THE BOTTOM TRAWL FISHERY

by

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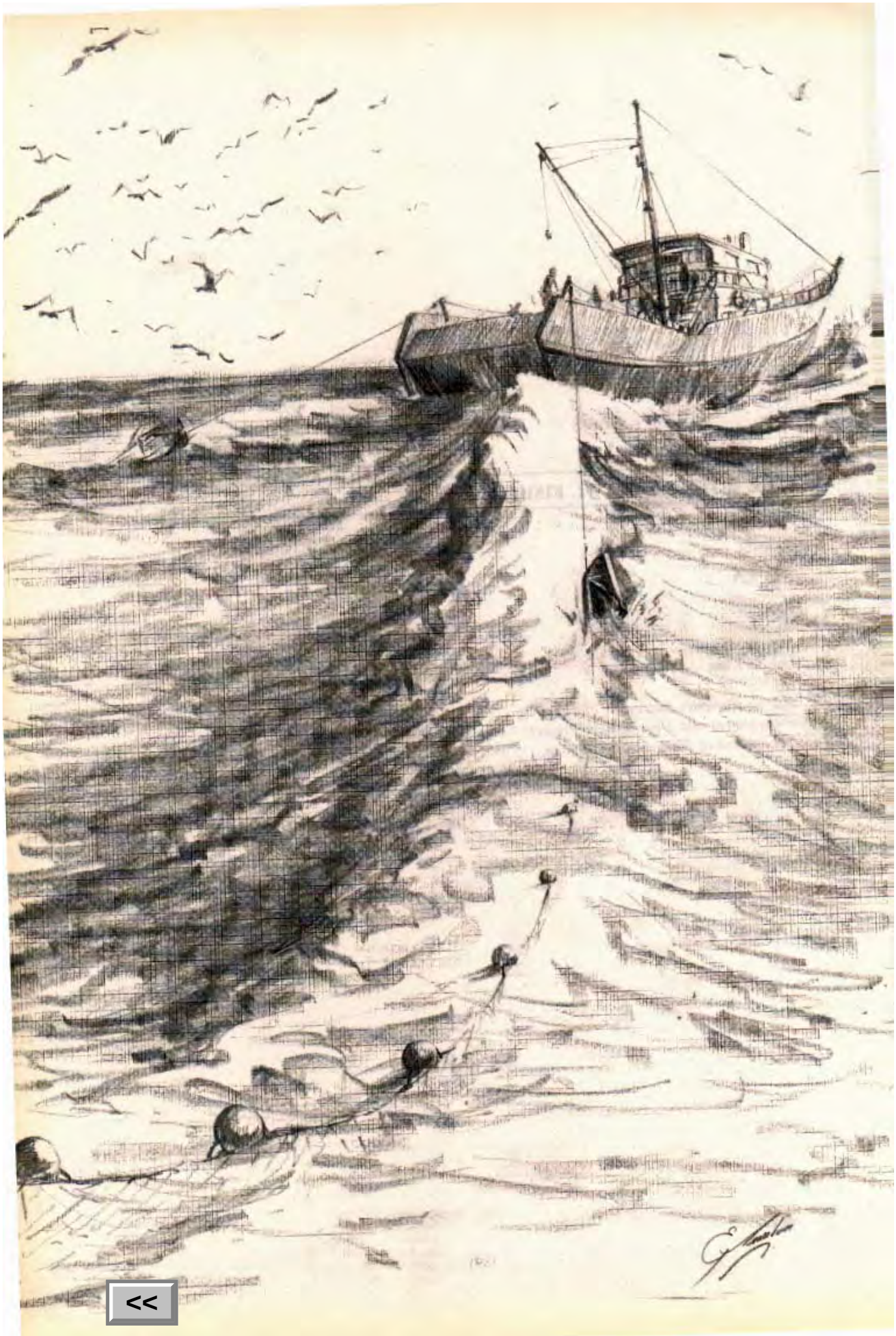

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31. *INTRODUCTION*

Commercial trawling with large vessels (21-41 m length) commenced around 1978/79 in Bangladesh. Initially there were only four trawlers, but there was a rapid increase to about 130 in 1980-81, as a result of a joint venture with Thailand. The fleet size declined after a few years and only about 50 were in operation in the late 1980s. Though all the vessels initially were shrimp trawlers, finfish trawlers increased to 46. as against 27 shrimp trawlers, in 1983-84. But by the late 1980s, there were 31 shrimp trawlers, 10 finfish trawlers and 8 combination trawlers.

Shrimp production increased from 240 tin 1978/79 to 5500 tin 1983-1985. It thereafter declined to around 3,000 t in 1990. Finfish landings increased from 1,300 t in 1978/79 to 7,400 t in 1986/87 and has fluctuated since then. However, *50-65* per cent of the finfish caught as by-catch are being discarded at sea.

The Bangladesh Department of Fisheries (DOF) has been concerned about the impact of the dramatic increase in trawl fishing effort on the resources (White and Khan, 1985a). Various estimates of maximum sustainable yield (MSY) have been made for penaeid shrimp and demersal finfish in Bangladesh waters. For shrimp, it ranged from 9.000t (West 1972) to 2,100 t for poor recruitment years (Penn. 1982). For demersal finfish, it is estimated to be 10,000-14,000 t (Penn, 1982).

The Marine Fisheries Survey and Development Project conducted numerous survey cruises and operated both shrimp and finfish trawis on the DOF's r.v. *Anusandhani* and r.v. *Matsuranga* between 1985 and 1990. These surveys were conducted to assess the stocks which were basic for development and exploitation of the marine resources.

The principal species caught in the trawl fishery are, among the shrimp, the Brown Shrimp *(M. monoceros)* and Tiger Shrimp ***(P.** nionodon)* (Mustapha ***et** al* .1987). Major contributions to the finfish catches are Silver and Black Pomfret *(Pampas argenteus* and *Forrnio niger),* Grunts *(Poniadasvs* spp.). Indian Salmon *(Polvnenius* spp.), Snapper ***(Lurjanus*** spp.). Goatfish (Mullidae), Croaker (Sciaenidae). Mackerel *(Rasrrelliger* spp.), Lizardfish *(Saurida* spp.) and Hairtails/Ribbon-fish *(Trichiurus* spp.) (Lamboeuf 1987 and Khan et a!. 1989).

This study was undertaken to estimate and/or determine:

- Fishing effort:

  Catch and species composition;

  Biological parameters of important shrimp and finfish species, such as growth, mean length at recruitment, size at first maturity, fishing mortality, etc.

- Cost and revenue in the trawl fishery;

  Ecology of the fishing area; and

  Seasonality in abundance.

32. *MATERIAL AND METHODS*

Data from trawl surveys (1988-1989) conducted by r.v. ***Anusandhani*** and r.v. *Machrranga* were used to establish detailed species and size compositions in the respective trawlnets: by fishing grounds, depth ranges and seasons covered by the commercial shrimp and finfish trawler fleets. Catch data from the commercial fleet in more recent years, compiled for routine production estimates, were used along with the detailed percentage species compositions from the survey data, to estimate catch rate and production of individual species.

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32.1 *The gear*

SHRIMP TRAWL

Two shrimp trawlnets of the same size were operated from outriggers on either side *of* the vessel. Each net had a headrope of 15.2m and a groundrope of 18.6m. The codend mesh was 45mm.

Detailed description of the gear is given in Mustafa *et* al. 1987. The gear was operated at a speed of 3 n miles/hr by a 900 hp trawler of 32.4m overall length. Except for a slight difference in size, the shrimp trawl used was similar in design to the commercial net.

FISH TRAWL

The trawlnet used was an Engel's high opening trawl with a headrope of 57.5m and a groundrope of 18.6 m length. The codend mesh was 32 mm. Detailed description of the gear is given in White, T.F., 1985. The design and dimensions of the finfish trawl used during the survey was similar to the net used by commercial trawlers.

