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Estimated biomass of demersal fishes off Saurashtra coast

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ABSTRACT

Analysis of exploratory trawl survey data for the areas between latitudes 20°N (off Veraval) and 23°20'N (off Jakhau) and longitudes 68°E and 70°50'E in the Saurashtra coast for a 5-year period from 1985 to 1989 revealed that the average demersal fish biomass in this area was 430.4 kg/km^2. The biomass per unit area increased in the northwestern direction from Veraval up to Harshad. Sciaenid and ribbonfish contributed substantially to the resource, forming as high as 62.5% of total demersal biomass. During the 5-year period, the demersel biomass declined from 634.7 kg/km^2 in 1985 to 355.0 kg/km^2 in 1989, i.e. a decrease of about 44%.

Trawl survey conducted at regular intervals for a long period provides valuable information on the status of the biomass and spatial and groupwise distribution of fishes, thus enabling formulation of fishery management policies. There are only a few attempts to estimate the fish biomass of the northwest coast of India (Bapat *et al.* 1982, Rao and Kunjipalu 1989). An analysis was, therefore, done to strengthen the existing knowledge on the demersal fish biomass along the Saurashtra coast.

MATERIALS AND METHODS

During 1985–1989, the Fishery Survey of India operated one 17.5 m trawler, M V *Meena Prapi* from Porbander base. Every voyage of the trawler lasted for 5–10 days. During the 5-year period, survey was conducted in 88 squares (10′ each) between latitudes 20°N (off Veraval) and 23°20′ N (off Jakhau) (Fig. 1) at a depth range of 12–70 m. The data were provided to the Research Centre of CMFRI, Veraval.

To estimate the biomass, swept area method (Gulland 1969, Pauly 1983) was followed:

$$\text{Biomass} = \frac{AC \times C/f}{As \times X_1}$$

where Ac, area considered = area of each 10′ square (≈ 326.6 km^2) x no. of squares fished; C/f, catch/unit effort; As, area swept by gear per unit effort; and X_1, proportion of the fish in the path of the gear that were actually retained by the net.

As the value X_1 is not available, a value of 0.5, which is commonly used in southeast Asian waters (Isarankura 1971, Saeger *et al.* 1976, Anonymous 1978) has been used in the present study. Pauly (1979) opined that this value might be very realistic.

The area swept (As) by the gear during one unit of effort was computed from the expression:

$$As = t \times v \times h \times X_2$$

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where t, time spent in trawling; v, speed of the vessel when trawling; h, length of the trawl net's head rope; and X_2, a fraction expressing the width of the area swept by the net divided by the length of the head rope. In this investigation, the trawling speed was 2.5 knots. The head rope length of the trawl nets operated by M V *Meena Prapi* was 24 m. Again, as information on X_2 is not available, a value of 0.5 was used, which is suggested to be the best compromise (Shindo 1973, Pauly 1979).

For determining all year biomass, the catch in each zone (1° latitude x 1° longitude square) during the study period was pooled and the C/f was calculated; the biomass was subsequently calculated for the areas fished in each zone. Each 10′ square that was repeated over the years was considered as a single square while calculating the all year biomass. For calculating the all zone biomass, the catch in each year in the entire study area was pooled and the C/f and subsequently the biomass was calculated.

RESULTS AND DISCUSSION

The number of 10′ squares fished in the designated area and the effort employed by M V *Meena Prapi* in each zone (1° square) during the 5 year exploratory-survey period are presented in Table 1. The trawler surveyed for 4675.2 hours in 88 squares (10′) of 7 zones, covering a total area of 28740.8 km^2. Of the 7 zones, the maximum effort (2881.10 hr) was spent in 21°N 69°E (off Porbander).

For biomass estimation, 8 fish groups with catch rate above 1 kg/hr were selected. The groups thus selected were elasmobranch, catfish, carangid, sciaenid (ghol and other sciaenids), ribbonfish, perch, *Lactarius* and cephalopod. Though catfish and ribbonfish are generally considered as pelagic, they were included for biomass estimation in this study as their landings from private trawlers constitute 60 and 85% of all-gear landings in Gujarat (Balan *et al.* 1987). Groups with catch rate below 1 kg/hr were pooled as others, which included pomfret, eel, clupeid, seerfish, prawn, etc.

