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RELATIVE ABUNDANCE OF TRAWL FISHES IN THE BOMBAY-SAURASHTRA WATERS*

By K. VIRABHADRA RAO, P. T. MEENAKSHISUNDARAM AND K. DORAIRAJ
Central Marine Fisheries Research Institute

WITH the help of skilled Japanese technicians very intensive commercial fishing by two pairs of bull trawlers, 'Arnalla'—'Paj' and 'Satpati'—'Pilotan' (each of 29 meters length, 250 BHP and about 91 gross tonnage) of the New India Fisheries Company, Bombay, was carried out from April 1956 to October 1963 in Bombay-Saurashtra waters, landing a total catch of 26,304 metric tons of fish sold at a whole sale price of about Rs. 1.6 crores (Anon, 1965). The annual effort varied from 2,850.97 hours to 5,453.27 hours and the catch rates from 601.60 to 899.70 kg. per hour of trawling for a pair of vessels. Fishing by these vessels was preceded by exploratory bull-trawling by the Government of India cutters, M. T. Ashok and M. T. Pratap of the Deep Sea Fishing Station, Bombay during 1953-'55. These cutters, prior to 1953 using otter trawl had annual catch rates varying from 94.4 to 195.4 lbs. per hour of fishing, but during 1953-'55 when they had taken to the Japanese method of paired trawling (bull-trawling) the average catch per vessel had gone upto 1,562.4 lbs. per hour of trawling (Jayaraman *et al.*, 1959). The present report shows that the best of trawling grounds in Bombay-Saurashtra waters are in Kutch region, the fishery potential of which was hitherto unexplored.

REGIONS OF OPERATION AND THE EXTENT OF FISHING BY TRAWLERS

The continental shelf of Bombay-Saurashtra coasts is divided into certain regions viz. 1. Bombay (lat. 18°.00′ to 19°.40′N. and long. 69°.30′ to 73°.00′E.), 2. Cambay (lat. 19°.40′ to 20°.40′N. and long. 69°.00′ to 72°.30′E.), 3. Veraval (lat. 20°.40′ to 21°.00′N. and long. 69°.00′ to 72°.30′E.), 4. Porbundar (lat. 21°.00′ to 22°.00′N. and long. 68°.00′ to 70°.00′E.), 5. Dwarka (lat. 22°.00′ to 22°.40′N. and long. 67°.30′ to 69°.00′ E.), and 6 Kutch (lat. 22°.40′ to 24°.00′N. and long. 66°.30′ to 69°.00′ E.). These regions are further divided into areas 30 miles long and 20 miles wide and are serially numbered 1 to 52 to include Veraval, Cambay and Bombay and named by alphabets A to Z in Porbundar, Dwarka and Kutch.

In the earlier operations of Ashok, Pratap and Taiyo Maru 17, the first five regions only were covered, Dwarka having been noted for the highest overall catch returns and abundance of quality fishes. It was observed that while *Ghol* occurred in considerable quantities in all regions, *Dara* and *Koth* were best obtained from Dwarka ; *Wam* very high from Cambay and Veraval, *Karkara* from Porbundar and Dwarka and catfishes and elasmobranchs from Bombay and Cambay (Jayaraman *et al.*, *loc. cit.*). The New India Fisheries Company's trawlers have fished in all the six regions and the catch analyses of these vessels have established that Kutch

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region is the most productive of all in its fishery resources. In the operations of the British trawler ' William Carrick ' in the north-western coast of India during 1921-22 the catch rates in general were extremely low ; the catch rate registered for two hauls in the Gulf of Kutch was 145 lbs. per hour of trawling which was higher than that from any other region ; and ranking next in order were Kathiawar west and south coasts with 132 lbs. and 120 lbs. respectively per hour of trawling (Hefford 1949).

For the entire eight-year period when the New India Fisheries trawlers were fishing in Bombay-Saurashtra coasts, the total yield for all fish and the number of hours expended were the highest in Kutch region ; of the six regions from Bombay to Kutch, the last one had also the highest catch rate for the entire period, except certain unspecified areas treated together which gave a slightly higher average catch rate, although the total catch and the effort spent in the said areas were low.

In 1957 December when the New India Fisheries Company's vessels commenced fishing in this region for the first time, the catch rate obtained was higher than in any other region, but the catch and the effort were low. In 1958 there was a slight increase in effort in the region, but the catch rate was moderate. In 1959 the effort was much increased and the catch rates were extremely good. During 1960-63 the annual effort, the catch and catch rate were the highest from Kutch. The annual average catch and catch rate for the period 1957-'62 when the trawlers were fishing in all the months of the year were also the highest for Kutch region, and ranking next in order were Porbundar, Cambay, Dwarka and Veraval (Tables 1 and 2).

