLE 4. Total bag-net landings (Kg) in (a) winter migratory fishery (b) entire lower zone and (c) whole estuary in different years and percentages commended by (a) in some special cases

		Actual landings				
		1964-65	65-66	66-67	67-68	1968-69
a.	Winter fishery	2110040	1734247	1773085	3108690	2854485
b.	Lower zone	3699584	3257960	2817180	4003352	3762443
c.	Whole estuary	4238349	4081312	3688413	5389936	4934588

		Percentage of (a)				
Year	Total yearly bag-net catch		Total bag-net catch of lower zone	Total catch of lower zone	Total yearly catch of	
	whole estuary = 100	lower zone = 100	during winter = 100	during winter = 100	whole estuary = 100	
1964-65	49.78	57.03	66.41	25.45	20.26	
1965-66	42.49	53.23	71.66	44.47	26.61	
1966-67	48.07	62.94	74.88	39.84	26.20	
1967-68	57.68	77.65	84.76	61.51	35.30	
1968-69	57.85	75.87	83.75	53.51	34.50	

#### VOLUME OF LANDINGS

From Table 6 it is seen that the migratory bag-net fishery has reaped a yearly harvest of 1734 to 3109 tonnes of fish between 1964-65 to 1968-69, increased landings being obtained in later years. November and December are the periods of peak landing accounting for about 70 to 90% of the total seasonal harvest.

#### Centrewise comparison in respect of total yields

Among the four centres, Bok-khali and Jambudwip have led in yield where catches had been about 7-9 hundred tonnes and 3-4 hundred tonnes respectively during the first 3 years which further increased to 14 hundred and 11-12 hundred tonnes respectively during the last 2 years (Table 7). On the other hand, at Frasergunj during the first 4 years and at Kalisthan during the first 3 years, the catch had been of the order of 3 to 5 hundred tonnes and 2 to 5 hundred tonnes respectively which fell to 2 hundred tonnes and one hundred tonnes during the last two years respectively. An examination of the changing pattern of concentration revealed in Table 2 shows that available effort potential in the form of existent

nets at a centre has contributed to the changing trends in yield pattern in a fair measure. Over the years, the concentration of nets has steadily increased at Bok-khali and Jambo, whereas, at Frasergunj and Kalisthan it has steadily fallen, rather sharply at Kalisthan where only 7 nets migrated in 1968-69. However, the difference in concentration is not the sole cause of differential yields of the centres which also depend on the differential catches per unit effort at the centres. This becomes clear from a comparison of yields for Bok-khali and Jambo, the former contributing higher yields with a smaller number of operating units. The catch per unit figures with distinguish the species are presented in Table 9.

TABLE 5. Total number of bag-net of different sizes categories in the migratory fishery

	Number of meshes		
	below 800	800 - 1000	above 1000
1969-68	4	232	98
1968-67	—	191	82
1967-66	4	191	77
1966-65	11	304	14
1965-64	20	218	51
Total	39	1136	322
Average %	All centres combined	76	21
	Bok-khali	46	54
	Frasergunj	82	11
	Jamboodwip	89	10
	Kalisthan	82	14

TABLE 6. Monthly total catch of fish (Kg) by the migratory bag-net fishery around Frasergunj\*

	November	December	January	February	Total
1968-69	1011517 (35.44)	1241497 (43.49)	485871 (17.02)	115600 (4.05)	2854485
1967-68	1079784 (34.73)	1069573 (34.41)	892051 (28.70)	67282 (2.16)	3108690
1966-67	1081365 (60.99)	480215 (27.08)	173610 (9.79)	37895 (2.14)	1773085
1965-66	697497 (40.22)	842139 (48.56)	191122 (11.02)	3489 (0.20)	1734247
1964-65	402192 (19.06)	1130846 (53.59)	526930 (24.97)	50072 (2.37)	2110040

\*Figures in brackets indicate percentages to total seasonal harvest by the fishery.

In availability as measured by C.P.U.E., Kalistan with a C.P.U.E. value of 56 Kg follows Bok-khali, the centre with highest C.P.U.E. value (85 Kg) Frasergunj and Jambo coming next with C.P.E.U. values of 35 Kg and 32 Kg respectively. It appears that remoteness and comparative lack of safety are probably the reasons for Kalisthan being not preferred by the fishermen as a camping spot in recent years, although availability is quite high at the centre.