The annual biomass of each group and of all demersal fishes in each zone (1° square) are presented in Table 2. In the entire area surveyed, sciaenid (4020 tonne) and ribbonfish (3710 tonne) formed the maximum resource, followed by catfish (1293 tonne) and ceph-

Table 1. Annual effort (hr) and area considered in each zone (1° square) by M V *Meena Prapi*

Zone	Effort (hr)					In five years		
	1985	1986	1987	1988	1989	Effort (hr)	No. of 10′ squares	Area considered (km^2)
20°N 70°E	10.00	19.50	53.25	130.25	163.50	376.50	13	4245.8
20°N 69°E	21.00	—	31.50	29.25	56.25	138.00	10	3266.0
21°N 70°E	2.75	6.50	—	—	—	9.25	1	326.6
21°N 69°E	971.75	595.25	354.50	476.75	482.85	2881.10	22	7185.2
21°N 68°E	21.00	—	233.50	362.25	8.00	624.75	17	5552.2
22°N 68°E	—	9.25	—	55.00	568.85	633.10	20	6532.0
23°N 68°E	—	—	—	12.50	—	12.50	5	1633.0
All zones	1026.50	630.50	672.75	1066.00	1279.45	4675.20	88	28740.8

—, indicates zones not surveyed

Table 2. Biomass (tonnes) of demersal fishes off Saurashtra coast

Zone (1° square)	1985	1986	1987	1988	1989	Average (tonnes)	Average (kg/km²)	1985	1986	1987	1988	1989	Average (tonnes)	Average (kg/km²)
	i. *Elasmobranch*							ii. *Catfish*						
20°N 70°E	0	8	13	8	1	5	1.0	465	13	47	91	53	75	17.6
20°N 69°E	3	—	0	29	0	6	1.9	167	—	189	151	35	119	36.3
21°N 70°E	2	0	—	—	—	0.3	1.0	26	2	—	—	—	8	26.5
21°N 69°E	183	50	42	71	56	98	13.6	274	569	204	449	148	337	47.0
21°N 68°E	244	—	98	19	0	22	3.9	305	—	282	451	135	380	68.5
22°N 68°E	—	13	—	13	128	115	17.6	—	0	—	0	229	205	31.3
23°N 68°E	—	—	—	0	—	0	0.0	—	—	—	0	—	0	0.0
All zones (tonnes)	523	125	99	167	314	337		805	1378	733	1695	682	1293	
(kg/km²)	25.5	6.9	4.8	5.9	11.7		11.7	39.1	75.4	36.3	59.7	25.5		44.9
	iii. *Carangid*							iv. *Sciaenid*						
20°N 70°E	136	37	34	47	26	37	8.8	491	423	481	428	593	510	120.3
20°N 69°E	35	—	71	0	19	29	8.8	236	—	1035	693	245	518	158.5
21°N 70°E	5	3	—	—	—	3	11.7	61	40	—	—	—	47	142.8
21°N 69°E	133	77	14	14	6	63	8.8	1181	885	744	900	823	956	133.0
21°N 68°E	337	—	93	66	207	82	14.6	277	—	1352	776	1678	988	177.9
22°N 68°E	—	0	—	0	192	173	26.5	—	294	—	58	1041	946	144.7
23°N 68°E	—	—	—	0	—	0	0.0	—	—	—	35	—	35	21.5
All zones (tonnes)	403	197	178	167	393	366		3280	2218	3327	3476	3694	4020	
(kg/km²)	19.6	10.7	8.8	5.9	14.6		12.7	159.4	121.3	164.3	122.2	137.8		139.9
	v. *Ribbonfish*							vi. *Perch*						
20°N 70°E	0	274	311	308	703	470	110.5	669	26	37	83	21	63	14.6
20°N 69°E	1173	—	13	0	93	220	67.5	202	—	19	42	16	48	14.6
21°N 70°E	0	29	—	—	—	21	61.6	0	0	—	—	—	0	0.0
21°N 69°E	1322	983	1118	892	717	1054	146.8	183	42	21	77	106	106	14.6
21°N 68°E	760	—	945	544	27	695	125.1	1286	—	168	136	180	184	33.2
22°N 68°E	—	1035	—	1424	428	525	80.2	—	0	—	561	135	173	26.5
23°N 68°E	—	—	—	0	—	0	0.0	—	—	—	0	—	0	0.0
All zones (tonnes)	3784	2451	2990	3084	2384	3710		664	90	258	584	419	534	
(kg/km²)	183.8	133.9	147.7	108.6	89.0		129.1	32.2	5.0	12.7	20.5	15.7		18.6

Table 2 (Contd)