The total amount of effort spent in Veraval region was more than that spent in Bombay, but much less than in any other of the remaining four regions. In Bombay region, excepting in 1956, when the fishing effort spent was over 693 hours, in all other years the number of fishing hours was negligible. In the aforesaid year when Bombay region was fished intensively, it gave a catch rate of 717 kg. per hour of trawling which should be considered to be fairly high. The overall catch rate for this region, as may be seen from Table I, was nearly as high as that of Veraval; the very low yields in the former were evidently due to comparatively low fishing effort expended.

Region-wise abundance of different categories of fishes

The region-wise annual abundance of catches, catch rates and percentages of different categories of fishes in the total landings for the period 1957-'62 are given in Tables II and III. While the percentage of a particular category denotes only its intra-regional abundance in relation to other groups, it does not give the amount of catch that can be obtained in a unit amount of time. The catch rates are reliable measures for determining the inter-regional abundance, for they furnish information as to how much more or how much less in amount a category of fish can be obtained in a unit amount of time from one region as compared with other regions.

Ghol (*Pseudosciaena diacanthus*) : The highest catches with the highest catch rates were from Kutch region, followed by Porbundar and Dwarka. In the other three regions, the catch and the catch rates were very low. The yields from Cambay were better than those from Veraval, but the catch rate in the latter was higher. In the region-wise landings the percentage of *Ghol* was the highest from Porbundar,

TABLE I

Region-wise Fish Landings (catch per hour) in Kg. by the New India Fisheries Company's Bull Trawlers in Bombay-Saurashtra waters for 1956-'63

Years	Bombay	Cambay	Veraval	Porbundar	Dwarka	Kutch	Unspecified	All regions
1956	497,050 (717.00)	1100,721 (869.54)	61,136 (725.13)	17,510 (390.33)	601,400 (806.12)	.. ..	26,531 (1233.09)	2304,348 (808.27)
1957	24,578 (323.19)	1287,309 (640.39)	274,763 (524.24)	899,207 (630.57)	786,156 (562.58)	1,896 (712.78)	6,737 (398.40)	3280,646 (601.60)
1958	26,863 (336.88)	1331,825 (754.01)	443,313 (634.77)	1120,517 (703.53)	639,202 (721.50)	17,970 (481.64)	1,096 (412.03)	3580,786 (707.23)
1959	36,915 (397.92)	686,210 (535.95)	283,677 (559.59)	534,313 (587.91)	482,328 (580.25)	696,564 (1,021.67)	.. ..	2720,007 (632.27)
1960	2,748 (238.96)	67,957 (470.68)	229,708 (594.79)	653,065 (718.95)	265,299 (719.44)	3029,425 (904.79)	.. ..	4248,202 (822.13)
1961	441 (252.00)	377,528 (576.33)	288,951 (701.51)	497,561 (762.39)	199,357 (834.65)	2574,709 (968.80)	.. ..	3938,547 (852.90)
1962	3,004 (527.94)	636,158 (878.83)	165,366 (626.69)	784,723 (848.58)	123,861 (881.76)	1836,428 (973.33)	.. ..	3549,540 (899.66)
1963	2,952 (203.59)	488,259 (648.39)	226,260 (642.67)	704,696 (715.86)	101,320 (853.72)	1158,546 (869.60)	.. ..	2682,033 (754.45)
Total catch in Kg.	594,551	5975,967	1973,174	5211,592	3198,923	9315,538	34,364	26304,109
Effort in hrs.	974.88	8599.15	3228.41	7439.71	4727.61	9947.25	36.22	34,953.23
Catch rate in K .	609.87	694.95	611.19	700.51	676.65	936.49	948.76	752.55
Annual average catch	15,758	731,165	280,963	748,231	416,034	1359,499	1306	3552,955
Effort	44.52	1096.71	465.34	1068.41	643.81	1435.83	3.26	4757.88
Catch rate for 1957-'62*	353.96	666.69	603.78	700.32	646.21	946.84	400.46	746.75

* In 1956 and 1963 there was no fishing in some of the months. Hence these years have been omitted for arriving at annual average.

