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OBSERVATIONS ON THE DEMERSAL FISHERY RESOURCES OF THE COASTAL AND DEEP SEA AREAS OF THE EXCLUSIVE ECONOMIC ZONE OF INDIA

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ABSTRACT

This paper deals with the results obtained in cruises 1 to 49 undertaken by FORV *Sagar Sampada* during the period 1985-'88. Fishery resources obtained from the south, central and north zones along the west and east coasts and from the Andaman-Nicobar Archipelago were analysed in estimating the yield. While southwest zone had the maximum yield, central-east zone had lesser concentration of fishes. Nemipterids formed the dominant group along both the west and east coasts. Depth-wise, 151-398 m depth range had the maximum catch along the west coast, contributed mainly by the deeper waters of the southwest zone. Along the east coast and Andaman-Nicobar Archipelago, 51-100 m depth range yielded the maximum catch. Species composition of the catch, indicated the occurrence of unconventional forms like *Psenopsis* spp. *Trichiurus auriga, Chlorophthalmus agassizi, Neoepinnula orientalis* and *Cubiceps* spp. in addition to the conventional forms especially in the deeper waters of the southwest zone. Relative abundance of major species and their productive areas are also indicated.

INTRODUCTION

Since the declaration of 2.02 million sq. km area as the Exclusive Economic Zone of India, in 1976, there has been a growing awareness to augment marine fish production in the country. Thus, by increasing the fishing effort in number and efficiency, and by consecutive exploratory surveys, the fish production which had been at a stagnant level of 1.4 to 1.5 m. tonnes in 1981-'83, could register an increase to 1.7 m.t in 1984 (Sudarsan and Somavanshi, 1988). Nevertheless, the industry has to go a long way in attaining the potential yield of 4.5 m.t.

The demersal fishery resources of the EEZ of India have been estimated to be 1.1 m.t. as against the current yield of 0.34 m.t. (James *et al.*, 1986). While exploratory surveys conducted by organisations like Fishery Survey of India and Central Institute of Fisheries Nautical and Engineering Training can catalyse exploitation, serious thoughts have to be made as to how to tap the unexploited areas beyond 50 m depth. The Central Marine Fisheries Research Institute, Cochin, had been making pioneering attempts in this line using the Fisheries Oceanographic Research Vessel (FORV) *Sagar Sampada* since 1985. The present paper deals with the data collected by this vessel in the spatial distribution and species composition of the various demersal fishes of the coastal and deep sea areas along the EEZ of India during the period 1985-'88.

MATERIAL AND METHODS

The material for the present study was collected onboard FORV *Sagar Sampada.* During the cruises 1-49, the fish samples obtained in Chalute Bottom Trawl, High Speed Demersal Trawl (HSDT-III), Granten Bobbin Trawl and High Life Queen's Trawl were analysed.

In analysing the catch details, stations covered within the latitudes 6°-10°, 10°-16° and 16°-22°N were included under south, central and north zones respectively. Longitudinally, areas within 64°-77° 30' E and 77° 30-89° 00'E were included in the west and east coasts respectively. Cruises undertaken in the Andaman-Nicobar Archipelago were analysed separately.

Depth-wise distribution and abundance of the resource were assessed after grouping the stations covered in each cruise/zone into 4 depth zones of less than 50 m, 51-100 m, 101-150 m and more than 150 m to the maximum depth operated in each zone. Catch per unit effort was estimated against the total number of hours operated in each zone.

RESULTS

A. Exploitation

Fishery in different zones (Table -1)

West coast: In the southwest zone (Lat. 04°00'-

10°00'N, Long. 64°00 -77°30'E) where a total of 110 stations were covered, the total catch amounted to 96.186 tonnes at an effort of 104 hrs 35 min the catch/hr being 919.71 kg. The depth of operation ranged from 35-398 m.

In the centralwest zone (Lat.10°00' - 16°00'N, Long. 64°00'- 77°30'E) the total catch was 36.923 t expending an effort of 62 hrs 40 min at 65 stations. The catch/hr was 589.2 kg and gear depth ranged from 30-250 m.

In the northwest zone (Lat. 16°00'N Long. 64°00' - 77°30'E) covering 46 stations with an effort of 45 hrs, the total catch amounted to 23.222 t with a catch/hr of 5160.5 kg. The depth of operation ranged from 26 - 235 m.

West coast taken as whole, had a total catch of 156.33 t, the catch/hr being 736.54 kg at a total effort of 212 hrs 15 min.

East coast : Southeast zone (Lat. 04°00' - 10°00'N; Long. 77°30'-89°00'E) with 13 stations covered at an effort of 11 hr yielded a total catch of 24.562 t with a catch rate of 2,232.3 kg/hr. The depth of operation varied from 26-631 m.

In the central-east zone (Lat. 10°00' - 16°00'N; Long. 77°30' - 89°00'E), the total catch from 32 stations at an effort 31 hrs amounted to 6.087 t, with a catch/hr of 196.37 kg. Gear depth ranged from 23-168 m.

In the northeast zone (Lat. 16°00' - 22°00'N; Long: 77°30' - 89°00' E) the total catch was 23.971 t. From the 77 stations covered at a total effort of 76 hrs, the catch rate was 315.41 kg. Gear depth ranged from 27-260 m.

East coast taken as a whole had a total catch of 54.620 tonnes at an effort of 118 hrs, the catch rate being 462. 884 kg/hr.

Andaman-Nicobar Archipelago : (Lat. 6° 00'-15°00' N; Long. 92°00'95°00'E) : The total catch from the islands amounted to 2.966 t at an effort of 12 hrs covered in 18 stations, the catch/hr being 234.122 kg. The depth of operation ranged from 34-142 m.

The total catch in the west coast, east coast and Andaman Nicobar Archipelago amounted to 213.917 t, at a total effort of 342 hrs 15 min the catch per hour being 625 kg.

Fishery in different depths

West coast (Table - 1) : Along the southwest zone, depth range of 151-398 m had the maximum catch with a catch/hr of 1,283 kg (Total catch: 56.122 t). The next catch in abundance was from 51-100 m depth range with a catch/hr of 794.5 kg (total catch: 33.57 t). With catch/hr of 525.63 kg, less than 50 m depth range brought a total catch of 3.986 t. Depth range of 101-150 m yielded the least catch of 2.51 t, the catch/hr being 223 kg.

In the central west zone, the maximum catch of 27.314 t was obtained from 51-100 m depth range with a catch/hr of 815.4 kg. Shallow waters of less than 50 m range had the next total catch of 5.331 t the catch/hr being 477.43 kg. From the depth range of 101-150 m, the yield amounted to 3.1 t with a catch rate of 277.64 kg/hr. Deeper waters of 151-250 m range with a total catch of 1.223 t and catch rate of 175 kg/hr yielded the least from the zone.

In the northwest zone, 51-100 m depth range had the maximum catch amounting to 18.76 t with a catch/hr of 625 kg. In the shallow waters of less than 50 m depth range, the total catch amounted to 3.977 t, with a catch/hr of 568.11 kg. In the deeper waters, catch was negligible.

West coast taken as a whole, the highest catch was obtained from 151-398 m depth range with a catch/hr of 1,069 kg/hr (total catch: 57,464 t). The next abundant concentration with a catch rate of 753 kg/hr (total catch : 79.64 t) was in depth range of 51-100 m. Shallow waters of less than 50 m depth had a catch rate of 520 kg/hr (total 13.3 t). Depth range of 101-150 m had the lowest catch with a catch rate of 217.8 kg/hr (total catch : 5.934 t).