Zone (1° square)	1985	1986	1987	1988	1989	Average (tonnes)	Average (kg/km²)	1985	1986	1987	1988	1989	Average (tonnes)	Average (kg/km²)
	vii. *Lactarius*							viii. *Cephalopod*						
20°N 70°E	0	75	0	0	2	5	1.0	125	104	37	50	117	83	19.6
20°N 69°E	319	—	0	0	0	83	25.5	223	—	32	26	32	61	18.6
21°N 70°E	0	13	—	—	—	8	26.5	11	13	—	—	—	11	36.3
21°N 69°E	457	141	0	0	0	183	25.5	197	120	42	71	106	127	17.6
21°N 68°E	125	—	0	27	0	59	10.7	385	—	120	146	157	146	26.5
22°N 68°E	—	0	—	0	2	3	0.6	—	103	—	377	460	448	68.5
23°N 68°E	—	—	—	0	—	0	0.0	—	—	—	0	—	0	0.0
All zones (tonnes)	1368	340	0	56	3	505		603	322	258	528	1100	731	
(kg/km²)	66.6	18.6	0.0	1.9	0.2		17.6	29.4	18.6	12.7	18.6	41.1		25.5
	ix. *Others*							x. *Total*						
20°N 70°E	1331	40	20	87	197	152	36.3	3218	1001	980	1097	1711	1400.3	329.6
20°N 69°E	712	—	123	34	22	277	36.1	3070	—	1482	974	464	1201.4	367.8
21°N 70°E	75	2	—	—	—	26	72.2	180	101	—	—	—	123.5	378.4
21°N 69°E	526	83	134	35	125	241	33.2	4456	2951	2319	2509	2087	3163.1	440.1
21°N 68°E	1466	—	101	88	38	136	24.7	5186	—	3160	2254	2422	2693.1	485.1
22°N 68°E	—	154	—	276	106	114	17.8	—	1598	—	2709	2722	2702.7	413.7
23°N 68°E	—	—	—	0	—	0	0.0	—	—	—	35	—	35.3	21.5
All zones (tonnes)	1631	249	395	359	520	873		13061	7370	8238	10116	9509	12368	
(kg/km²)	79.1	13.5	19.7	12.7	19.4		30.3	634.7	402.9	406.9	356.1	355.0		430.4