32.2 *Selection of survey cruises*

The trawl survey did not cover all the twelve months in any calendar year. Since there was no evidence of significant differences in the species composition in the trawl catches, the data of 1985 and 1986, with best coverage of areas and seasons, were used in estimating the percentage species composition. The schedule of survey cruises and depth ranges was as follows

Cruise type by gear	*Depth range (metre)*	*Month covered*	
		1985	*1986*
Shrimp trawl	< 30	Nov.	Jan.. Feb.. Mar.. Apr.. Jul.
	30-80	Aug.. Oct.. Nov.. Dec.	Jan., Feb.. Mar.. Apr., Jul.
Fish trawl	< 30	Jul., Sep.. Oct.	Jan.. Feb.. Mar.. Apr.. May.. Jun.
	30.80	Jul.. Aug.. Sep.. Oct.	Jan., Feb., Mar.. Apr.. May.. Jun.

32.3 *Selection of survey stations*

Although the survey with finfish and shrimp trawls covered all possible depth ranges from 10 to 80 m, only those stations falling within the trawling grounds of the commercial trawlers were selected for analysis. This was done to improve the compatibility of the catch and size composition in the commercial and survey trawls. The data from the selected stations were classified into two depth-wise strata — < 30m and 30-80 m. The number of stations from which the data were selected for analysis is recorded alongside

Catch by species, fishing effort and length frequency data collected at these stations were used in the analysis.

Type of trawl	*Strata (depth in m)*	*No.of stations*
Shrimp	< 30	40
	30-80	136
Fish	< 30	49
	30-80	81

32.4 *Data analysis*

The distribution of the stations in the two depth ranges are shown in Figures 34 and 35.

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Fig. **34. Shrimp trawl stations surveyed in the 30m(o) and 30 - 80m (•) depth ranges.**

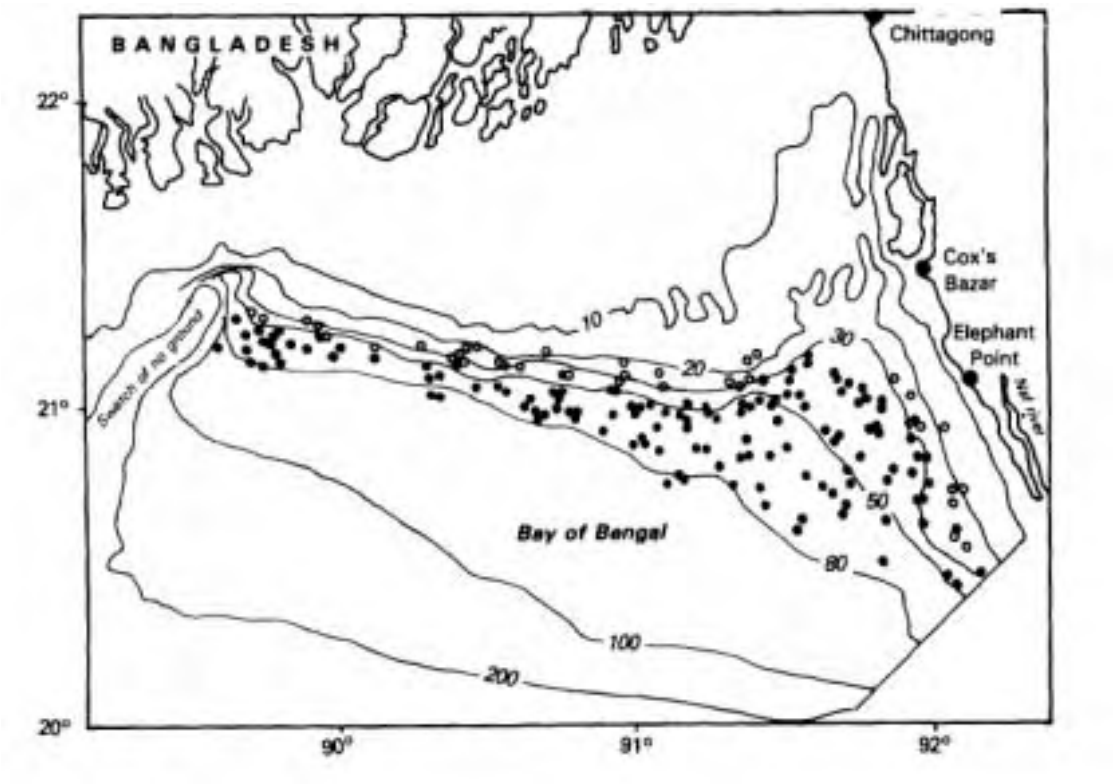
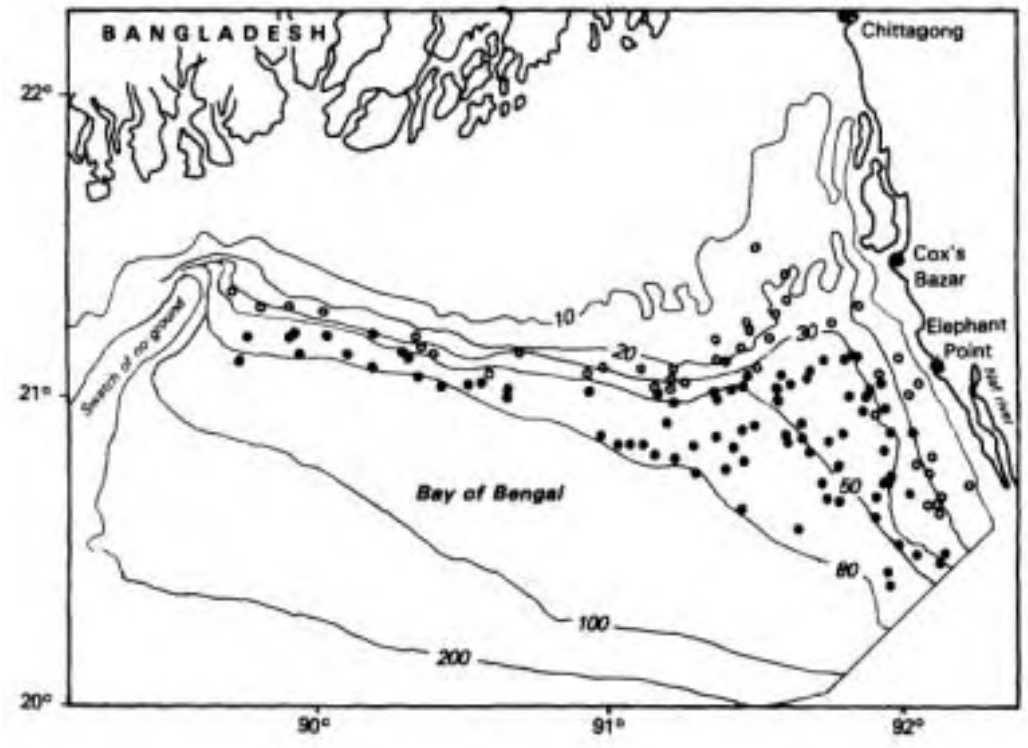


Fig 35. Finfish trawl stations surveyed in the 30m (o) and 30 - 80m (•) depth ranges



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A Hewlett Packard 86B and a Tandon 286SX/20 microcomputer were used to analyze the catch data and to prepare the graphs.

SPECIES COMPOSITION AND PRODUCTION

Species composition and catch rate (kg/hr) were determined for each month and depth stratum. using the survey and commercial catch data. Commercially valuable species were further analyzed to identify the pattern of spatial distribution of fish and shrimp. Monthly species composition of penaeid shrimp in the shrimp trawl surveys, at depths between 30 and 80m, were used as the basis to estimate the catch rate for the various shrimp species in the commercial catches. Annual production of each species, by shrimp trawls, was then obtained by multiplying the estimated catch rate of species (kg/hr) by the total standardized trawling effort (hr) of the shrimp trawl. However. due to tack of survey data for May, June and September the annual species composition was estimated without data for these three months. It was assumed that this would not signit'icantly affect the estimates of production. Schaeffer and Fox models were applied to the commercial catch and effort data for 1982-1990 in order to estimate the MSY.