East coast (Table 1) : In the southeast zone, depth range of 51-100 m had a dense population with a catch rate of 4,500 kg/hr (total catch 16.5 t). Shallow waters less than 50 m depth range with a catch rate of 1,256 kg also had good concentration of fishes (total catch : 8.1 t). Catch in other depths was negligible.

Centraleast zone generally with a poor catch had a catch rate of 231 kg/hr and 180 kg/hr in 51-100 m and less than 50 m depth range respectively while other depths had negligible catch.

In the Northeast zone also 51-100 m range had a catch rate of 430 kg/hr (total catch 12-795 t) followed by less than 50 m range where the catch rate was 263 kg/hr (total catch : 9.009 t) with very little catch from other depths.

East coast taken as a whole had the shelf

TABLE 1 *Catch details of coastal and deeep sea demersal fishery resources along the EEZ of India during 1985- '89*

Zones/ Position range	No. of stns	Depth range (m) /Catch details															
		50			51-100			101-150			>151			Total			
		Catch (t)	Effort (hrs/ min)	C/E (kg)	Catch (t)	Effort (hrs/ min)	C/E (kg)	Catch (t)	Effort (hrs/ min)	C/E (kg)	Catch (t)	Effort (hrs/ min)	C/E (kg)	Catch (t)	Effort (hrs/ min)	C/E (kg)
A. *West coast*	110	3.986	7/35	525.626	33.569	42/15	794.548	2.508	11/15	222.933	56.122	43/45	1,282.794	96.186	104/35	919.706
04° South west 04° - 10° N 64 - 77.30'E																
Central west 10° -16°N 64° -77°. 30 'E	65	5.331	11/10	477.430	27.314	33/30	815.358	3.054	11/-	277.639	1.223	7/-	174.67	36.923	62/40	589.189
Northwest 16° -22°N 64° -77°. 30E	46	3.976	7/-	568.11	18.754	30/-	652.152	0.372	5/-	74.314	0.119	3/-	39.8	23.222	45/-	516.05
Total	221	13.293	25/35	519.626	79.638	105/45	753.085	5.934	27/15	217.746	57.464	55/45	1,069.104	156.331	212/15	736.540
B. *East Coast*																
Southeast 04° - 10°N 77°. 30 '-89°E	13	8.056	6/25	1,255.575	16.500	3/40	4500.00	--	--	--	0.005	1/-	5.00	24.562	11/-	2,232.29
Centraleast 10° -16°N 77°. 30 '-89°E	32	3.239	18/-	179.998	2.772	12/-	231.04	-	-	-	0.075	1/-	75.00	6.087	31/-	196.37
Northeast 16° -22°N 77°30 .-89°E	77	9.009	34/15	263.051	12.795	29/45	430.09	0.390	3/-	130-13	1.776	9/-	197.37	23.971	76/-	315.41
Total	122	20.306	58/40	346.126	32.067	45/25	706.07	0.390	3/-	130.13	1.856	11/-	168.75	54,620	118/-	462.884
C. *Andman-Nicobar Archipelago* 06°-15°N 92°-95°E	18	0.577	2/30	230.92	2.370	8/30	258.584	0.018	1/-	17.90	-	-	-	2.966	12/-	234.122
Grand total	361	34.177	86/45	393.933	114.077	160/20	711.499	6.342	31/15	202.94	59.32	64/45	916.15	213.917	342/15	625.030

waters of 51-100 m range densely populated with a catch/hr of 706 kg (total catch: 32 t) while still shallow waters of less than 50 m range had a catch rate of 346 kg/hr (total catch: 20.3 t).

Andaman Nicobar Archipelago (Table 1): In this region, depth ranges of 51-100 m and less than 50 m had comparatively good concentration of fishes, the catch rate being 259 kg/hr (total catch: 0.6 t) respectively.

B. **Species composition**

West coast vis-a-vis-east coast (Table 2)

It is discernible that, nemipterids represented by *N. japonicus, N. delagoae,* and *N. bleekeri* formed the dominant group along both west and east coasts contributing to about 28.43 and 26.71% of the total catch respectively. In addition, *Trichiurus* spp. (*T. lepturus, T. haumala, T. auriga)* forming 7.73% carangids (*Decapterus russelli, D. macrosoma, Megalaspis cordyla, Atule mate, Carangoides malabaricus)* forming 3%, *Psenopsis* spp. forming 11%, and *Chlorophthalmus* spp., forming 10.4% were the dominant groups occurring along the west coast. Besides, perches (*Priacanthus* spp, *Lutjanus* spp., *Epinephelus* spp. , *Lethrinus* spp) , *Upeneus* spp., *Psettodes erumei* and sciaenids were also encountered from the west coast.

Along the east coast, *Sphyraena* spp. (*S. obtusata, S. barracuda, S. jello)* forming 8.9% and carangids (*Caranx ferdue, Decapterus dayi* and *Megalaspis cordyla)* forming 8.4% were the major groups realised in addition to nemipterids (26.71 %). Minor groups encountered along the east coast were silverbellies, *Pentaprion longimanus, Psenes indicus, Rastrelliger kanagurta* and deep sea fishes.

Species composition (zone wise) (Tables 3-9, Fig.1)

Along the southwest zone, (Table 3, Fig. 4) the dominant groups were *Psenopsis* spp (17.45%), *Nemipterus* spp. (16.6%), and *Chlorophthalmus* sp. (16.85%). While *Nemipterus* spp. formed the bulk of the catch (61%) in the centralwest zone (Table 4) followed by *Priacanthus* spp. (11.5%), northwest zone was mainly represented by *Nemipterus* spp. (25.7%) and *Trichiurus* spp. (25.2%) (Table 5). Southeast zone (Table 6) had *Nemipterus* spp. contributing to 52.4% of the total catch followed by *Sphyraena* spp. (14.4%). Perches represented by *Priacanthus* spp., and *Lethrinus* sp. constituted about 33% of the catch in the centraleast zone (Table 7).

Along the northeast zone (Table 8) *R. kanagurta* (20.32%), *Priacanthus* spp. (11.6%) and carangids (11%) were the major groups encountered.

In the Andaman-Nicobar Archipelago, silverbellies (30%), carangids (17.2%) and perches (16%) were the dominant groups in the catches (Table 2 & 9, Fig.1).

Abundance of major species - depth wise
(Tables 3 - 9, Fig.1)

Psenopsis spp. which formed the most dominant group caught from the southwest zone was abundant in 151-398 m depth range with a catch rate of 383.54 kg/hr (30%). *Chlorophthalmus* spp. and *Cubiceps* spp. with catch rates of 370 kg/hr (29%) and 76.2 kg/hr (6%) respectively also formed good catches from these deeper waters (Table 3). *Nemipterus* sp. and *Priacanthus* spp. with a catch rate of 359 kg/hr (45%) and 136 kg/hr (17%) respectively were abundant in 51-100 m depth area. In the shallower waters of 0-50 m depth range, *Sphyraena* spp. yielded a catch rate of 158 kg/hr (30%). In the centralwest zone, nemipterids with a catch rate of 602 kg/hr (74%) was abundant in 51-100 m depth range (Table 4, Fig.1).

Northwest zone (Table 5) with *Trichiurus* spp. abundant in less than 50 m and 51-100 m depth range, the catch rate was 240 kg/hr (42.3%) and 139 kg/hr (22.24%) respectively.