—, indicates zones not surveyed

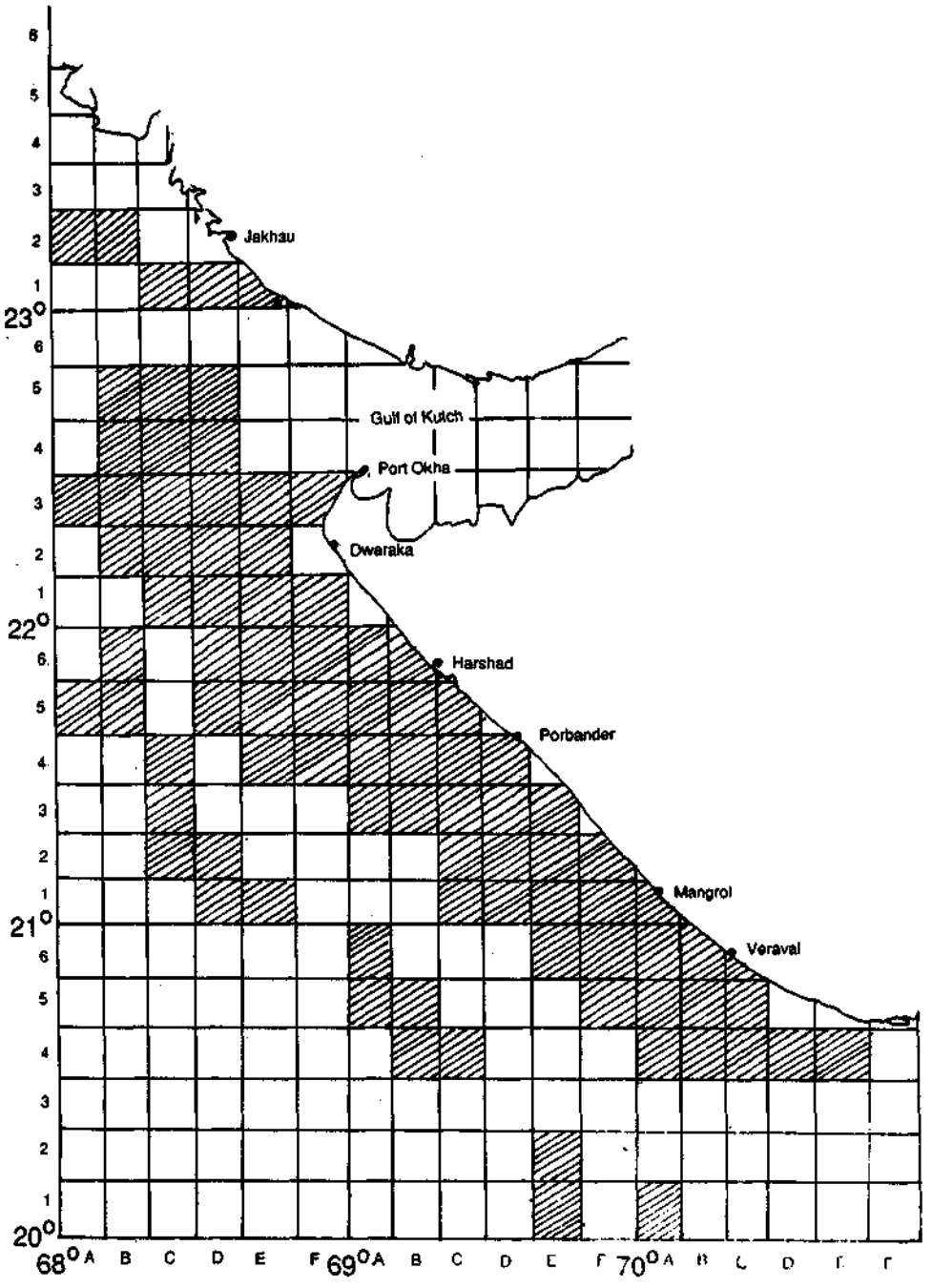

Fig. 1. Part of Gujarat coast; the shaded areas were surveyed by M V *Meena Prapi* during 1985–89.

alopod (731 tonne). Of the total demersal fish biomass of 12 368 tonne off Saurashtra, the sciaenid and ribbonfish formed 32.5 and 30.0%, respectively. The biomass of most of the selected groups and that of total demersal fish were concentrated in the zones 21°N 69°E, 21°N 68°E and 22°N 68°E (Table 2). The biomass of most of the groups (elasmobranch, carangid, ribbonfish, perch, *Lactarius*) and that of total demersal fish declined since 1985. The biomass of catfish, sciaenid and cephalopod fluctuated over the years.

The biomass estimations mentioned so far pertain only to the areas that were considered for survey in each zone (Fig. 1). Since the area considered for survey was not equal in the explored zones (Table 1), the biomass estimation of each zone did not represent resource concentration in an equal area. However, these estimates provide zone-wise and year-wise comparative abundance of the demersal groups. Analysis of data on the biomass per unit area during the 5-year period revealed that the total demersel fish biomass increased in the northwestern direction from Veraval (20°N 70°E; 329.6 kg/km^2) up to Harshad (21°N 68°E; 485.1 kg/km^2). The biomass decreased in the further northern areas off Dwaraka (22°N 68°E; 413.7 kg/km^2) and Jakhau (23°N 68°E) (Table 2). Elasmobranch, carangid, and cephalopod were abundant in 22°N 68°E and sciaenid, perch and catfish were abundant in 21°N 68°E.

The total fish biomass off Saurashtra coast during 1985–1989 was 430.4 kg/km^2. Sciaenid with 139.9 kg/km^2 and ribbonfish with 129.1 kg/km^2 contributed substantially to the resource, forming as high as 62.5% of the total demersal biomass. However, the ribbonfish biomass decreased substantially during the 5-year period and the biomass in 1989 was only about 60% of what it was in 1985. The biomass of 4 more groups, viz. elasmobranch, carangid, perch and *Lactarius* also declined during the 5 years, resulting in reduction of total fish biomass from 634.7 kg/km^2 in 1985 to 355.0 kg/km^2 in 1989, i.e. a reduction of 44%. Analysis of data on catch/hr also revealed that the catch rate of total demersal fish declined steadily from 7.9 kg/hr in 1985 to 4.6 kg/hr in 1989.

Studies on the pattern of exploitation by commercial trawlers have indicated a 40% increase in fishing effort off Saurashtra coast. For instance, the effort of trawlers operating from Veraval increased from 5.23 lakh hr in 1985 to 7.34 lakh hr in 1989. Furthermore, the cod-end mesh size of commercial trawl nets has been drastically reduced (10 mm), resulting in recruitment of very young juveniles to the fishery. Intensification of fishing effort coupled with drastic reduction in cod-end mesh size is likely to pressurize the demersal stock. These two factors are probably responsible for the declining trend in catch rate and biomass of demersal resources. The situation off Saurashtra coast calls for judicious management of exploitation immediately.

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