Commercial catch data of shrimp were available by species for Tiger. White and Brown Shrimp and 'other' categories, while the finfish were separated into 'discarded' and 'retained'. This categorization was useful in checking the estimate production of penaeid shrimp and for taking the discarded by-catch into consideration for composition and overall catch rate.

BIOLOGICAL PARAMETERS

Length-frequency data of selected, commercially valuable species were analyzed using ICLARM'S IBM version of 'complete ELEFAN version 1.11' to estimate growth parameters, mortality rate, selection pattern, recruitment pattern and yield per recruil. Length-weight relationships were also established for ten species, using the LFSA package (Length Frequency Based Stock Assessment) (Sparre, 1987).

Catch rates of penaeid shrimp and finfish, by depth range, were estimated in terms of kg/hr for shrimp trawl and kg/30 min for finfish trawl. Distribution patterns were also studied for a few of the penaeid shrimp and finfish. Total production by the shrimp trawl for the year 1989-90 and the MSY was also estimated using commercial catch and effort data for the period 1981 to 1991. A similar attempt was made for the finfish catch also.

33. *RESULTS*

33.1 *Species composition*

IN THE SHRIMP TRAWL CATCH

The shrimp trawl catch included eleven species of shrimp and spiny lobsters, 15 species of commercially valuable finfish species/groups, 38 species/groups of species classified as by-catch, 28 species classified as trash fish and about eight other commercially important species/groups which were sometimes discarded.

Major species of penaeid shrimp were Brown Shrimp, Tiger Shrimp, Indian White Shrimp and Banana Shrimp. Noteworthy commercially high-valued finfish were Tigertooth Croaker. Blotched Croaker, Bombay Duck, Lizardfish, Goatfish and Ilisha Shad.

Ponyfish, small sizes of Lizardfish, Goatfish, Croakers, Tripodfish, Pufferfish, Squilla, Swimming Crab and small molluscs and Flatfish were considered trash fish. Cuttlefish, squid, octopus, shark and ray are also discarded by some.

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The number of species or groups of species of the five categories mentioned above and their percentage by weight in the total shrimp trawl catch by depth range was as follows:

Categories	*Shrimp trawl*			
	<30 m depth range		*30 . 80 m depth range*	
	Appx. No, of spectes	*Percentage in the catch*	*Appx. No. of species*	*Percentage in the catch*
Shrimp + lobster	11	1.5	11	4.8
Commercial finfish	15	10.0	IS	12.0
By-catch	3]	56.0	38	48.0
Trash fish	18	20.5	28	26.0
Others	8	12,0	8	9.2
Total	**83**	**100**	**100**	100

There was a noticeable decline in the relative proportion of White Shrimp and an increase in the proportion of Brown and Tiger Shrimp in the 30-80 m depth range compared to those in the depth range below 30 m. Among commercially valuable finfish species, an increase in the relative proportion of Ribbonfish/Hairtail, mackerel and Silver Pomfret were evident in the depth range 30-80 m. Croaker continued to maintain a relatively high proportion both in the <30 m and 30-80 m depth ranges. Among the by-catch species, Threadfin Bream, and Tongue Soles were significantly more in the 30-80 m depth range than in the <30 m depths. More trash fish were present in the catches from the 30-80 m depths than from in the < 30 m depths. The proportion of trash fish also increased with the catch. Ponyfish and Silver Biddies were conspicuous among the trash fish. Occurrence of 'other' species discarded were more or less similar in both depth ranges.

IN THE FINFISH TRAWL CATCH

All shrimp species caught by the shrimp trawl in the 30-80 m depth range were also observed in the finfish trawl catches, but only six of the species were present in the finfish trawl catches made in the <30 m depth. Smaller penaeid shrimp *(Metapenaeus* spp. and *Parapenaeopsis* spp.) were caught in relatively higher proportions at depths < 30m. In the 30-80 m depth range, the Tiger and Brown Shrimp were relatively more. Though most of the penaeid shrimp were also caught in the finfish trawl, their percentages were much less than from the shrimp trawl catches.

Among the commercial finfish catches, croaker occurred occasionally, unlike in the shrimp trawl catches, hut Indian Salmon. grouper. grunt, pomfret and Ribbonfish showed relatively higher proportion even in the shallow waters (<30 m). In the 30-80 m depth, Ribbonfish formed a very significant portion, followed by three species observed in the relatively shallow waters. The by-catch category included species which also increased with the increase in fishing depth. Indian Mackerel and False Trevally in the <30 m depth and Seabream in the 30-80 m depth were significant additions found in the finfish trawl catches.

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Trash fish species showed hardly any difference in the number of species caught in the two depth ranges, but a significantly higher percentage was observed in the <30 m depth range. Approximate numbers of species and their percentages under the five categories and in the two depth ranges were as follows:

Fin/Ish trawl

Categories	*<30 m depth range*		*30 - 80 rn depth range*	
	Appx.No. of species	*Percentage in the catch (hr wt)*	*Appx.No. of species*	*Percentage in the catch (by wt)*
Shrimp + lobster	6	0.6	11	0.5
Commercial finfish	20	9.0	20	17
By-catch	43	48	50	55
Trash fish	24	37	24	24
Others discarded	8	5.4	8	3.5
Total	101	100	**113**	100

33.2 *Catch rate*

OF SHRIMP IN THE SHRIMP TRAWL

In the shrimp grounds of < 30 m depth, the annual mean catch rate was estimated at 5.7 kg/hour. It was 7.5 kg/hr in the 30-80 m depth.

The seasons of peak catch rates for different shrimp varieties in the two depth ranges are summarized below. Monthly variations are shown in Figures 36, 37 and 38 (facing page).

Categories	*< 30m depth range*	*30-80m depth range*
a) All shrimp	Apr., Jul.	Aug.. Dec-Feb. (secondary peak)
b) Brown Shrimp	Apr.. Jul.	Aug-Feb.
c) White Shrimp **(sporadic** occurrences)	Jul.	Jan.. Jul. and Aug.
d) Other penaeids	Aug.	Dec-Jan.

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Fig **36. Catch** rates **(kg/hr) of** penaeid **shrimp in** the **shrimp trawl,** during different months **and** In the < **30m and 30** - 80m **depth ranges**

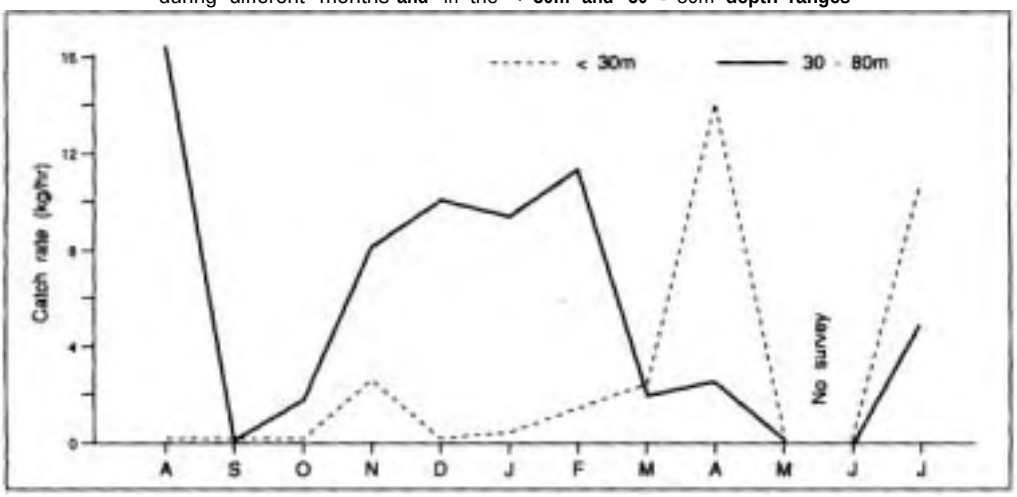


Fig **37. Catch** rates **(kg/hr) of penaeld shrimp in** the **commercial shrimp trawl during** 1988-'89