Along the east coast, the southeast zone (Table 6) with fish catches exclusively from the coastal waters had dense population of nemipterids in the 51-100 m depth area with a catch rate of 3509 kg/hr (78%). However, along the less than 50 m depth area, *Sphyraena* spp. (551.84 kg/hr), carangids (130.4 kg/hr) and perches such as *Epinephelus* spp. (101 kg/hr) *Lethrinus* sp. (37 kg/hr) and *Lutjanus* spp. (7 kg/hr) and balistids (61 kg/hr) were the major groups encountered. Catches in other depths were negligible.

In the centraleast zone (Table 7), generally with lesser catches, *Priacanthus* spp. with a catch rate of 102 kg/hr (44%) was the dominant group caught only in 51-100 m depth range.

In the northeast zone (Table 8) having more catches from the coastal waters, 51-100 m depth range had *R. knagurta* (159 kg/hr, 37%) and carangids (67 kg/hr, 15.65%) as the dominant groups.

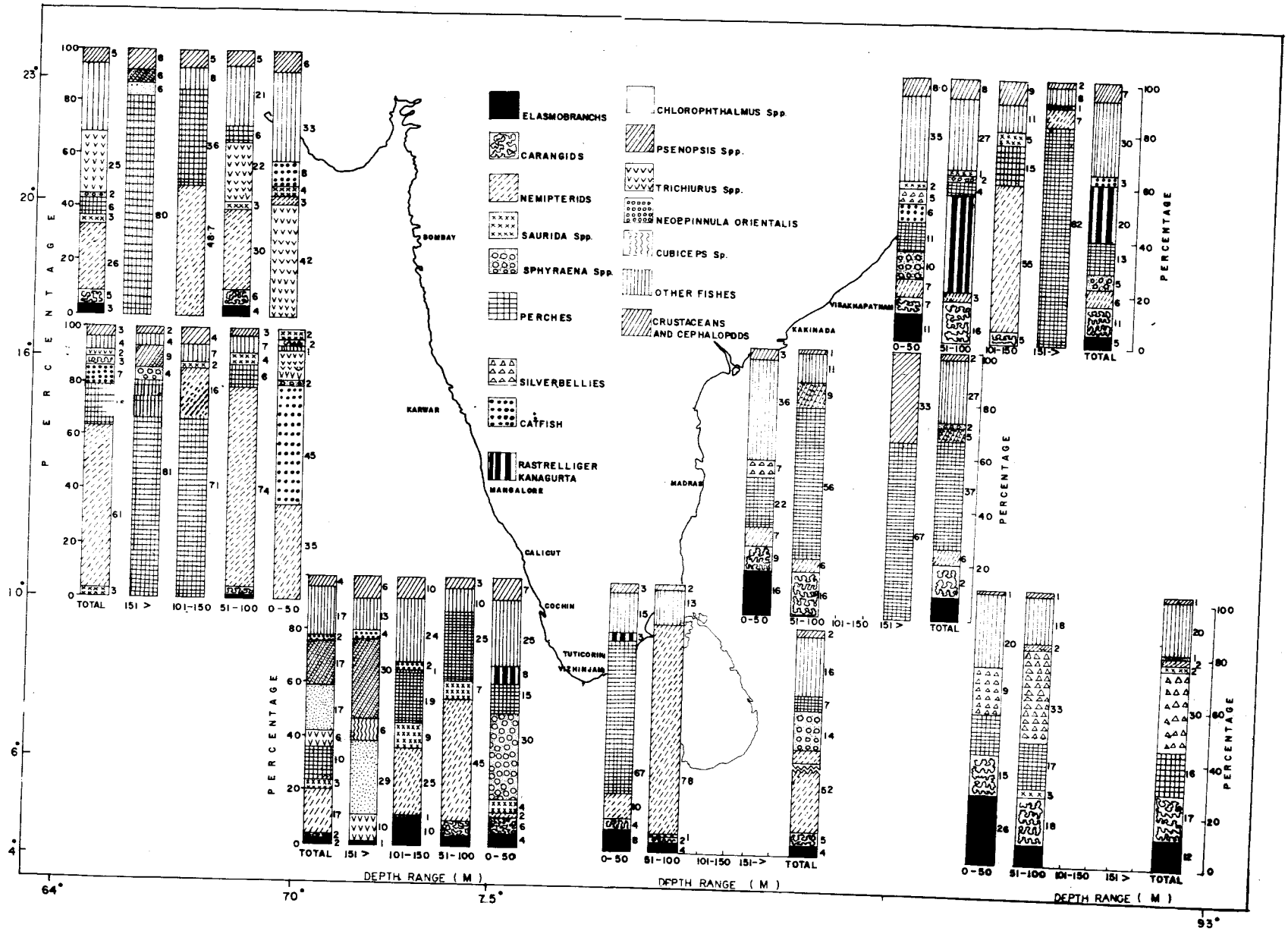

Fig. 1. Depthwise species composition of major fishery resources from the various zones of the EEZ of India. (Figures given on the right side indicate percentage of each group).

TABLE 2. *Percentage composition of various groups of coastal and deep sea demersal fishery resources along west and east coasts of India*

Area:	West coast	East coast	Andaman & Nicobar Archipelago
Effort (hrs/min):	212 hrs/ 15 min	118 hrs	12hrs/40 min
Composition	%	%	%
Shark	0.80	1.81	2.46
Skates	0.17	1.01	0.06
Rays	0.66	2.17	9.22
Carangids	2.89	8.39	17.20
Nemipterids	28.43	26.71	1.56
Saurida spp.	3.12	0.96	2.22
Upeneus spp.	0.97	1.97	1.88
Sphyraena spp.	1.28	8.85	0.68
Priacanthus spp.	6.98	7.55	0.39
Epinephelus spp.	0.73	2.25	3.24
Lethrinus spp.	0.78	1.44	7.21
Lutjanus spp.	1.25	0.28	5.90
Lutianus spp.	0.14	0.74	-
Other perches	0.45	0.66	-
Scieanids	0.84	1.26	-
Silverbellies	0.004	1.42	29.65
Mackerel	0.23	9.38	0.47
Cat fish	2.01	1.47	-
Flat fish	0.63	0.11	-
Trichiurus spp.	6.17	0.53	1.01
T. auriga	1.56	1.00	
Chlorophthalmus spp.	10.37	-	-
Cubiceps spp.	2.14	-	-
Neoepinnula spp.	1.29	-	-
Pseneopsis spp.	10.89	0.46	-
Psenes indicus	0.21	4.96	3.04
Psenes spp.	0.12	-	-
Pipe fish	2.31	-	-
Deep sea fish	0.96	2.26	-
Other fishes	6.74	9.16	12.72
Crustaceans & cephalopods	4.39	4.25	1.08

TABLE 3. *Species composition of coastal and deep sea demersal fishery resources along the EEZ of India (south/west zone)*