#### Species composition of the harvest

The species-wise landings made by the migrant fishermen during different years are presented in Table 10. Evidently, (i) *Harpodon nehereus*, (ii) *Setipinna phasa*



TABLE 7 a - d. Monthly landings (kg) of dominant species by migratory bag-net fishery (Figures in brackets indicate percentage total catch of the species by the fishery during the whole season)

7 a. *Harpodon nehereus*

	November	December	January	February	Total
1968-69	478468 (37.87)	561040 (44.41)	185905 (14.71)	37977 (3.01)	1263390
1967-68	639779 (37.08)	617516 (35.79)	461779 (26.76)	6489 (0.38)	1725563
1966-67	582291 (68.98)	191577 (22.69)	51707 (6.13)	18589 (2.20)	844164
1965-66	318110 (37.00)	464347 (54.00)	75241 (8.75)	2004 (0.23)	859702
1964-65	205533 (23.25)	491372 (55.59)	160552 (18.16)	26489 (3.00)	883946

b. *Setipinna phasa* and *Setipinna taty*

	November	December	January	February	Total
1968-69	122936 (26.89)	223444 (48.87)	80370 (17.58)	30433 (6.66)	457183
1967-68	57724 (25.00)	58703 (25.43)	90746 (39.31)	23690 (10.26)	230863
1966-67	52979 (44.92)	28990 (24.58)	31369 (26.59)	4613 (3.91)	117951
1965-66	81686 (47.50)	67592 (39.30)	22436 (13.05)	268 (0.16)	171982
1964-65	37934 (15.37)	139852 (56.65)	63889 (25.88)	5196 (2.10)	246871

c. *Trichiurus haumela* and *Trichiurus savala*

	November	December	January	February	Total
1968-69	135611 (38.33)	137410 (38.83)	68832 (19.45)	11990 (3.39)	353843
1967-68	68311 (21.86)	118636 (37.96)	112538 (36.01)	13069 (4.18)	312554
1966-67	33303 (39.20)	26002 (30.60)	23211 (27.32)	2443 (2.88)	84959
1965-66	123399 (47.79)	100731 (39.00)	33862 (13.11)	213 (0.08)	258205
1964-65	22116 (14.53)	93593 (61.51)	34740 (22.83)	1710 (1.12)	152159

TABLE 7 contd.

## d. Prawns

	November	December	January	February	Total
1968-69	68779 (61.23)	24681 (21.97)	15135 (13.47)	3729 (3.32)	112324
1967-68	173625 (54.76)	91193 (28.76)	49039 (15.47)	3211 (1.01)	317068
1966-67	80047 (56.35)	49198 (34.63)	10576 (7.44)	2243 (1.58)	142064
1965-66	22714 (32.14)	29402 (41.60)	17943 (25.39)	606 (0.86)	70665
1964-65	75117 (31.22)	132119 (54.91)	30081 (12.50)	3296 (1.37)	240613

and *Setipinna taty*, (iii) *Trichiurus savala* and *Trichiurus haumela* and (iv) Prawns (of a number of species) dominate the catches, the average percentage shares of the four groups during 64-65 to 68-69 being 48%, 11%, 10% and 8% respectively. The other species indicated in Table 10 together constitute about 20% of the catch. *Harpodon nehereus* or Bombay-duck, locally known as 'nehere', 'lutea' or 'bombla', is the species caught in abundance. From Table 11 it is seen that the catch of this species was 8 to 9 hundred tonnes during the first three year but has increased in the last two years to 13 to 17 hundred tonnes. Removals by the winter migratory fishery account for 46 to 86% and 43 to 76% respectively of the total removals of the species during the whole year from the lower zone and the whole estuary showing the effectiveness of the fishery. Table 7 a shows the monthly catches during the 5-year period under review. November and December are the peak landing periods when 70 to 90% of the total seasonal harvest are reaped. The yield falls during January and is comparatively quite low in February (not more than 3% of seasonal total). Considering centrewise, the picture is similar to that noted for the total landings which is expected since the trends in total landings are determined to a great

TABLE 8. Total landing at different migratory fishing centres during 1964-65 to 1968-69 (Figures in brackets indicate percentage to seasonal harvest)

	Frasergunj	Bok-khali	Jamboodwip	Kalasthan	Total
1968-69	189245 (6.63)	1417813 (49.67)	1178607 (41.29)	68820 (2.41)	2854485
1967-68	465981 (14.99)	1442204 (46.39)	1068265 (34.36)	132240 (4.25)	3108690
1966-67	325075 (18.33)	919337 (51.85)	319943 (18.04)	208730 (11.77)	1773085
1965-66	362865 (20.92)	747071 (43.08)	292062 (16.84)	332249 (19.16)	1734247
1964-65	437808 (20.75)	816477 (38.69)	359256 (17.03)	496499 (23.53)	2110040

TABLE 8 a - d. Landings of dominant species at migratory fishing centres during 1964-65 to 1968-69