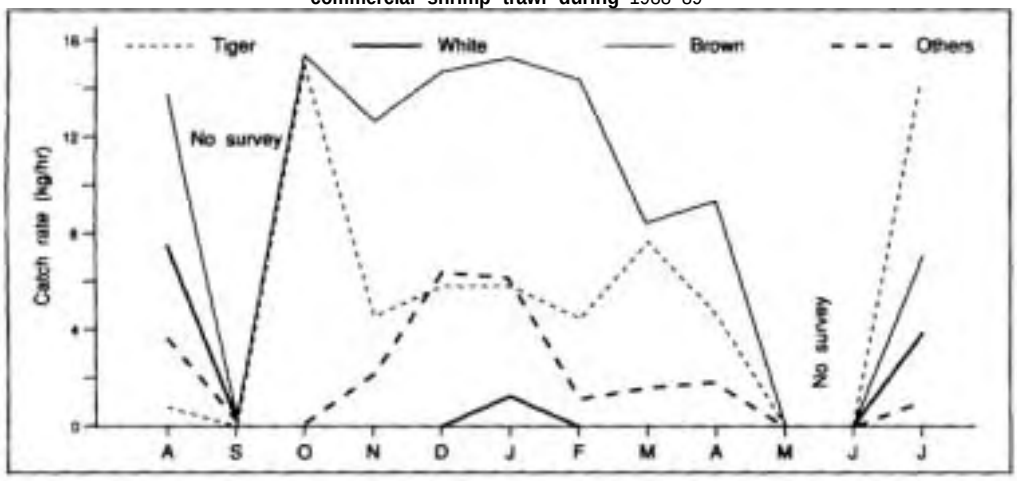
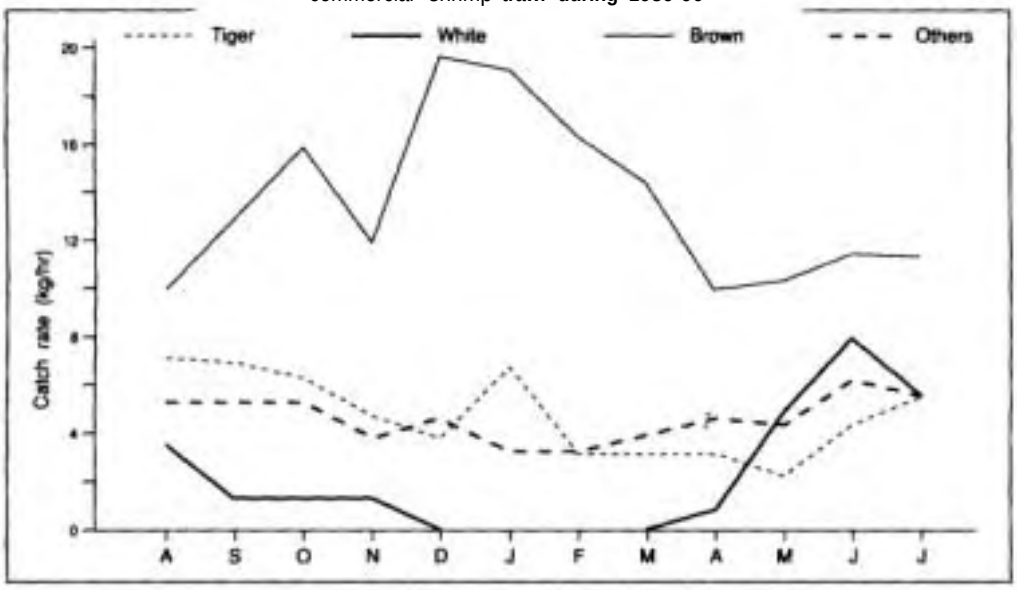


FIg 38. Catch rates (kg/hr) **of penaeid shrimp in the** commercial shrimp **trawl during** 1989-90



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OF FINFISH IN THE SHRIMP TRAWL

The annual mean catch rate of different categories of finfish in the shrimp trawl catches, peak season and main contributors to the peak catch rates are summarized separately, below, for the two depth ranges. Monthly variations in catch rates are shown in Figures 39, 40 and 41 (facing page).

	< 30 m Depth range			*30 - 80 m Depth range*		
Categories	*Annual catch rate kg/hr*	*Peak season and catch rate*	*Major contributors*	*Annual catch rate kg/hr*	*Peak season and catch rate*	*Major contributors*
a) High value finfish	3.3	Jul. (114)	Grunt	2.3	Jul./Aug.(30)	Croaker
b) Low value finfish	188	Apr. (303) Jul. (281)	Croaker Catfish Lizardfish Tongue Sole Small Grunt	67	Feb. (100) Jul. (100)	Threadfin Bream
c) Trash fish	68	Apr. (186)		34	Apr. (80)	
d) Other discards	39			19		

OF SHRIMP IN THE FINFISH TRAWL

Penaeid shrimp catches were extremely low in the finfish trawls operating in < 30 m depth (0.7 kg/30 min) and > 30 m depth (1.3 kg/hr). They recorded nil catches in most months.

OF FISH IN THE FINFISH TRAWL

The mean annual catch rates of different categories of finfish in the finfish trawl catches and the peak months are summarized below:

	< 30 m Depth		*30 - 80 m Depth*	
Categories	*Annual catch rate (kg/hr)*	*Peat season and catch rate*	*Annual catch late (kg/hr)*	*Peak season and catch rate*
a) High value finfish	16.4	Feb. (17) May. (17) Sep. (17)	24.7	Mar. (40) Aug. (25)
b1 Low value by-catch	75	Jul. (232) Mar. (105)	75	Sep. (208)
c Trash fish and other discards	69		48	

Catch rate of finfish showed a decline with increasing depth. The predominant finfish variations in different depth ranges were as follows:

Depth	*10-20m*	*20-50m*	*50-80m*	*50-100m*
kg 30 min haul	*119*	*84*	*53*	*30*
	Croaker	Croaker	Catfish	Threadfin/Bream
	Catfish	Catfish	Goatfish	Mackerel
	Ray	Ponyfish	Threadfin/Bream	Lizardfish
	Grunt	Ribbonfish	Scad	Scad

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Fig 39. Catch rates (kg/hr) of finfish in shrimp trawl catches, during different months and in < 30m and 30 - 80m depth ranges

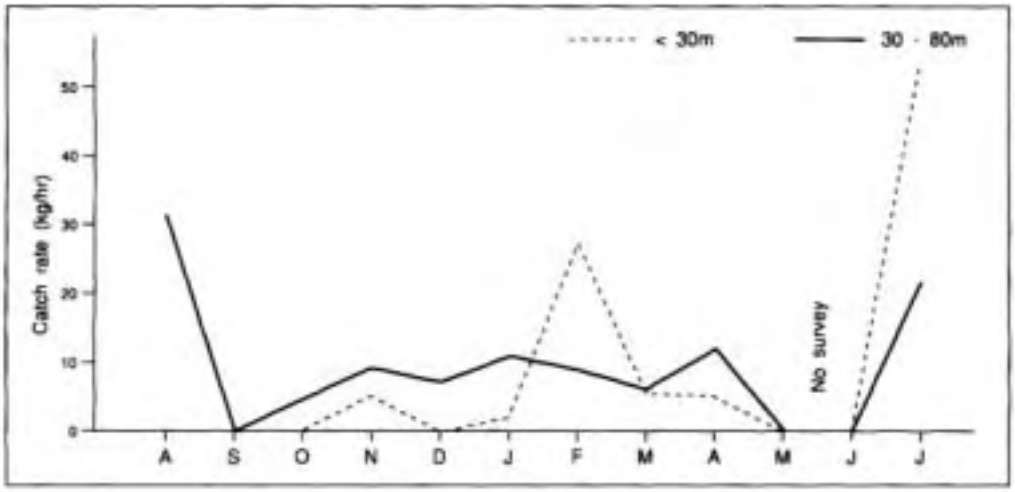


Fig 40. Catch rates (kg/hr) of finfish by-catch in shrimp trawl catches, during different months and in < 30m and 30 - 80m depth ranges