Depth range (m) : Effort (hrs/min) : Composition	< 50 7/35 C/E (kg)	51-100 42/15 C/E (kg)	101-150 11/15 C/E (kg)	> 150 43/45 C/E (kg)	Total 104/35 C/E (kg)	%
Sharks	-	13.950	1.69	9.23	9.68	1.05
Skates	-	3.716	8.00	0.23	2.46	0.27
Rays	21.098	2.367	12.89	-	3.87	0.42
Carangids	31.385	34.195	2.40	0.07	22.18	2.41
Nemipterus spp.	11.208	359.137	54.73	1.21	152.29	16.56
Saurida spp.	21.026	53.846	19.91	3.54	29.94	2.93
Upeneus spp.	38.242	4.426	-	-	4-56	0.56
Sphyraena spp.	158.242	1.437	-	-	12.05	1.31
Priacanthus spp.	1.319	136.178	18.13	6.72	59.87	6.50
Epinephelus spp.	47.736	3.818	1.16	9.80	9.05	0.98
Lethrinus spp.	13.846	25.728	0.71	-	11.47	1.25
Lutjanus spp.	9.231	19.136	-	0.23	8.49	0.92
Lutianus spp.	3.297	4.793	-	-	2.18	0.24
Other perches	2.638	10.059	22.49	-	6.67	0.73
Psenes indicus	7.912	2.106	-	3.28	2.80	0.30
Psenes spp.	-	-	-	4.31	1.80	0.19
Silverbellies	0.659	0.040	-	-	0.07	0.007
Cat fishes	1.583	-	-	-	0.11	0.01
Flat fishes	-	0.876	0.44	0.62	0.66	0.07
Pentaprion spp.	15.824	4.733	-	-	3.06	0.33
R. kanagurta	55.305	0.012	-	-	2.87	0.31
Trichiurus spp.	-	0.663	-	71.37	30.13	3.28
T. auriga	-	-	-	55.59	23.26	2.53
Chlorophthalmus spp.	-	0.260	1.87	369.75	154.98	16.85
Cubiceps spp.	-	-	1.69	76.20	37.06	3.48
Pseneopsis spp.	-	-	-	383.54	160.44	17.45
Neoepinnula spp.	-	-	4-89	45.00	19.35	2.10
Fistularia villosa	30.329	2.982	-	6.58	6.16	0.67
Scolopsis spp.	-	-	15.29	-	1.14	0.18
Deep sea fish	-	-	-	0.57	4.43	1.56
Pipe fishes	-	-	-	82.56	34.54	3.76
Other fishes	34.286	64.561	35.29	56.16	55.06	6.07
Crustaceans & cephalopods	36.923	31.147	21.33	62.69	43.78	4.76
Total	526.626	794.532	222.91	1282.78	919.69	

TABLE 4. *Species composition of coastal and deep sea demersal fishery resources along the EEZ of India (Centralwest zone)*

Depth range (m) :	< 50	51-100	101-150	> 151	Total	%
Effort (hrs/min) :	11/10	33/30	11/0	7/0	62/40	
Composition	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	
Sharks	-	-	-	-	-	-
Skates	-	-	-	-	-	-
Rays	-	4.84	-	-	2.59	0.44
Carangids	7.46	26.72	0.96	1.94	15.94	2.71
Nemipterus spp.	166.57	602.38	45.58	-	359.70	61.05
Saurida spp.	8.96	34.11	4.20	-	20.57	3.49
Upeneus spp.	-	10.49	0.18	0.21	5.66	0.96
Sphyraena spp.	9.67	5.82	0.05	7.86	5.72	0.97
Priacanthus spp.	0.19	58.34	146.00	95.71	67.54	11.46
Epinephelus spp.	2.69	5.45	1.59	-	3.67	0.62
Lethrinus spp.	-	-	0.20	-	0.04	0.006
Lutjanus spp.	1.79	1.13	48.30	45.09	14.44	2.45
R. kanagurta	0.27	1.25	...	-	0.72	0.12
Trichiurus spp.	56.64	0.30	-	0.07	10.26	1.74
Sciaenids	0.09	4.93	-	-	2.65	0.45
Pomfrets	4.48	-	-	-	0.80	0.14
Catfish	215.37	8.24	2.06	-	43.14	7.32
Flat fish	-	0.12	-	0.04	0.06	0.01
Lactarius sp.	-	1.49	-	-	0.80	0.14
Pomadasys spp.	-	0.12	-	-	0.86	0.01
Chlorophthalmus spp.	-	-	-	0.29	0.03	0.005
Pseneopsis spp.	-	0.45	10.91	15.56	3.89	0.66
Other fishes	1.58	22.13	6.37	4.99	13.79	2.34
Crustaceans & cephalopods	1.98	27.04	11.21	2.90	17.10	2.90
Total	477.43	815.34	277.60	174.68	589.18	

In Andaman-Nicobar Archipelago (Table 9), where coastal waters alone yielded catches, silverbellies (91 kg/hr, 33%), carangids (50 kg/hr, 17.5%) and perches (17%) were mainly caught from the 51-100 m depth area.

Productive areas in different zones(Fig. 2a-c, 3a-d)

In determining the productive areas, average catch rate in each sub area was categorized based on the relative abundance of the fishes. In the southwest zone (Fig. 2a) sub areas such as 7-76/6F, 7-77/

TABLE 5. *Species composition of coastal and deep sea demersal fishery resources along the EEZ of India (northwest zone)*

Depth range (m) :	<50	51-100	101-150	> 150	Total	%
Effort (hrs/min) :	7/0	30/0	5/0	3/0	45/0	
Composition	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	
Sharks	1.20	7.68	-	-	5.31	1.03
Skates	-	0.47	-	-	0.31	0.06
Rays	-	15.26	-	-	0.18	1.97
Carangids	2.57	39.37	0.24	-	26.67	5.17
Nemipterus spp.	14.43	189.61	36.16	-	132.67	25.71
Saurida spp.	21.43	21.00	-	-	17.33	3.36
Upeneus spp.	64.43	8.00	-	-	15.36	2.98
Sphyraena spp.	-	13.00	-	-	8.67	1.68
Priacanthus spp.	-	9.44	21.20	8.67	9.23	1.78
Epinephelus spp.	-	21.60	7.60	-	15.26	2.96
Lethrinus spp.	-	9.42	-	-	0.28	0.05
Lutjanus spp.	1.00	3.00	-	23.00	3.69	0.71
Lutianus spp.	-	-	-	-	-	-
Other perches	-	-	-	-	-	-
Psenes indicus	-	1.13	-	-	0.76	0.15
Silverbellies	-	-	-	-	-	-
Cat fishes	45.86	3.62	-	-	09.55	1.85
Flat fishes	0.24	30.39	-	-	20.30	3.93
Sciaenids	70.43	21.75	-	-	25.46	4.93
R. kanagurta	0.29	0.33	-	-	0.27	0.05
Trichiurus spp.	240.03	139.02	0.78	-	130.10	25.21
Chlorophthalmus spp.	-	-	-	2.30	0.15	0.03
Pseneopsis spp.	-	-	-	2.23	0.15	0.03
Pomadasys hasta	0.02	0.03	-	-	0.03	0.005
Polynemus spp.	-	6.13	-	-	4.10	0.80
Dussumieria spp.	-	0.83	-	-	0.56	0.11
Lactarius sp.	21.43	0.23	-	-	3.49	0.67
Diagramma spp.	-	-	-	-	-	-
Pomfrets	2.29	-	-	-	0.36	0.07
Other fishes	49.59	60.86	4.79	-	48.82	9.46
Crustaceans & cephalopods	32.77	31.95	3.54	3.47	27.02	5.24
Total	568.02	625.15	74.31	39.8	516.03	

TABLE 6. *Species composition of coastal and deep sea demersal fishery resources along the EEZ of India (southeast zone)*