8 a. *Harpodon nehereus*

	Frasergunj	Bok-khali	Jamboodwip	Kalisthan	Total
1968-69	93013 (7.36)	625087 (49.48)	514482 (40.72)	30808 (2.44)	1263390
1967-68	234047 (13.56)	813409 (47.14)	603916 (35.00)	74191 (4.30)	1725563
1966-67	148506 (17.59)	471443 (55.85)	133163 (15.77)	91052 (10.79)	844164
1965-66	165426 (19.24)	481940 (56.06)	86841 (10.10)	125495 (14.60)	859702
1964-65	184304 (20.85)	353162 (39.95)	186148 (21.06)	160332 (18.14)	883946

b. *Setipinna phasa* and *Setipinna taty*

	Frasergunj	Bok-khali	Jamboo	Kalisthan	Total
1968-69	21354 (4.67)	265145 (58.00)	157656 (34.48)	13028 (2.85)	457183
1967-68	54241 (23.49)	116570 (50.49)	49150 (21.29)	10902 (4.72)	230863
1966-67	25109 (21.28)	57466 (48.72)	21444 (18.18)	13932 (11.81)	117951
1965-66	22187 (12.90)	42072 (24.46)	49535 (28.80)	58188 (33.83)	171982
1964-65	62066 (25.14)	95267 (38.59)	38009 (15.40)	51529 (20.87)	246871

c. *Trichiurus haumela* and *Trichiurus savala*

	Frasergunj	Bok-khali	Jamboodwip	Kalisthan	Total
1968-69	21262 (6.01)	131971 (37.30)	196621 (55.57)	3989 (1.13)	353843
1967-68	40552 (12.97)	151374 (48.43)	101847 (32.58)	18781 (6.01)	312554
1966-67	16762 (19.73)	42000 (49.43)	17231 (20.28)	8966 (10.55)	84959
1965-66	47178 (18.27)	80609 (31.22)	73741 (28.56)	56677 (21.95)	258205
1964-65	29014 (9.07)	55257 (36.31)	33125 (21.77)	34763 (22.85)	152159

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TABLE 8 *contd.*

d. Prawns

	Frasergunj	Bok-khali	Jambo	Kalisthan	Total
1968-69	7913 (7.04)	67887 (60.43)	33215 (29.57)	3309 (2.95)	112324
1967-68	39312 (12.40)	120866 (38.12)	151860 (47.90)	5030 (1.59)	317068
1966-67	23794 (16.75)	70962 (49.95)	29752 (20.94)	17556 (12.36)	142064
1965-66	43050 (60.92)	13519 (19.13)	5607 (7.93)	8489 (12.01)	70665
1964-69	4321 (18.00)	93589 (38.90)	27205 (11.31)	76498 (31.79)	240613

extent by *H. nehereus*. From Table 8 a showing the centrewise yields in different years, it may be seen that the catches in Bok-khali and Jambo have increased from 4-5 hundred tonnes and 1-2 hundred tonnes respectively during the first three years to 6-8 hundred tonnes and 5-6 hundred tonnes in the last two years. Frasergunj which yielded 1 to 2 hundred tonnes during the first 4 years decreased in yield to one hundred tonnes during the last year. Yields have steadily fallen at Kalisthan from 160 tonnes in 1964-65 to 31 tonnes in 1968-69. Part of these trends is accounted for by the changing pattern of migratory concentrations as already noted. However, the availability of the species at the centre or the richness of the centre is to be judged by the specific C.P.U.E. value for the centre. From Tables 12 a - d showing the centrewise average C.P. U.E. values over the different years for the dominant species, it is seen that C.P.U.E. for the species is highest at Bok-khali, followed by that at Kalisthan, C.P.U.E. values for Jambo and Frasergunj being lower than these. This shows that the fishing ground at Kalisthan is not being exploited to the same extent as those at the other spots, as revealed from the pattern of migration in recent years shown in Table 2. On the other hand Jambo is comparatively more exploited in relation to its C.P.U.E. values. The overall C.P.U.E. for the fishery in different years show that on the whole seasonal abundance of the species has increased progressively with years, except for 65-66 when it was damped (Table 13 a). The average monthly C.P.U.E. values steadily decrease from 37 Kg in November to 13 Kg in February which has been depicted graphically in Fig. 3.