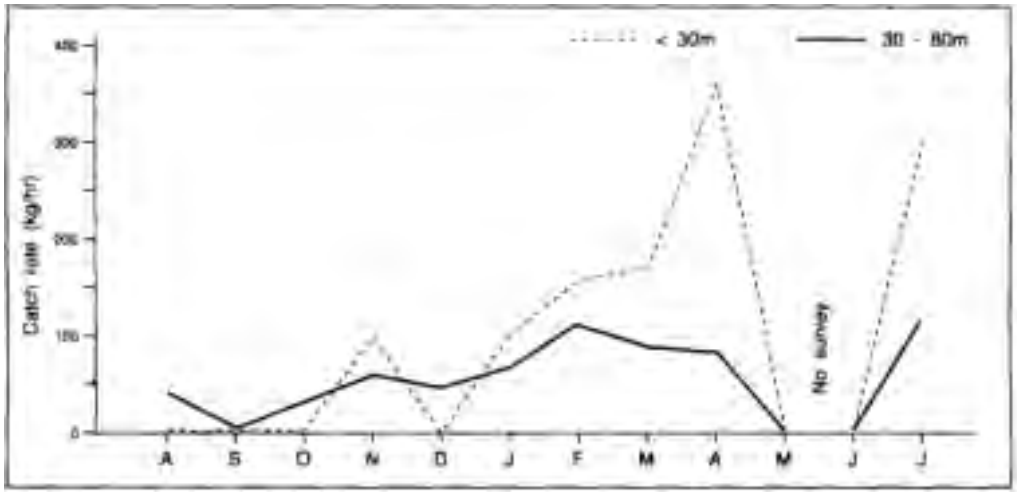
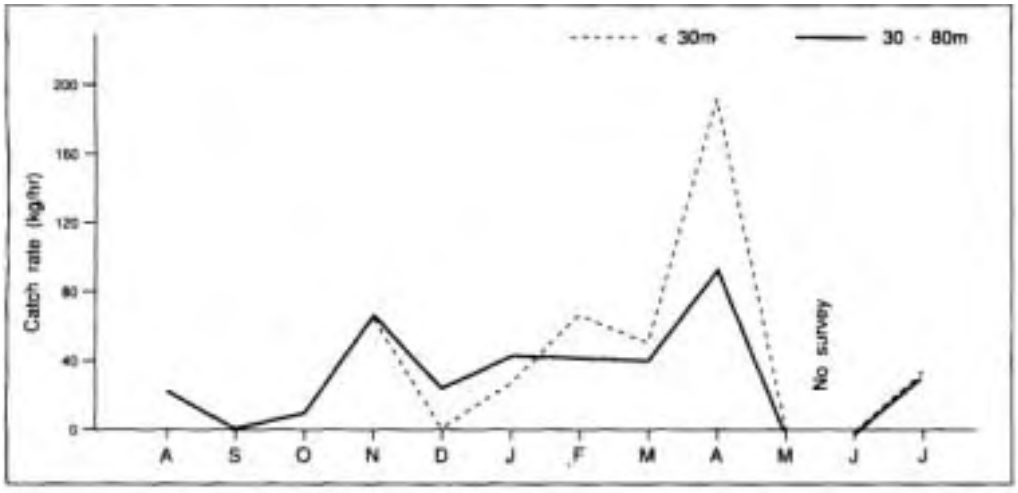


Fig 41. Catch rates (kg/hr) of trash fish in shrimp trawl catches, during different months and in < 30m and 30 - 80m depth ranges



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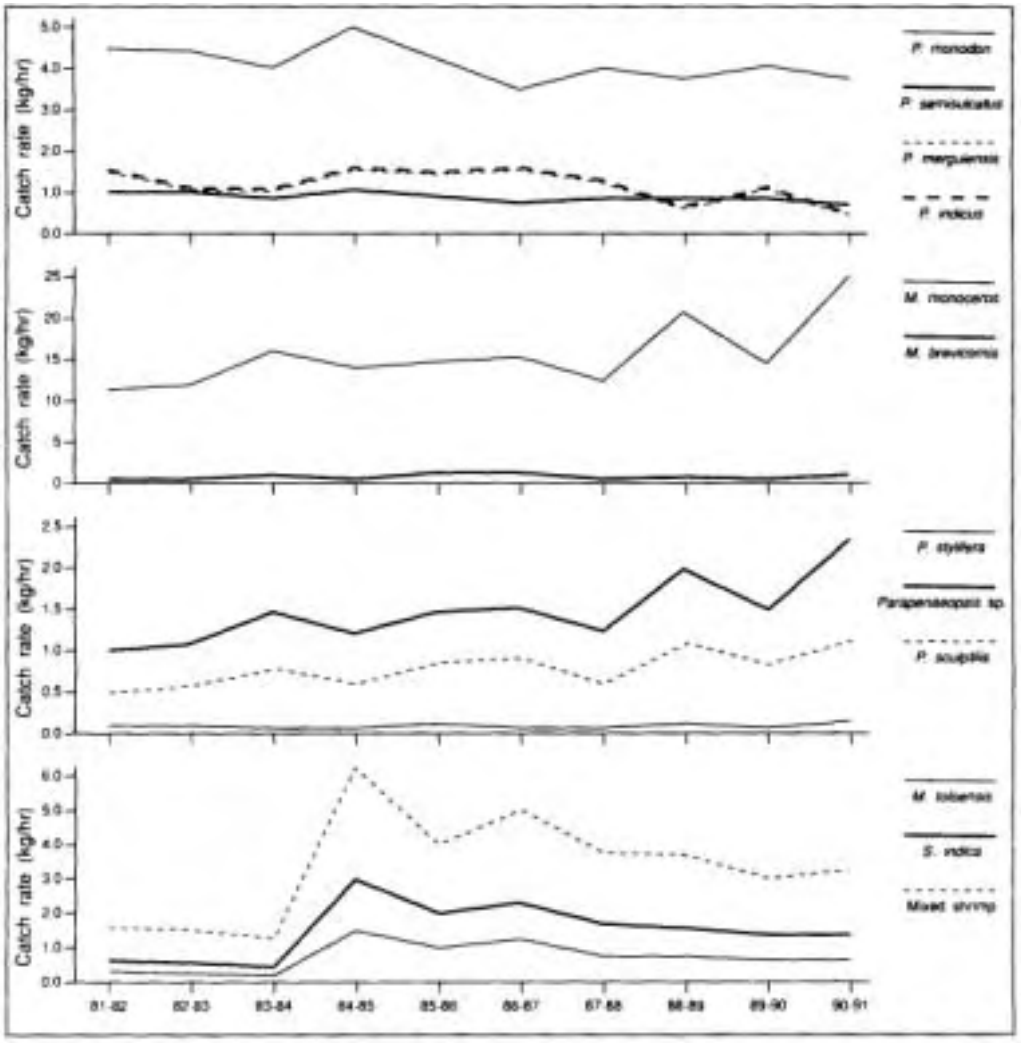
ANNUAL VARIATION IN THE CATCH RATE OF PENAEID SHRIMP

The annual variation in the catch rates of the four commercial categories of penaeid shrimp recorded (Tiger, White, Brown and others) and of all these categories combined, in the shrimp trawl catches for the period 1980/81 to 1990/91, are shown in Figure 42.