Depth range (m) : Effort (hrs/min) : Catch details :	< 50 6/25 C/E (kg)	51-100 3/40 C/E (kg)	101-150 C/E (kg)	> 150 1/100 C/E (kg)	Total 11/05 C/E (kg)	%
Sharks	105.19	-	-	-	61.36	2.75
Rays	48.62	20.45	-	-	35.18	1.58
Carangids	130.41	102.27	-	-	110.09	4.94
Nemipterus spp.	0.47	3,508.63	-	-	1,169.81	52.39
Saurida spp.	4.36	46.36	-	-	18.00	0.81
Upeneus spp.	13.66	-	-	-	7.97	0.36
Sphyraena spp.	551.84	-	-	-	321.90	14.42
Priacanthus spp.	-	19.09	-	-	6.36	0.28
Epinephelus spp.	100.75	83.18	-	-	86.45	3.87
Lethrinus spp.	37.34	-	-	-	21.78	0.97
Lutjanus spp.	6.67	-	-	-	3.89	0.17
Lutianus spp.	19.48	23.18	-	-	19.09	0.85
Other perches	5.45	69.54	-	-	26.36	1.18
Psenes indicus	7.79	95.45	-	-	36.36	1.63
Silverbellies	6.23	-	-	-	3.36	0.16
Cat fish	10.44	-	-	-	0.09	0.22
R. kanagurta	33.81	-	-	-	19.72	0.88
Trichiurus spp.	0.16	-	-	-	0.09	0.004
Fistularia villosa	0.05	-	-	-	0.03	-
Diagramma spp.	23.38	54.55	-	-	31.81	1.42
Scombromorous spp.	7.79	-	-	-	4.55	0.20
Sarda orientalis	1.56	-	-	-	0.91	0.04
Deep sea fish	-	-	-	-	110.00	4.93
Balistids	60.55	-	-	-	35.32	1.58
Other fishes	39.90	92.82	-	5.0	54.64	2.45
Crustaceans & cephalopods	39.65	54.55	-	-	41.31	1.85
Total	1255.58	4,500.00	-	5.0	2,232.87	

5B, 6C; 8-75/4E, 5D, 5E, 6E; 8-76/3E had catches above 2,000 kg/hr. Sub areas 7-77/2A, 4A; 8-75/6D, 6F and 9-75/3F yielded a catch ranging from 1,001-2,000 kg/hr. Catches within the range of 751-1,000 kg/hr were obtained from sub-areas at 8-76/4B, 8-77/1B and 9-75/1F while stations at 7-76/4A, 7-77/2A, 6A, 8-76/1F, 5A, and 9-76/1A yielded a catch rate of 501-750 kg/hr.

In the centralwest zone (Fig. 2b), sub-areas such as 10-75/6D; 11-75/3B and 4A had a catch rate of above 2,000 kg/hr, while those at 14-73/SE, 3F; 15-73/2A, 5B, 6A had catch between 1,001-2,000 kg/hr. Sub-areas such as 11-75/3A and 13-74/3B; yielded a catch rate of 751-2,000 kg/hr and those at

TABLE 7. *Species composition of coastal and deep sea demersal fishery resources along the EEZ of India (central east zone)*

Depth range (m) :	< 50	51-100	101-150	> 150	Total	%
Effort (hrs/min) :	18/0	12/0		1/0	31/0	
Composition	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	
Sharks	10.61	0.75	-	-	6.45	3.28
Skates	3.17	-	-	-	0.10	0.05
Rays	18.33	-	-	-	10.65	5.42
Carangids	16.77	37.48	-	-	24.24	12.35
Nemipterus spp.	12.29	11.42	-	-	11.55	5.86
Saurida spp.	1.04	1.92	-	-	1.35	0.69
Upeneus spp.	4.34	2.79	-	-	3.60	1.83
Sphyreana pp.	5.82	2.29	-	-	4.27	2.17
Priacanthus spp.	-	102.42	-	50.00	41.26	21.00
Epinephelus spp.	4.39	10.87	-	-	6.76	3.44
Lethrinus spp.	25.00	7.66	-	-	17.48	8.90
Lutjanus spp.	1.28	5.22	-	-	2.76	1.41
Lutianus spp.	0.28	3.43	-	-	1.49	0.76
Other perches	3.47	-	-	-	2.00	1.03
Psenes indicus	-	0.50	-	-	0.19	0.093
Silverbellies	11.69	0.25	-	-	6.88	3.51
Cat fish	0.69	-	-	-	0.40	0.21
Flat fish	0.53	0.13	-	-	0.35	0.18
R. kanagurta	1.90	0.12	-	-	1.15	0.59
Pentaprion spp.	24.62	2.08	-	-	15.10	7.69
Sciaenids	12.29	-	-	-	7.13	3.63
Pomadasys hasta	0.61	1.29	-	-	0.85	0.44
Scombromorous spp.	0.76	0.43	-	-	0.61	0.31
Diagramma spp.	1.66	2.00	-	-	1.74	0.89
Dussumieria spp.	1.33	-	-	-	0.77	0.39
Psenopsis spp.	-	20.83	-	-	8.06	4.50
Mullets	1.09	-	-	-	0.63	0.32
Other fishes	14.16	14.57	-	-	13.86	7.06
Crustaceans & cephalopods	4.89	2.56	-	25.00	4.65	2.36
Total	179.99	231.04	-	75.00	196.37	

TABLE 8. *Species composition of coastal and deep sea demersal fishery resources along the EEZ of India (northeast zone)*

Depth range (m) :	< - 50	51-100	101-150	>150	Total	%
Effort (hrs/min) :	35/15	29/45	3/0	9/0	76/0	
Composition	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	
Sharks	1.61	2.00	-	-	1.51	0.48
Skates	14.86	1.31	-	-	7.21	2.28
Rays	12.25	1.65	-	-	6.16	1.95
Carangids	16.97	67.30	6.78	2.19	34.52	10.94
Nemipterus spp.	18.79	12.75	71.49	13.81	17.91	5.68
Saurida spp.	3.87	4.43	6.77	-	3.75	1.18
Upeneus spp.	27.39	7.39	-	-	15.24	4.83
Sphyraena spp.	16.11	10.97	-	-	11.55	3.66
Priacanthus spp.	23.77	14.73	19.68	162.37	36.49	11.57
Epinephelus spp.	0.06	2.25	-	-	0.91	0.29
Lethrinus spp.	-	0.17	-	-	0.07	0.02
Lutjanus spp.	-	0.81	-	-	0.32	0.10
Lutianus spp.	4.15	0.20	-	-	1.95	0.62
Pomadasys hasta	2.14	6.18	-	-	3.39	1.07
Pentaprion spp.	5.81	3.29	-	-	3.91	1.24
Sciaenids	10.62	2.79	5.60	0.10	6.11	1.94
R. kanagurta	3.92	159.18	-	-	64.08	20.32
Silverbellies	13.47	2.05	-	-	6.87	2.18
Catfish	15.96	5.97	-	-	9.53	3.02
Flatfish	0.18	1.49	0.33	-	0.67	0.21
Trichiurus spp.	3.18	6.02	-	-	3.79	1.20
Psenes indicus	14.75	59.29	1.23	3.57	30.33	9.62
Pomfrets	6.10	10.64	-	-	6.91	2.19
Scombromorous spp.	1.27	0.49	-	-	0.76	0.24
Chirocentrus spp.	0.79	0.20	-	-	0.44	0.14
Polynemus spp.	-	0.81	-	0.60	0.07	0.02
Other fishes	26.19	11.54	7.03	11.73	17.98	5.70
Crustceans & cephalopods	18.84	34.17	11.16	2.99	22.66	7.18
Total	263.05	430.09	130.13	197.37	315.40	