*Setipinna* spp. : *S. phasa* and *S. taty* are locally called phasa. In the catch they are seen to occur together and their joint share in the catch can be more easily and more reliably estimated than their individual shares. The same considerations apply to *Trichiurus haumela* and *Trichiurus savala*, the fishery of which will be discussed later. Of the two *Setipinna* spp. the removals by the fishery in the different years vary (Table 11) between 118 to 457 tonnes for 34 to 76% and 31 to 68% of the total removals during the year in the lower zone and the entire estuary again showing the effectiveness of the fishery for these species also. Initially the landings decreased in the course of the first three years but during the last two years have increased beyond the initial value obtained in the first year. Peak landing periods (Table 7 b) are November and December, when 70 to 86% of the seasonal total is usually harvested out. The yield falls in January but not as markedly as for *H. nehereus*, although it falls almost as rapidly in February. Among the different centres, Bok-khali and Jambo have led (Table 8 b) in catches of the species

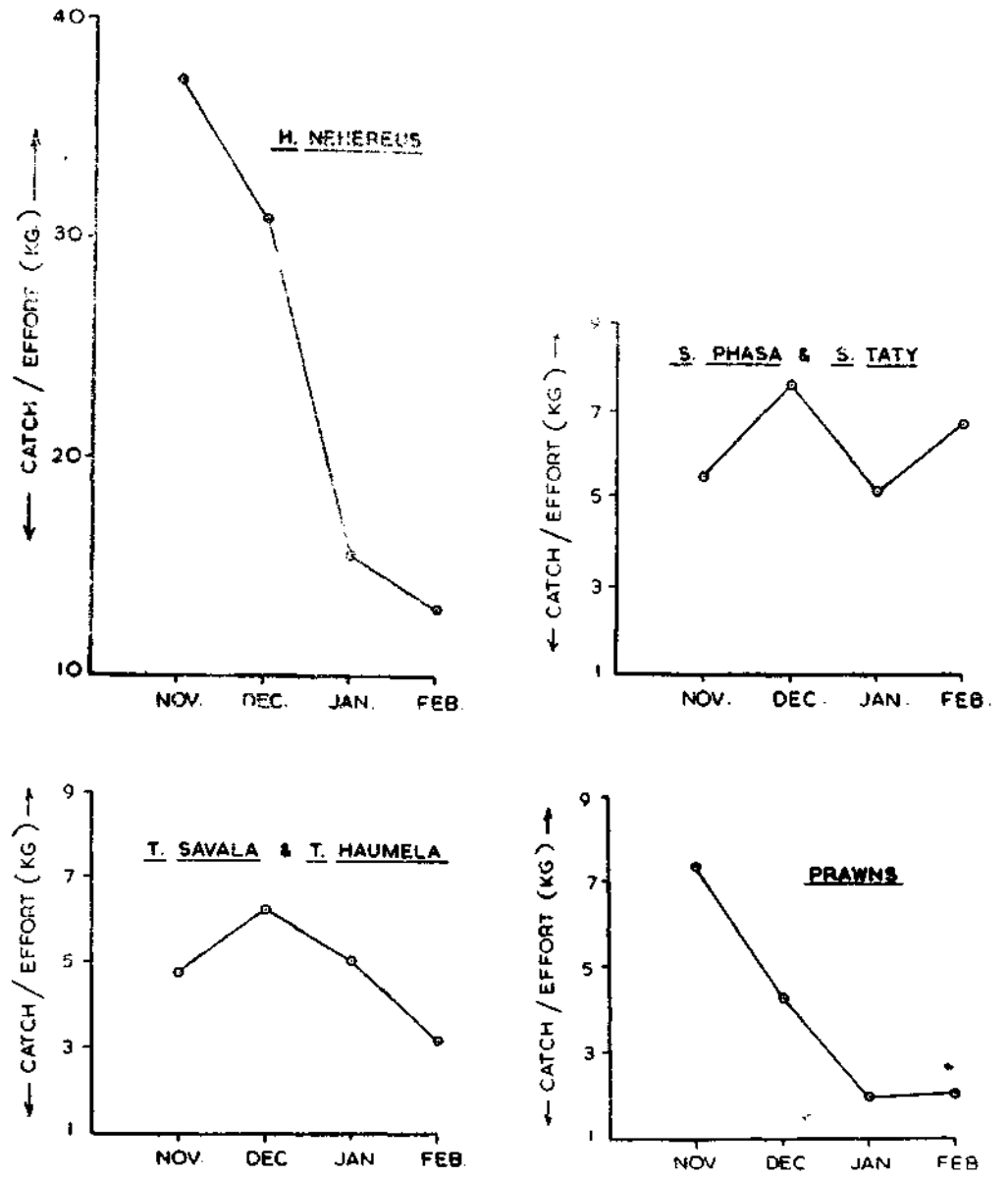


Fig. 3. Availability of *Harpodon nehereus*, *Setipinna phasa* and *S. taty*, *Trichiurus savala* and *T. haumela* and prawns to the migratory fishery in different months.