Fig 42. Annual variations in the catch rate (kg/hr) tor the four commercial categories of penaeid shrimp, 1981-82 to 1990-'91



The annual catch rate for all penaeid shrimp combined showed year to year fluctuations, but an increasing trend was observed from 1980/81 to 1990/91. Annual average catch rate of Tiger Shrimp showed less annual fluctuations, but a declining trend was evident with an average of 4.5 kg/hr until 1984/85 and 3.7 kg/hr thereafter — approximately a 17 per cent decline between 1980/81 and 1990/91. The White Shrimp and the Banana Shrimp achieved slight increases in annual average catch rate until the mid-'80s (1 .5 kg/hr), but exhibited a noticeable decline (0.7 kg/hr) in later years approximately 50 per cent decline between 1980/81 and 1990/91. The Brown Shrimp had the highest catch rate with wide annual fluctuations and a significantly increasing trend from 1980 (13.5 kg/hr) to 1990/91 (31 kg/hr) — approximately a 130 per cent gain. The small mixed or other shrimp (other *Metapenaeus* spp. and nonpenaeids such as *Solenocera* spp. had a peak in

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1984/85, which declined significantly thereafter but remained higher than the catch rates recorded between 1980/81 and 1983/84. These changes also indicate a significant change in the composition of penaeid shrimp in the trawl catches as shown alongside.

	1980/81 %	*1990/91* %
Tiger	21	10
White	14	4
Brown	58	77
Others	7	9
Total	190	100

It is quite evident that the catch rate of Brown Shrimp has largely influenced this trend in the overall penaeid shrimp catch rate.

The shrimp catch, the standardized fishing effort in the number of fishing days and the catch rates over the last decade are given below.

Year	*Shrimp catch (t)*	*Fishing effort standardized (No. offishing dais)*	*Catch late (kg/fishing day)*	*Revenue in Tk. 1.000.000*
1981-82	1697	3780 *	449	320 *
1982-83	3120	7020	444	580
1983-84	5460 *	9660 *	565	1000*
1984-85	5518 *	8160 *	676	1030 *
1985-86	4034	6440	626	730
1986-87	4488	6930	648	830
1987-88	3523	6580	535	650
1988-89	4893	6940	705	900
1989-90	3134	5540	565	540
1990-91	3430	4500 **	762	650

* Data not used in the production models. as estimated fishing effort was considered unreliable.

** Effort reduced due to loss/damage of trawlers during the cyclone of April 1991.

Source: Marine Fishery Research Development and Management Project, Chittagong.

Annual fishing effort of the trawlers exhibited variations which were difficult to understand or explain.

33.3 *Production*

Using the catch data of the commercially important shrimp and finfish in the trawler landings during 1989/90 and the relevant fishing effort applied by the fleet, the annual production of the commercial categories was estimated. These were further separated into speciets or species groups using the detailed species composition established from the stratified shrimp trawl survey data. Production thus estimated for the shrimp trawl fishery in 1989/90 was 56,217 t of which 2,713t was penaeid shrimp, 6,898 t high-value finfish, 26,568 t low-value .by-catch, 14,526 t trash fish and 5,439 t of other species discarded. Specieswise production under each main category is given in Appendix I.

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33.4 *Population parameters*

GROWTH PARAMETERS OF SOME OF THE MAJOR SPECIES

The length frequency data collected for Tiger Shrimp, Brown Shrimp and Ribbonfish during the survey were analyzed for growth parameters, mortality and recruitment pattern, using ELEFAN vetsion 1.11. (Figure 43 facing page) and the results are presented below.

	ELEFAN METHOD					*WETIFERALL METHOD*		
SPECIES	*L*	*K*	*M*	Z	E	*L*	*L*	*Z/K*
P.monodon Male)	28.8	.2	2.035	7.9	0.74	7.5	30.7	8.036
P.pnonodon (Female)	30.5	.7	2.514	5.8	0.57	15.7	30.8	3.22
M.rnonoceros Male)	8.0	1.4	2.89	6.3	0.54	8.9	15.6	3.92
M.monoceros (Female)	8.6	1.6	2.77	6.3	0.55	9.5	16.8	2.26
L.savala	105	0.85	1.33	2.06	0.65	20.05	—	—

Two recruitments were evident for all three species. The two recruitments were four months apart for the Tiger and Brown Shrimp and five months apart for the Ribbonfish.

PRODUCTION MODELS — MAXIMUM SUSTAINABLE YIELD (MSY)

Surplus production models of Schaeffer (1954) and Fox (1970) were used to estimate maximum sustainable yield (MSY) for the shrimps, based on the catch and effort data for shrimps listed in Section 33.2. These data are from the records of the trawl catch statistics compiled by the Marine Fishery Survey Management and Development Project of the Department of Fisheries. The MSY values obtained for penaeid shrimp were 4145 **t** and 4329 **t** and the effort levels required to achieve this were estimated to be 8500 (158,100 trawling hours) and 11,000 boat-days per year, for. the Schaeffer (a = 0.96357; b = 0.00005599) and Fox models (a= 0.0645 16; b = 0.0000906) respectively (Figure 44. see page 104). These results indicate that the fishing effort of the trawl fishery may have been at or. little above, the optimum effort level in 1983/84 and 1984/85. The correlation between catch rate and effort was slightly better for the Schaeffer model than for the Fox model.

Similar analysis for the finfish catches exhibited extremely poor correlation between catch rates and effort values, probably due to the error in the estimates of discarded by-catch. Hence the results were not considered.

MAXIMUM ECONOMIC YIELD (MEY)

By applyine the average value (Tk/kg) of penaeid shrimp caught to the annual production values (see table in Section 33.2), a Schaeffer-type economic yield model was obtained. The linear regression for the change in the costs of operating the shrimp trawlers was established with the annual changes in their fishing effort. The maximum economic yield level and the corresponding effort level were estimated from these two plottings (Figure 45, see page 105). Maximum Economic Yield appears to he realized when the fishing effort is around 6650 boat-days and the total revenue around 1k 727 million. In fact, in many of the years, 82/83, 85/86, 86/87, 87/88 and 88/89, the fishing effort was more or less at the MEY level, but had fallen below that in the more recent years. The MSY effort level is about 28 per cent greater than the MEY effort level.

It appears that shrimp trawling has generally been swinging between the MSY and MEY, except in the two most recent years.