TABLE 9. *Species composition of coastal and deep sea demersal fishery resources along the Andaman Nicobar Archipelago*

Depth range (m) :	< - 50	51-100	101-150	> 150	Total	%
Effort (hrs/min) :	2/30	8/30	1/0		12/0	
Composition	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	C/E (kg)	
Sharks	16.00	3.88	-	-	6.08	2.46
Skates	-	60.00	-	-	0.15	0.06
Rays	44.40	19.00	-	-	22.78	9.20
Carangids	21.34	49.64	-	-	42.50	17.20
Nemipterus spp.	-	5.16	2.50	-	0.04	1.56
Saurida spp.	-	7.74	-	-	5.48	2.20
Upeneus spp.	15.20	1.97	-	-	4.65	1.88
Sphyraena pp.	-	2.36	2.00	-	1.67	0.68
Priacanthus spp.	-	1.15	-	-	0.98	0.40
Epinephelus spp.	15.20	6.84	-	-	8.01	3.24
Lethrinus spp.	17.40	20.04	-	-	17.83	7.21
Lutjanus spp.	1.76	20.07	-	-	14.59	5.90
Lutianus spp.	-	-	-	-	-	-
Psenes indicus	-	-	-	-	-	-
Psenes spp.	-	10.59	-	-	7.50	3.04
Silverbellies	43.60	90.58	-	-	73.25	29.65
Catfish	-	-	-	-	-	-
R. kanagurta	1.60	1.18	-	-	1.16	0.47
Pentaprion spp.	5.60	1.88	-	-	2.50	1.01
Trichiurus spp.	-	3.53	-	-	2.50	1.01
Pomadasys hasta	-	0.59	-	-	0.42	0.17
Plectorhyhchus spp.	-	0.78	-	-	0.55	0.22
Pristipomoides spp.	-	5.47	-	-	3.87	1.57
Monotaxis spp.	-	2.67	-	-	1.89	0.76
Other fishes	33.36	20.34	10.15	-	22.20	8.98
Crustaceans & cephalopods	1.20	3.02	3.25	-	2.66	1.07
Total	230.92	27.80	17.9	-	247.08	

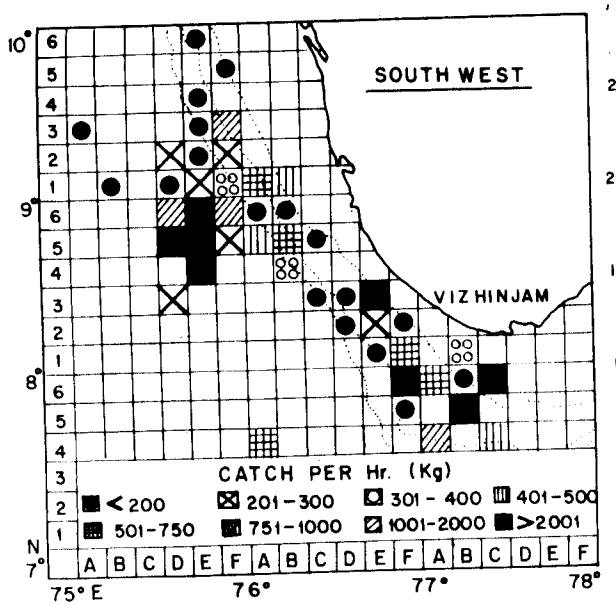

Fig. 2a. Quantitative distribution of Total fish in the southwest zone.

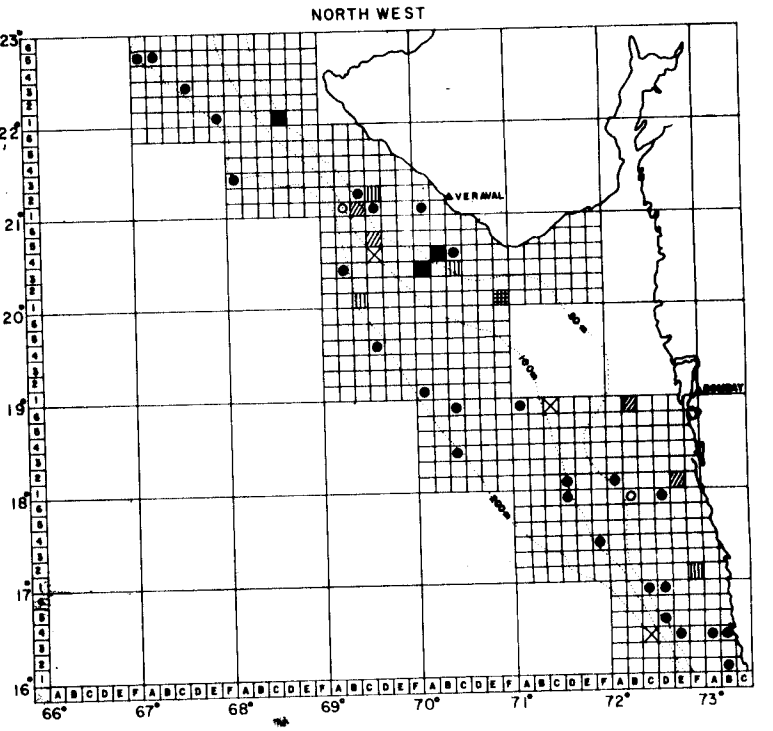

Fig. 2c. Quantitative distribution of total fish in the northwest zone. (For fish density see Fig. 2a).

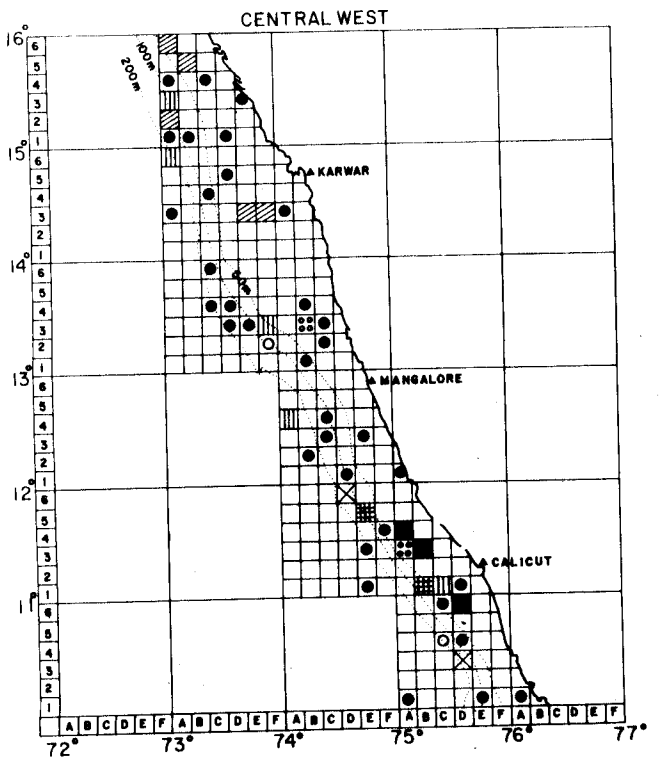

Fig. 2b. Quantitative distribution of total fish in the centralwest zone. (For fish density see Fig. 2a.