followed by Frasersgunj and Kalisthan. For Bok-khali, the catch which has varied between 42 to 95 tonnes in the first 3 years has increased to 12-26 tonnes in the last two years. Catch at Jamboo had remained within 21 to 50 tonnes during the first four years but has increased to 158 tonnes during the last year. At Frasersgunj, the catch of the species was 62 tonnes and 54 tonnes in 64-65 and 67-68; in the other years including the last year it was varying between 21 to 25 tonnes, so that on the whole there is a decline. At Kalisthan during the first 2 years 52 to 58 tonnes were landed which has fallen to 11 to 14 tonnes during the last 3 years, indicating a decline. The trends of landings over years are fairly well explained by the change in the pattern of migratory concentrations. On an average, availability of the species was highest (Table 12 b) at Bok-khali and gradually decreased at Kalisthan, Jamboodwip and Frasersgunj. The overall C.P.U.E. values in different years show (Table 13 b) that after an initial fall between 64-65 to 65-66, the seasonal abundance has steadily increased in the next 4 years. From the variation in monthly C.P.U.E. values averaged over years (Table 13 b) and in Fig. 3. The availability appears to remain more or less stable over the months, showing oscillations of small magnitude due to random fluctuations. This is a notable contrast in comparison to *H. nehereus* the availability of which steadily declines as the fishery progresses.

TABLE 9. Total catch per unit effort (in Kg) at different migratory fishing centres during 1964-65 to 1968-69

	Frasergunj	Bok-khali	Jamboodwip	Kalisthan	Average
1968-69	57.82	131.86	51.45	78.62	79.95
1967-68	39.55	85.02	35.08	80.54	60.05
1966-67	37.14	82.58	22.11	50.42	48.06
1965-66	18.35	36.68	16.80	28.36	25.05
1964-65	26.38	91.26	32.20	43.80	48.41
Total	179.24	427.40	157.64	281.74	
Average	35.85	85.48	31.53	56.35	52.30

*Trichiurus* spp. : *T. savata* and *T. haumela* are locally called as 'rupavati' and occur together in the catches. The quantities landed in the years 1964-65 to 1968-69 varied between 85 to 354 tonnes (Table 11). The catch has more or less steadily risen from 152 tonnes in 1964-65 to 354 tonnes in 1968-69 except for a slump in 1966-67 when it was 85 tonnes. The removals account for 56 to 89% and 54 to 88% of the total during the year in the lower zone and the whole estuary respectively. The months of peak landing are again November and December during which 60 to 87% of the total seasonal harvest is obtained. The yield generally falls in January but much less markedly compared to *H. nehereus*. In this respect it is more similar to the fishery of the *Setipinna* spp. However it falls as drastically in February (not more than 4% of seasonal total) as is noticed in the case of *H. nehereus*. The contributions of the landings at different centres to the total landings of these species are shown in Table 8 c whence it is seen that Bok-khali and Jamboo have led the other two centres in catches. In Bok-khali and Jamboo have led the other two centre in catches. In Bok-khali and Jamboo the catch varied between 42 to 80 tonnes and 17 to 74 tonnes respectively in the first 3 years which had increased to 132-151 tonnes and 102-197 tonnes at the two centres respectively during the last two years. Catch at Frasersgunj has shown a rise and fall in alternate years, the

landings being 17 to 29 tonnes at fall and 41 to 47 tonnes at rise. At Kalisthan catch was quite high in the two initial years, being 35 tonnes in 1964-65 and 57 tonnes in 1965-66. In the first year *i.e.* 1964-65 it was second only to Bok-khali in contribution while in 65-66 it was higher than Frasergunj. However in the next 3 years landings have decreased considerably remaining between 4 to 19 tonnes, being only 4 tonnes in 1968-69. The trends of landing at the centres over years is well related here also to the trends in the pattern of migratory concentrations (Table 2) so far as the centres Bok-khali, Jamboo and Kalisthan are concerned. The landing variations at Frasergunj are however not determined by the yearly strength of migration alone, the varying availability at the centre jointly with effort potential in the form of the number of existent bag-nets having determined the yield to a fair degree. The C.P.U.E. values had, on the whole, shown a rising trend Table 12 c and 13 c over years at all the centres and in the whole fishery, except for the year 1966-67 when there appears to have been a general depression in availability whose effect is most pronounced at Kalisthan and Jamboo. In average C.P.U.E. over the different years, Bok-khali is highest followed by Kalisthan, Jamboo and Frasergunj in that order. Hence, the recent trends in having a lower preference for Kalisthan is not related to the availability of these species at the centre. Availability appears to be highest in December. Corresponding to an average C.P.U.E. value of 6.28 Kg which gradually declines to about 3 Kg in February. In November and January, the availabilities on the average are about the same.