TABLE II

Region-wise annual average catch (and catch per hour) in Kgs. under different fish categories fished by the New India Fisheries Bull Trawlers in Bombay-Saurashtra waters for the Years 1957-'62

Fish Groups	Bombay	Cambay	Veraval	Porbundar	Dwarka	Kutch	Unspecified Areas	All regions
Ghol	380 (8.53)	14,347 (13.08)	9,838 (21.14)	53,452 (50.03)	24,724 (38.40)	92,676 (64.55)	42 (12.88)	195,459 (41.08)
Koth	65 (1.46)	1,377 (1.26)	826 (1.77)	1,637 (1.53)	38,031 (59.07)	6,395 (4.45)	138 (42.33)	48,468 (10.18)
Doma	3,351 (75.27)	190,818 (173.99)	69,990 (150.40)	224,043 (209.70)	37,646 (58.47)	142,233 (99.06)	426 (130.67)	668,507 (140.50)
Dara	28 (0.63)	317 (0.29)	380 (0.81)	1,525 (1.43)	64,360 (99.96)	23,094 (16.08)	45 (13.80)	89,749 (18.86)
Shende	123 (2.76)	31,233 (28.48)	8,205 (17.63)	16,692 (15.62)	18,435 (28.63)	40,951 (28.52)	24 (7.36)	115,663 (24.31)
Karkara	951 (21.36)	8,222 (7.49)	6,123 (13.16)	39,363 (36.84)	37,950 (58.95)	207,217 (144.32)	177 (54.29)	300,003 (63.05)
Wam	3,324 (74.66)	237,372 (216.44)	62,443 (134.19)	41,460 (38.80)	26,607 (41.33)	64,564 (44.97)	21 (6.44)	435,791 (91.59)
Catfish	1,806 (40.57)	34,299 (31.27)	18,180 (39.07)	77,895 (72.91)	30,169 (46.86)	120,445 (83.89)	78 (23.93)	282,872 (59.45)
Kati	357 (8.02)	10,422 (9.50)	8,313 (17.86)	43,152 (40.39)	22,290 (34.62)	33,582 (23.39)	51 (15.64)	118,167 (24.83)
Pomfrets	126 (2.83)	4,022 (3.66)	3,736 (8.03)	15,306 (14.33)	7,092 (11.02)	19,149 (13.34)	6 (1.84)	49,437 (10.39)
Prawns	336 (7.55)	11,078 (10.10)	2,685 (5.77)	4,351 (4.07)	1,321 (2.05)	3,707 (2.58)	9 (2.76)	23,487 (4.94)
Elasmobranchs	2,050 (46.05)	136,043 (124.05)	44,495 (95.62)	80,969 (75.78)	53,510 (83.13)	191,132 (133.12)	45 (13.80)	508,244 (106.82)
Misc. fishes	2,861 (64.26)	51,615 (47.06)	45,749 (98.31)	148,386 (138.38)	53,899 (83.72)	414,354 (288.58)	244 (74.85)	717,108 (150.72)
Total	15,758 (353.96)	731,165 (666.69)	280,963 (603.78)	7482'30 (700·23)	416,034 (646.21)	1,359,499 (946.84)	1,306 (400.46)	3,552,955) (746.75

Kutch and Dwarka ranking next. The percentage of *Ghol* from Veraval was higher than that from Bombay region.

Koth (*Otolithoides brunneus*) and *Dara* (*Polydactylus indicus*) : These highly esteemed fishes have in the last ten years dwindled much in the catches. Detailed examination of the catch data of offshore fishing vessels had shown that the declining trends were clearly evident from 1958. For both these fish species the catches and the catch rates were the highest from Dwarka, but they were considerably less in all other regions including Kutch, which ranked second. *Dara*, however, had slightly higher catch rates than *Koth* in the Kutch region. The percentages of both these fishes in the total catches, were also the highest from Dwarka, with other regions registering extremely low values. The above findings denote that Dara and Koth occur in fairly high concentrations in Dwarka even in years of declining catches. For the period 1951-'57 also *Dara* catch rates were reported to be the highest from Dwarka (Nayak, 1959).

Doma (Small Sciaenids): This mixed lot of small sciaenids of uneconomic varieties fetches low prices in the markets, but its quantitative abundance is high in all regions. The catch rates were the highest for the group in Porbundar ; in Cambay and Veraval they were higher than in Kutch, Dwarka and Bombay. In Dwarka and Kutch the preponderance of quality fishes follows reduction in yields of *Doma*. Its proportion in total catches in regions from Bombay to Porbundar was very high being about 21 to 30% and in the northernmost regions far low being 10%.

Shende (*Polynemus heptadactylus*) : Cambay, Dwarka and Kutch had all given catch rates equally high, Veraval and Porbundar moderate and Bombay the lowest. Its percentage occurrence in the total catches was the highest from Dwarka closely followed by Cambay. For a restricted period of two years 1957-58 and 1958-59, the data analysed and reported earlier (Nayak, 1965) had shown similar results.