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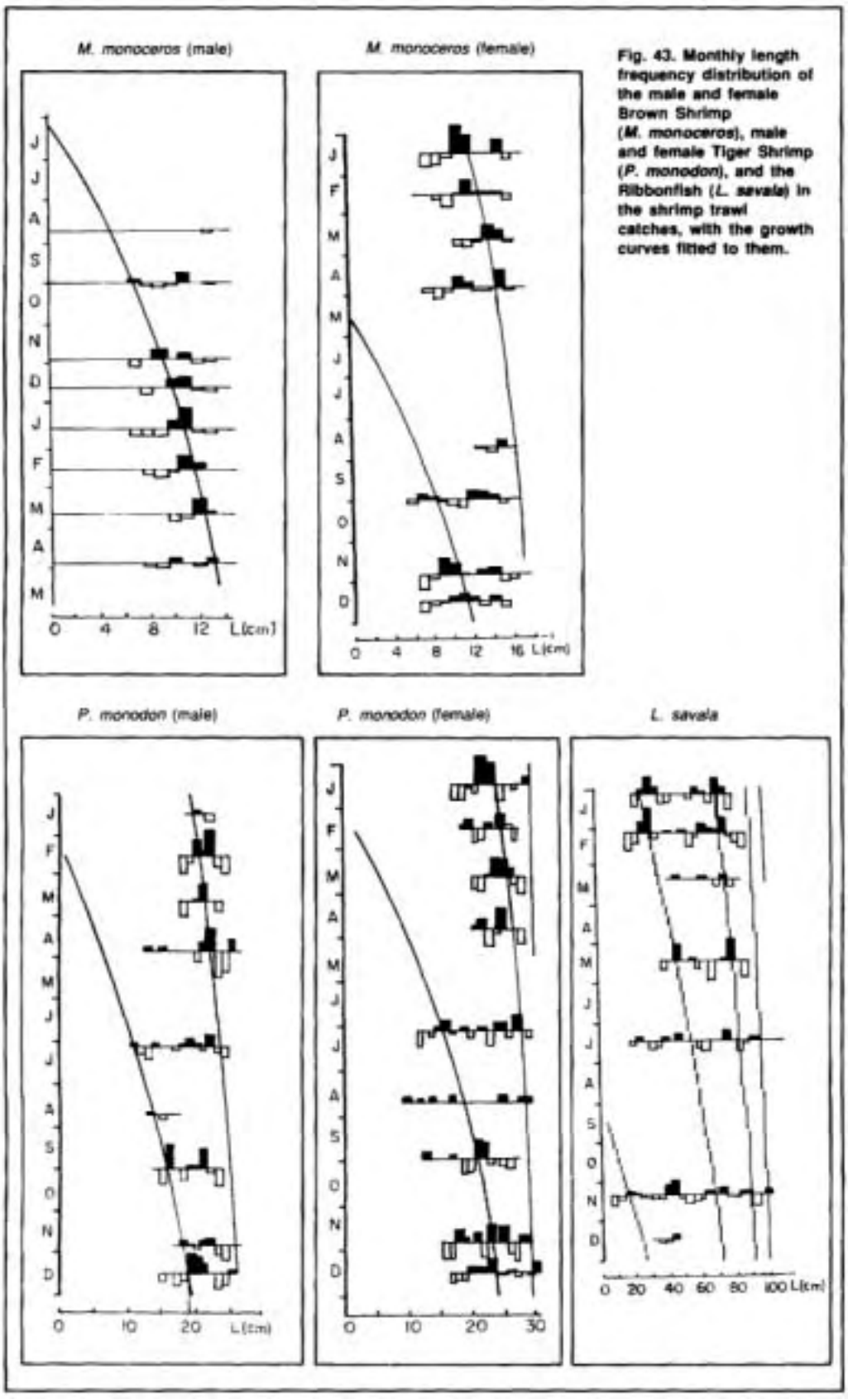

Fig. 43. Monthly length frequency distribution of the male and female Brown Shrimp (*M. monoceros*), male and female Tiger Shrimp (*P. monodon*), and the Ribbonfish (*L. savala*) in the shrimp trawl catches, with the growth curves fitted to them.

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Fig 44. The linear regressions and parabola for the production models fitted accordlng to the Schaeffer **and Fox methods**