TABLE 10. *Specieswise landings in Kg by migratory bagnet fishery*

Species	1964-'65	'65-'66	'66-'67	'67-'68	'68-'69	% (Average)
<i>Harpodon nehereus</i>	883946	859702	844164	1725563	1263390	48.16
<i>Setipinna phasa</i> and <i>Setipinna taty</i>	246871	171982	117951	230863	457183	10.58
<i>Trichiarus haumela</i> and <i>Trichurus savala</i>	152159	258205	84959	312154	353843	10.03
<i>Prawns</i>	240613	70665	142064	317068	112324	7.60
<i>Siana biauritus</i>	59562	4654	131391	55397	92531	2.97
<i>Ilisha elongata</i>	14168	13514	18793	16316	33417	0.83
<i>Panna panna</i>	2480	36705	2019	5976	10104	0.49
<i>Osteogeneiosus militaris</i>	5600	2385	9110	3140	5907	0.23
<i>Siana miles</i>	4357	374	4942	4886	10703	0.22
<i>Paradisus paradivens</i>	4009	397	4765	3194	4140	0.14
<i>Tachysurus jella</i>	—	506	—	5350	4908	0.09
<i>Hilsa toli</i>	2446	3288	355	353	755	0.06
<i>Coilia ramavati</i> and <i>Coilia borneensis</i>	1353	505	1896	1837	575	0.05
<i>Sillago panijus</i>	897	1135	2136	1352	212	0.05
<i>Stromateus cinereus</i>	1194	—	152	1953	173	0.03
<i>Pangasius pangasius</i>	231	371	252	—	1260	0.02
<i>Polydactylus indicus</i>	57	5	410	113	521	0.01
Others	490097	309854	407726	422775	502539	18.42
<b>Total</b>	<b>2110040</b>	<b>1734247</b>	<b>1773085</b>	<b>3108690</b>	<b>2854485</b>	<b>99.98</b>

*Prawns* : The prawns *Parapenaeopsis sculptilis*, *Palaemon tenuipes*, *Metapenaeus brevicornis*, *Palaemon styliferus* and *Acetes indicus* occurred in migratory bag-net fishery. The total yearly prawn landing during the 5 years varied between 71 tonnes to 317 tonnes (Table 11). This accounts for 13 to 45% and 8 to 25% of the total prawn landing during the whole year in the lower zone and whole estuary respectively. The peak landing periods are November

and December during which 73 to 90% of the entire seasonal total is harvested (Table 7). The catch falls markedly in January and is comparatively insignificant (1 to 3%) in February. Over the years, Bok-khali has contributed the maximum prawn catches amongst the centres (Table 8 d). In the first year Kalisthan contributed the highest (32%), Frasergunj and Jamboo following with 18 and 11% respectively. In the second year, Frasergunj topped in contribution with 61% of total landing, Bok-khali, Kalisthan and Jamboo following

TABLE 11. Landings of the dominant species in winter migratory fishery along with landings of the same species in the zone and whole estuary during the year. (Figures in brackets indicate relevant percentages formed by the winter fishery landings)

	1968-'69	'67-'68	'66-'67	'65-'66	'64-'65
<b>Prawns</b>					
Winter fishery	112324	317068	142064	70665	240613
Lower zone	483066 (23.25)	711011 (44.59)	580161 (24.49)	537879 (13.14)	736588 (32.67)
Whole estuary	1067294 (10.52)	1293203 (24.52)	1049495 (13.54)	857374 (8.24)	997809 (24.11)
<b><i>Trichiurus savala</i> and <i>Trichiurus haumela</i></b>					
Winter fishery	353843	312554	84959	258205	152159
Lower zone	397661 (88.98)	356068 (87.78)	152245 (55.80)	388854 (66.40)	179109 (84.95)
Whole estuary	403193 (87.76)	364560 (85.73)	156319 (54.35)	393295 (65.65)	189368 (80.35)
<b><i>Setipinna phasa</i> and <i>Setipinna taty</i></b>					
Winter fishery	457183	230863	117951	171982	246871
Lower zone	598194 (76.43)	420104 (54.95)	347452 (33.95)	369909 (46.49)	339383 (72.74)
Whole estuary	670617 (68.17)	473443 (48.76)	485814 (30.57)	439983 (39.09)	395931 (62.35)
<b><i>Harpodon nehereus</i></b>					
Winter fishery	1263390	1725563	844164	859702	883946
Lower zone	1619324 (78.02)	2008907 (85.90)	1192601 (70.78)	1346465 (63.85)	1938047 (45.61)
Whole estuary	2549703 (49.55)	2263632 (76.23)	1327934 (63.57)	1505930 (57.09)	2054776 (43.02)