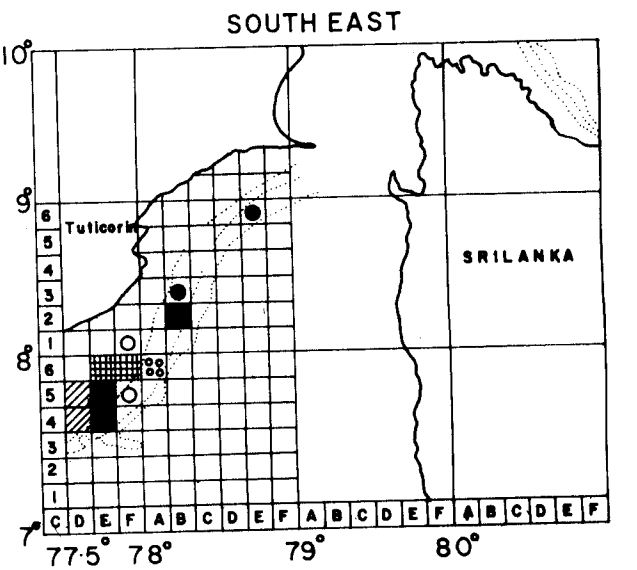

Fig. 3a. Quantitative distribution of total fish in the southeast zone. (For fish density see Fig. 2a).

11-75/1B, 11-74/5E had a catch rate of 501-750 kg/hr.

Along the northwest zone (Fig. 2c) sub-areas such as 20-70/3A, 4B and 22-68/1D yielded catches above 2,000 kg/hr while those at 18-72/1E, 6A, 20-69/50 and 21-69/1C had a catch rate of 1001-2,000 kg/hr.

In the southern zone of east coast (Fig. 3a) sub-areas such as 7-77/4E, 5E and 8-78/2B were found densely populated (catch rates above 2,000 kg/hr). Sub areas at 7-77/4D, 5D, had a catch rate of 1,001-2,000 kg/hr while those at 7-77/6E and 6F had catch rate of 501-750 kg/hr.

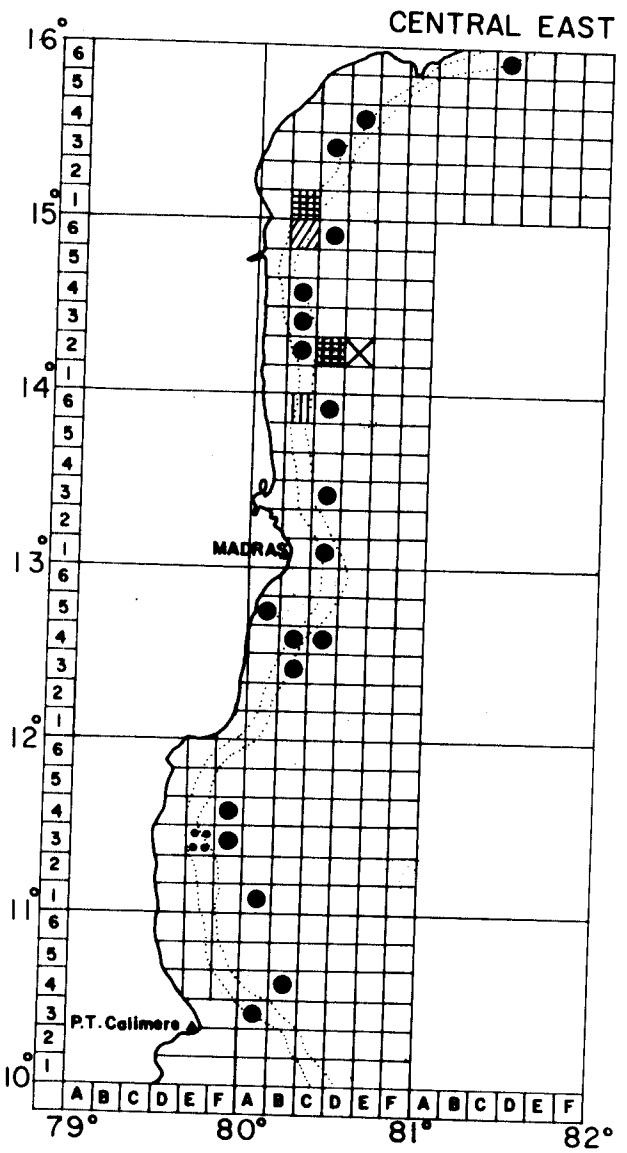

Fig. 3b. Quantitative distribution of total fish in the centraleast zone, (For fish density see Fig. 2a).

In the centraleast zone, (Fig. 3b) sub-areas such as 14-80/6B had a catch rate of 1,001-2,000 kg/hr while at 11-79/3E the catch was between 751-1,000 kg/hr. Sub-areas such as 14-80/2C and 15-80/1B had catches ranging from 501-750 kg/hr.

Along the northeast zone, (Fig. 3c) sub-areas like 19-86/5D, 20-87/3D yielded catch rate above 2,000 kg/hr. Sub areas like 16-81/1C had a catch range between 1,001-2,000 kg/hr while those at 16-82/3C had catch ranging between 501-750 kg/hr.

In the Andaman-Nicobar Archipelago (Fig. 3d) generally with less catch, sub-areas at 13-91/1D alone yielded a catch between 1,002-2,000 kg/hr.

Discussion

Based on the studies made on the nutrient concentration, chlorophyll and biomass estimation, it has already been established that Arabian Sea is more productive than Bay of Bengal. Primary productivity studies along the seas around India had shown that west coast had average value of 1.19 g $C/m^2/day$ while in the east coast it is only 0.63 g $C/m^2/day$ (Nair *et al.*, 1973). Trawl surveys conducted using R.V. *Anton Brunn* at different stations in the Arabian Sea and Bay of Bengal during 1963 had shown that west coast is about 2.5 times more productive than the east coast (Pruter, 1964). In the present study this view is further substantiated where the catch/hr along the entire west coast is 736.54 kg/hr in contrast to 463 kg/hr for the east coast. Discussing the various reasons which cause low productivity in the east coast such as narrow continental shelf, lack of upwelling and large number of rivers emptying their organic material in the land itself, Reghu Prasad (1969) quoting Panicker and Jayaram opines that a thorough understanding of the various factors is essential for finding a satisfactory solution to the major problem in the difference in fish production along the east and west coasts of India.

A closer evaluation of the species wise catch composition in different depths and the relative abundance of the major species in the productive areas reveal certain noteworthy features. Along the southwest zone, sub-areas of 8-76/3E, 8-75/4E, 7-77/4A, 5B in the depth range of 51-100 m were found to be promising fishing grounds for nemipterids and *Priacanthus* spp. Along the