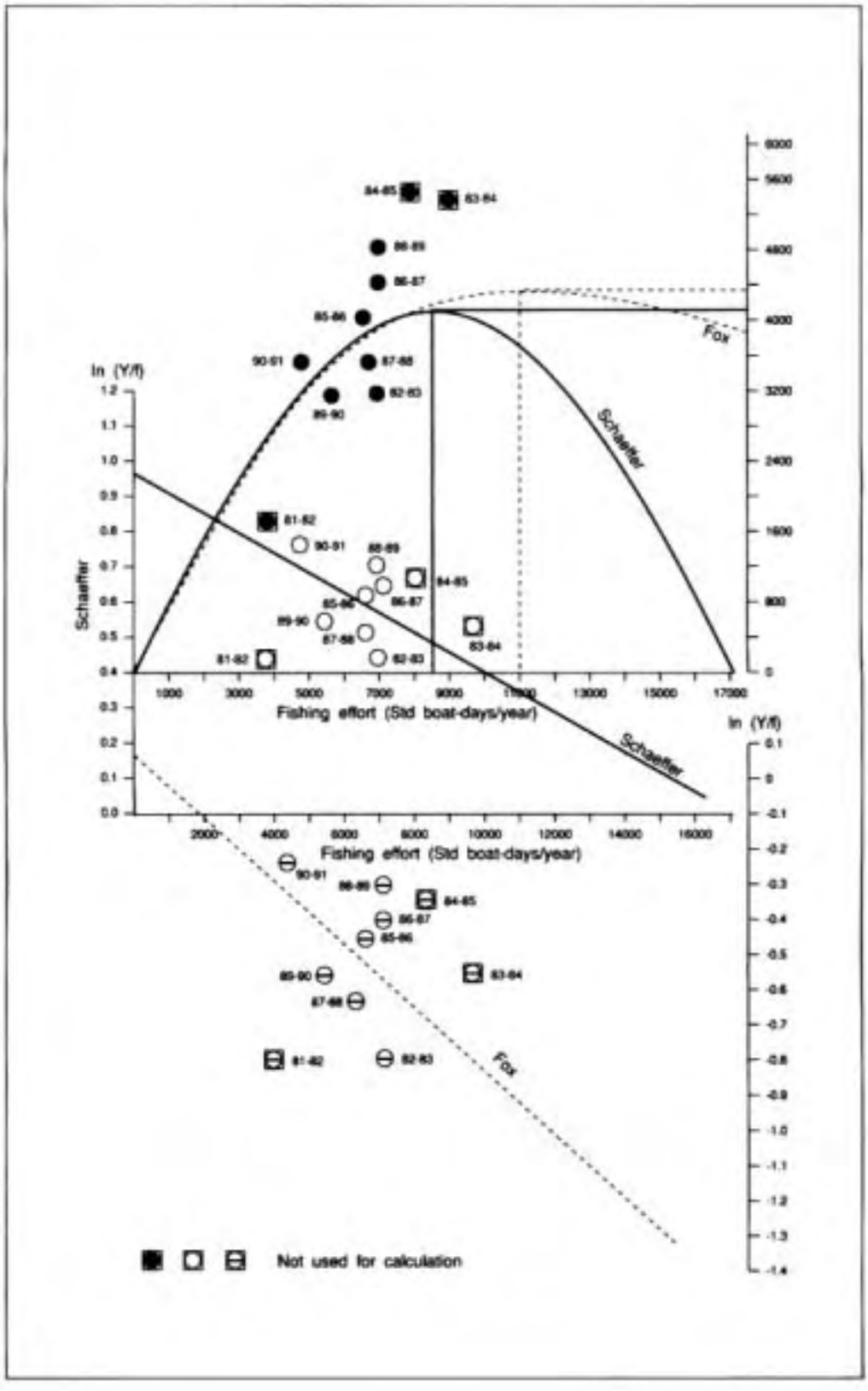

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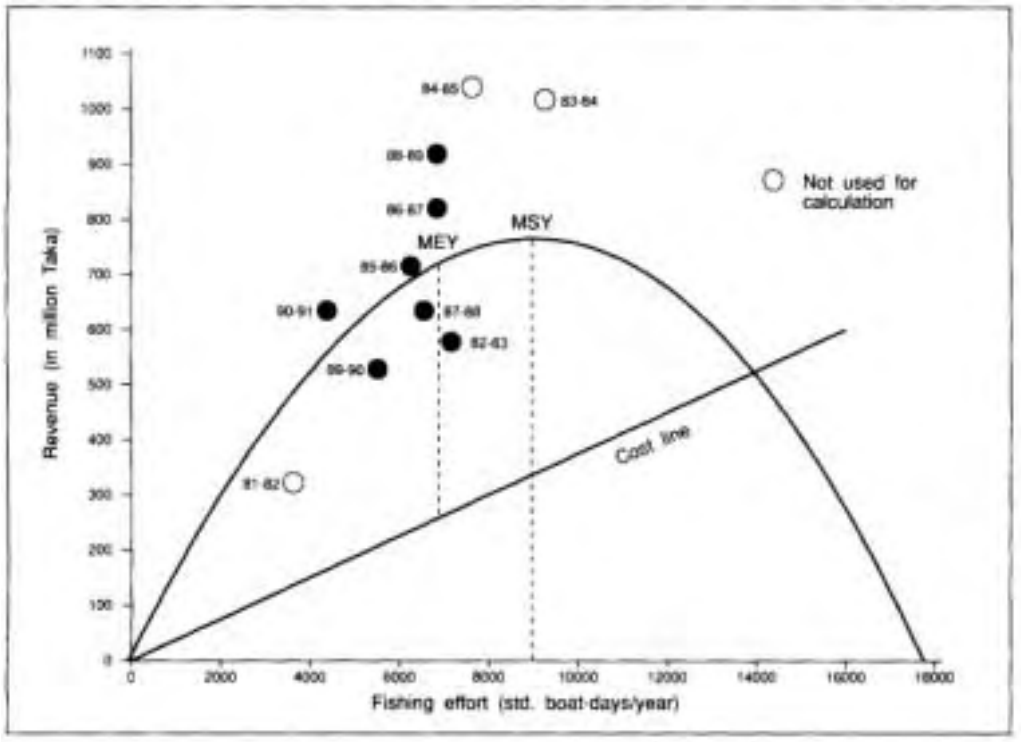
Fig 45. Maximum Economic Yield estimation by applying the cost and revenue values to the Schaeffer's surplus production model



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APPENDIX IV

Estimated production from shrimp trawlers during 1989-90

Shrimp		Total production (t)
Tiger Shrimp	*P. monodon*	452.7
Green Tiger Prawn	*P. semisulcatus*	71.8
Kuruma Shrimp	*P. japonicus*	0.6
Banana Shrimp	*P. merguiensis*	100.6
Brown Shrimp	P. *monoceros*	1567.0
Yellow Shrimp	*M. brevicornis*	43.7
Velvet Shrimp	*M. toloensis*	124.8
	Metapenaeus spp.	77.3
Kiddi Shrimp	*P. stylifera*	8.8
Rainbow Shrimp	*P. sculptilis*	1.7
	Parapenaeopsis spp.	96.9
Coastal Mud Shrimp	*Solenocera indica*	143.5
	Solenocera spp.	8.7
Mixed Shrimp		16.7
Lobster		70.9
Subtotal		2785.7

Commercial finfish		Total production (t)
Indian Threadfin	*P. indicus*	4.0
Silver Grunt	*P. hasta*	700.1
Ribbonfish (Hairtail)	*L. savala*	520.9
Silver Pomfret	*P. argenteus*	139.4
Chinese Silver Pomfret	*P. chinensis*	21.8
Black Pomfret	*P. niger*	13.8
Indian Pink Conger	*C. talabonoides*	115
Pink Conger	*Muraenesox* sp.	739.7
John's Snapper	*L. johni*	72.2
Snapper	*Lutjanus* sp.	7.5
Grouper	*Epinephelus* spp.	144.0
Silverpennah Croaker	*P. argentatus*	255.0
Croaker	*Johnius* spp.	2308.9
Belanger's Croaker	*P. belangeri*	34.5
Tigertooth Croaker	O. *argenteus*	1432.3
Blotched Croaker	O. *maculatus*	311.9
Croaker	*Otolithes* sp.	172.5
Spanish Mackerel	S. *commerson*	4.3
King Mackerel	S. *guttatus*	2.0
Talang Queenfish	S. *commersonnianus*	2.3
Subtotal		6898.6

Finfish by-catch		Total production (t)
Blackspot Threadfin	*P. sextarius*	116.1
Paradise Threadfin	*P. paradiseus*	4.9
Largehead Hairtail	*T. lepturus*	25.9
Cock Grunter	*P. maculatum*	947.0
Grunt	*Pomadasys* sp.	17.2
Ilisha Shad	*I. filigera*	1214.5
Hulsha Shad	*Hilsha ilisha*	15.8
Shad	*Ilisha* sp.	347.9
Sardine	*Sardinella* sp.	2.3
Sea Catfish	*Anus* sp.	3146.6
Malabar Blood Snapper	*L. sanguineus*	31.9
Bombay Duck	*H. nehereus*	1035.0
Croaker	*Protonibea* sp.	1143.7
Spotted Croaker	*P. diacanthus*	28.7
Croaker		968.9
Panna Croaker	*Panna microdon*	74.7
Indian Driftfish	*A. indica*	225.7
Indian Mackerel	*R. kanagurta*	330.3
Obtuse Barracuda	S. *obtusata*	40.8
Bigeye Bthacuda	S. *forsteri*	120.5
Barracuda	*Sphvraena* spp.	41.7
Cleftbelly Trevalty	*A. atropus*	59.8
Scad	*Selar* spp.	2.6
Salema	S. *boops*	42.8
Malabar Travally	*C. malaharicus*	125.0
Torpedo Scad	*M. cordvla*	165.3
Trevally	*Carangoides* sp.	1.4
Indian Threadfish	*Alectis indicus*	4.6
Silver Biddy	G. *filamentosus*	23.0
Wolf Herring	*C. dorab*	7.8
Goatfish	*U. suiphureus*	3860.0
False TrevaHy	*L. lactarius*	172.8
Japanese Threadfin Bream	*N. japonicus*	7369.5
Threadfin Bream	*Nemipterus* sp.	145.2
Cobia	*R. canadum*	12.9
Lizardfish	*Saurida* spp.	823.1
Greater Lizardfish	S. *tumbil*	2319.3
Bream	*A. spinifer*	18.7
Mullet	*Mugil* sp.	5.7
Tongue Sole	*C. cynoglossus*	1067.2
Indian Halibut	*P. erumei*	461.4
Subtotal		26,568.2

Trash fish		Total production (t)
Blackbanded Trevally	*Seriolina* sp.	13.8
Russelli Scad	*D. russelli*	369.7
Redtail Scad	*D. kurroides*	5.7
Scad	*Decapterus* spp.	27.3
Triggerfish	Balistidae	11.5
Bullseye	*Priacanthus* spp.	138.6
Brushtooth Lizardfish	S. *unodosquamis*	24.4
Elongate Sole	S. *elongate*	403.6
Tenpounder	*E. machnata*	12.1
Longfin Silver Biddy	*P. longimanus*	934.7
Silver Biddy	*Pentaprion* spp.	20.1
Terapon	*Terapon jarhua*	37.1
Red Cometfish	*F. villosa*	29.9
Ponyfish	*Leiognathus* spp.	932.2
Hairfin Anchovy	S. *taty*	0.9
Anchovy	*Thryssa* sp.	11.5
Goldspotted Grenadier Anchovy	*C. dussumieria*	13.8
Banded Sicklefish	*D. longimana*	97.7
Sicklefish	*Drepane* spp.	0.8
Flounder	Bothidae	152.1
Squirrelfish	Holocentridae	2.3
Cardinalfish	*Apogonidae* sp.	26.7
Pufferfish	Tetraodontidae	119.6
Tnpodfish	*Triacanthus* sp.	32.2
Spadefish	*E. orhis*	4.3
Starry Triggerfish	*A. stellaris*	6.9
Trash fish		11,105.4
Subtotal		14,525.9

Other discards	Total production (t)
Cuttlefish	1244.0
Squid	420.6
Crab	1836.8
Octopus	9.2
Other mollusc	170.5
Ray	809.3
Shark	949.0
Sub-total	5439.4
Grand total	56,217.8