(maximum concentration of nets during the 5 years took place in Frasergunj in this year). However from the third year the catch contribution has declined at Frasergunj; contribution of Kalisthan where the concentration has become thinner with years has also fallen markedly over the years, particularly in the last two years (2 to 3% of total). At Jamboo the catch on the whole has shown an increasing trend over the years except for the last year. The fluctuations are to be looked for in the changing pattern of concentrations (Table 2) and the trends in availability (Table 12 d). At Frasergunj the availability as measured by C.P.U.E. has remained more or less stable over the years and hence its total prawn landing has followed the pattern of concentration at the centre over years. At Bok-khali C.P.U.E. was very high (12 Kg) at the first year which fell to strikingly low value (1.0 Kg) the next year. Although not commensurately, concentration increased in the second year and had continued to increase till the last year. Hence total prawn catch fell from the 1st to the 2nd year at Bok-khali. In the next 3 years C.P.U.E. has gone up (6 to 8 Kg)



and concentration has continued to increase as a result of which prawn catch at Bok-khali has risen. Availability at Kalisthan varied in a fashion similar to Bok-khali but concentration decreased rapidly and steadily. Hence catch in the second year is particularly poor; although it increased in the next year due to rise in C.P.U.E. this was not maintained and the catch continued to fall later due to lack of effort or concentration. At Jamboo the C.P.U.E. fell to a very low value in the second year (1965-66) which appeared to be a year of general depression for all centres but markedly for the centres other than Frasergunj. In spite of the increase in concentration, the contribution has been the poorest of all years for Jamboo in 1965-66.

TABLE 12 a - d. C.P.U.E. values at the different centres in various years in respect of dominant species in the migratory bagnet fishery (in Kg)

12 a. *Harpodon nehereus*

Year	Frasergunj	Bok-khali	Jamboodwip	Kalisthan
1968-69	28.81	54.12	28.51	46.90
1967-68	18.62	45.08	22.12	46.88
1966-67	17.10	54.77	12.76	22.10
1965-66	8.98	28.54	7.60	11.20
1964-65	11.78	39.97	17.87	18.95
Average	17.06	44.50	17.77	29.21

12 b. *Setipinna phasa* and *Setipinna taty*

Year	Frasergunj	Bok-khali	Jamboodwip	Kalisthan
1968-69	6.67	27.24	8.31	17.16
1967-68	5.26	8.94	2.18	5.93
1966-67	3.11	6.21	1.86	3.00
1965-66	1.21	2.59	3.60	5.25
1964-65	3.56	10.52	4.52	5.91
Average	3.96	11.10	4.09	7.45

12 c. *Trichiurus savala* and *Trichiurus haumela*

Year	Frasergunj	Bok-khali	Jamboodwip	Kalisthan
1968-69	6.23	12.67	10.35	5.60
1967-68	4.08	8.95	4.03	10.21
1966-67	1.90	4.42	1.58	2.14
1965-66	2.03	4.93	5.32	5.32
1964-65	1.53	5.77	2.98	3.80
Average	3.15	7.35	4.85	5.41

12 d. Prawns

Year	Frasergunj	Bok-khali	Jamboodwip	Kalisthan
1968-69	2.49	5.62	1.87	6.34
1967-68	3.05	7.07	5.73	3.33
1966-67	2.73	7.71	2.52	3.94
1965-66	2.43	0.94	0.48	0.82
1964-65	2.67	12.06	2.40	9.65
Average	2.67	6.68	2.60	4.82

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TABLE 13. Average monthly total catch per unit effort (Kg) for the migratory bagnet fishery in different years

	November	December	January	February	Average
'68-'69	88.79	113.89	57.08	59.99	79.94
'67-'68	70.44	62.16	69.87	37.71	60.04
'66-'67	124.28	31.39	18.72	17.85	48.06
'65-'66	29.62	39.16	16.60	14.82	25.05
'64-'65	42.74	80.63	45.10	25.18	48.41
Average	71.17	65.45	41.47	31.11	52.30

TABLE 13 a - d. Monthly catch per unit effort (Kg) in respect of dominant species for the winter bagnet fishery around Frasergunj

a. *Harpodon nehereus*

	November	December	January	February	Average
1968-69	42.03	48.74	21.32	28.73	35.20
1967-68	41.69	36.25	30.26	3.10	27.82
1966-67	66.59	12.86	6.19	8.42	23.52
1965-66	14.17	21.22	6.29	9.92	12.90
1964-65	21.90	35.71	14.12	15.26	21.75
Average	37.28	30.96	15.64	13.09	24.24