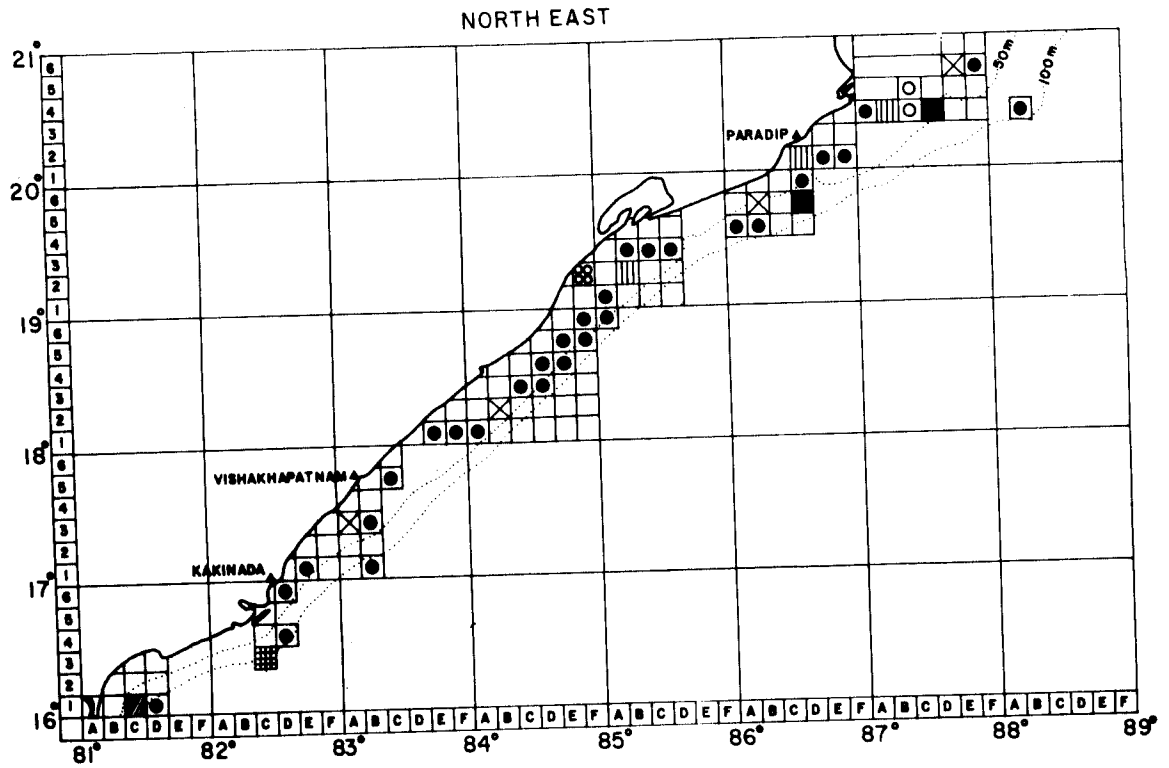

Fig. 3c. Quantitive distribution of total fish in the north east zone.

centralwest zone, sub-areas such as 10-75/6D; 11-75/3E, 3B, 4A in the shallow coastal waters were found densely populated with catfish, nemipterids and *Trichiurus* spp. While northwest zone had nemipterids and carangids in shelf waters at 21-68/1D sub area, with a catch rate upto 4,500 kg/hr, southeast zone with rich Wadge Bank area at 7-77/4E, 5E indicated dense population of nemipterids. While perches and carangids were located at 51-100 m depth range of 11-79/3E sub-area of centraleast zone, *R. kanagurta* and carangids formed the major representatives from the above depths at 16-81/1C and 19-86/5D sub areas of northwest zone. Andaman-Nicobar Archipelago, however, was sparsely populated by fishes.

While the shelf waters indicated dense congregation of a number of coastal species, the neritic waters in the depth range 151-398 m revealed promising potential for deep sea fishes like *Psenopsis* spp., *Chlorophthalmus* spp., *Priacanthus* sp., *Cubiceps* spp., *Neoepinnula* spp. and *T.auriga* especially in the sub areas of 8-75/4E, 5D, 6D in the south west zone. These fishes forming about 43% of the total fish caught from this area substantiate earlier observations emphasizing their potential stock in the deeper waters (Silas, 1969; Mohamed and Suseelan, 1973; Tholasilingam, *et al.*, 1973; Ommen, 1980,1985). Nevertheless simultaneous with attempts to exploit them, measures are also to be taken to popularise the market acceptability of these non-conventional forms. Studies made hitherto on the proximate composition of the species like *Priacanthus* spp. and *Chlorophtahlmus agassizi* have shown that they are rich in protein and fat content of 17.5% and 5.08% in the former and 14.4% and 2.8% in the latter respectively (Philip *et al.*, 1984). It is needless to say that other deep sea fishes should also be studied in this line and attempts to popularise them as food fishes are to be made.

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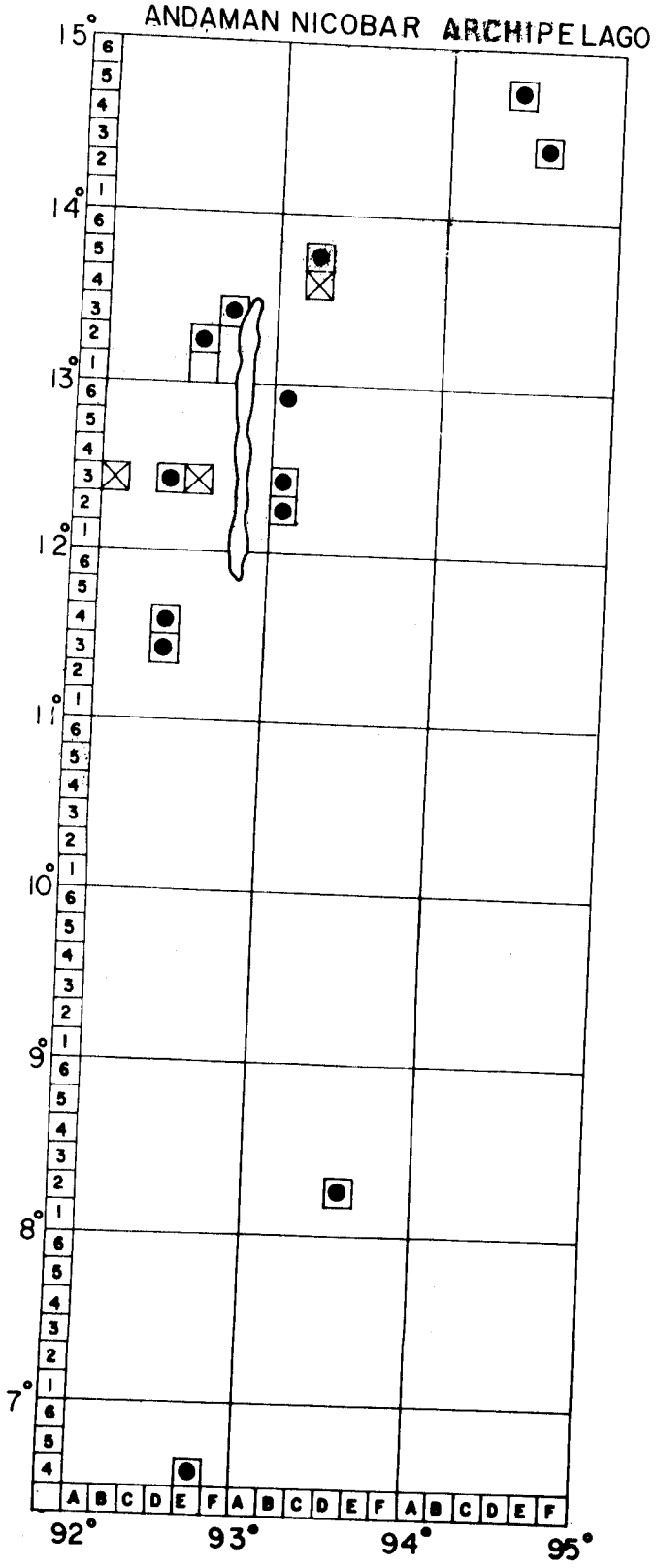

Fig. 3d. Quatitative distribution of total fish in the Andaman-Nicobar Archipelago (For fish density See Fig 2a)

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