b. *Setipinna phasa* and *Setipinna taty*

	November	December	January	February	Average
1968-69	9.91	19.63	8.28	19.52	14.34
1967-68	3.79	3.15	6.64	7.29	5.22
1966-67	5.58	2.08	3.14	2.73	3.38
1965-66	3.45	3.52	2.12	1.33	2.60
1964-65	4.93	9.69	5.78	2.98	5.84
Average	5.53	7.61	5.19	6.77	6.28

c. *Trichiurus haumela* and *Trichiurus savala*

	November	December	January	February	Average
1968-69	8.92	12.23	7.04	7.72	8.98
1967-68	4.01	5.99	9.66	4.21	5.97
1966-67	3.44	1.81	2.31	1.97	2.38
1965-66	4.81	4.86	3.25	1.05	3.49
1964-65	2.53	6.51	2.85	1.00	3.22
Average	4.74	6.28	5.02	3.19	4.81

d. Prawns

	November	December	January	February	Average
1968-69	6.26	2.54	1.72	2.72	3.31
1967-68	9.68	4.68	3.05	1.16	4.64
1966-67	8.94	3.29	1.18	1.85	3.82
1965-66	0.88	1.22	1.52	3.00	1.66
1964-65	10.94	9.50	2.45	1.74	6.16
Average	7.34	4.25	1.98	2.09	3.92

However, in the next 3 years the increase in concentration continued but increase in C.P.U.E. took place upto 67-68 after which there had been a sharp fall. Hence the total prawn catch increased to 30 tonnes and 152 tonnes in 66-67 and 67-68 respectively but fell to 33 tonnes again in 1968-69. Here again on the average highest availability has been recorded at Bok-khali, next being Kalisthan. Availability at Frasergunj and Jamboo were same. Year of highest availability (6.2 Kg in terms of C.P.U.E.) for the entire fishery was 1964-65 (Table 13 d) and in the next year availability was the lowest (1.7 Kg in terms of C.P.U.E.). In the next three years availability has improved to 3 to 5 Kg with an increase in C.P.U.E. (Table 13 d). It is noticeable that it steadily falls from 7.34 Kg in November to 1.98 in January remaining more or less at the same value in February.

*Disposal* : As already observed the season comes to a close about the middle or end of February when the south wind starts making operation of bag-nets difficult and unsafe. The catch landed during the season is mostly sun-dried barring the more economic species like Hilsa (*Hilsa ilisha*), pomfrets (*Stromateus cinereus* and *S. niger*), etc., which are caught in comparatively small numbers and sold out to fish merchants or their agents in the area. The dried fish are stacked in the 'Khuti's and boat-loads of them are periodically sent to marketing centres chiefly to the dry fish marketing centre of Uluberia from where further distribution to other markets takes place through dry-fish traders.

#### DISCUSSION

It has been emphasized that the short phase migratory fishery is very intensive in which about 300 men with 1000 units participate and a high percentage of total annual catch is obtained. However, from the study of C.P.U.E. values it is seen that excluding prawns, over the years the C.P.U.E. values have increased for the dominant species which the fishery removes in heavier proportions as well as for the total of all species. Further, the total catch in respect of the dominant species and for the sum total of all available species have also increased. Since the region exploited comprises the major grounds of exploitation in the whole estuarine system regarding the stocks corresponding to the dominant species it appears that no adverse effect on these stocks has been caused by the intensive removal and there is scope for exploitation at a higher rate. For prawns, it is found (Table 13 d) that C.P.U.E. in respect of total of all available species fell to a rather low value in 65-66 from the previous value in 64-65 but has again risen in the next two years and then has fallen a little in 1968-69.

The effort input in the migratory fishery is not distributed in the best possible way. Kalisthan, a comparatively rich centre is not being exploited properly, the concentration of migrants being relatively very small at the spot in recent years. The reasons which disfavour the site should be investigated for proper exploitation of the adjoining fishing ground.

It may be thought that but for the onset of south wind, this lucrative fishery might have continued for quite some months. But this does not appear very sound from a number of considerations. The graphs of C.P.U.E. are typified by a drastic fall in February in respect of all the dominant species and a similar picture holds for the total catch also from which it appears that the margin of profit will fall to an attractive value in the immediate future. If, as is quite reasonably thought, the increased abundance results mainly from the winter bloom of plankton causing a feeding migration of fish and prawn, the local abundance will decrease rapidly in the future months.

Such large-scale drying is not noticed in this estuarine fishery anywhere else except at the migratory bag-net fishing centres of winter. This fishery is the backbone of the most important dry fish industry relative to the Hooghly Estuary supporting a great many people directly and indirectly. Some of the species which are caught in high abundance like *H. nehereus*, *T. savala* and *T. haumela* do not rank high in demand as fresh fish in the markets of West Bengal, whereas these have good demand as dry fish in a number of markets outside West Bengal.

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