Karkara (*Pomadasys hasta*) : This is not only highly esteemed and consequently highly priced, but also occurs to a much greater extent than *Koth* and *Dara*. Hence, this fish is of very great importance in the economy of trawler fishing in Bombay-Saurashtra waters. Its catch rates were the highest from Kutch, followed by Dwarka and Porbundar. Over two-thirds of the average catch for the six-year period comes from Kutch. The contribution of Karkara catch from Dwarka and Porbundar together was to the extent of over one-sixth of the total for this species from all the regions. The difference in catch rates for *Karkara* in Kutch (144.32 kg.) and Dwarka (58.95 kg.) was very wide. In Bombay region the catch rates for *Karkara* were higher than those from Veraval and Cambay even though the catches in the former were smaller because of the low fishing effort. The percentage proportion of *Karkara* in the total catches was the highest in Kutch (15.24%) followed by Dwarka (9.12%), Bombay (6.04%) and Porbundar (5.26%).

Hence, Kutch may be said to possess excellent grounds for this species ; its percentage occurrence and the catch rates were good in some of the other regions also, viz. Dwarka, Porbundar and Bombay.

Wam (*Muraenesox talabonoides*) : In the bulk of the landings and the catch per hour returns, Cambay region has been found to be the best for this species. The catch rates of Wam from Veraval ranked second and Bombay third. While *Ghol*, *Koth* and *Dara* occurred in greater abundance in the two northern regions viz.

TABLE III

Region-wise percentage composition of different fish categories in the landing of bull trawlers based on average catch for 1957-'62

	Bombay	Cambay	Veraval	Porbundar	Dwarka	Kutch	Unspecified	All region
Ghol	2.41	1.96	3.50	7.14	5.94	6.82	3.22	5.50
Koth	0.41	0.19	0.29	0.22	9.14	0.47	10.57	1.36
Doma	21.27	26.10	24.91	29.94	9.05	10.46	32.62	18.82
Dara	0.18	0.04	0.14	0.20	15.47	1.70	3.45	2.53
Shende	0.78	4.27	2.92	2.23	4.43	3.01	1.84	3.26
Karkara	6.04	1.12	2.18	5.26	9.12	15.24	13.55	8.44
Wam	21.09	32.46	22.22	5.54	6.40	4.75	1.61	12.27
Catfish	11.46	4.69	6.47	10.41	7.25	8.86	5.96	7.96
Kati	2.26	1.43	2.96	5.77	5.36	2.47	3.90	3.33
Pomfrets	0.80	0.55	1.33	2.05	1.70	1.41	0.46	1.39
Prawns	2.13	1.52	0.96	0.58	0.32	0.27	0.69	0.66
Elasmobranchs	13.01	18.61	15.84	10.83	12.86	14.06	3.45	14.30
Miscellaneous	18.16	7.07	16.28	19.83	12.96	30.48	18.68	20.18

Dwarka and Kutch, Wam was significantly high in its yields per unit of effort in the three southern regions. The catch rates were uniformly moderate in the three northern regions. The percentage proportion of Wam in the annual average yields has been observed to follow the same order as the catch rates.

Catfishes : Tachysurus thalassinus and *T. dussumieri* contributed to the major part of the catfish catches along with small quantities of *Osteogeneosus militaris*. The catch rates and the catches were the highest from Kutch (83.89 kg./hr.), Porbundar ranking second (72.91 kg./hr.) ; in Bombay, Cambay, Veraval and Dwarka the catches varied with the effort, but the catch rates were steadily moderate (between 31 kg. and 47 kg./hr.). The percentage proportion of catfishes was the highest from Bombay, with Porbundar and Kutch ranking close behind.

Kati (*Ilisha filigera*) : Porbundar gave the highest catch rates and highest regional percentage for this species. Catch rates from Dwarka, Kutch and Veraval ranked next in order. The percentage of *Kati* in total catches was high in Dwarka also, which ranked second to Porbundar.

Pomfrets (*Parastromateus niger* and *Pampus chinensis*) : These high quality fishes were obtained in good quantities from Kutch and Porbundar with catch rates higher than in all other regions. Dwarka, Veraval and Cambay ranked next in order.

Prawns : A variety of penaeid prawns along with some palaemonid prawns is usually caught by trawlers in these waters and among them *Metapenaeus affinis* and *Parapenaeopsis* spp. are comparatively more common (Kagwade, 1964). The bull trawl not being a specialized gear for prawn fishing, the prawn catches obtained by the New India Fisheries vessels were only incidental. Since the same type of gear was used in all the regions in the same periods, the results indicate the relative regional abundance of this group. The catches and the catch rates were the highest from Cambay. In Bombay, while the catch rate ranked second, the percentage of prawns in the total catches was higher than in any other region. The catch rates for Veraval, Porbundar, Kutch and Dwarka ranked third to sixth in the respective order.

Elasmobranchs (*Sharks, Skates* and *Rays*) : These were best obtained from Kutch followed by Cambay, which ranked second. The catch rates for them from Veraval, Porbundar and Dwarka were fairly high and from Bombay moderate. In the regional percentage of these fishes Cambay had the highest followed by Veraval, Kutch, Bombay and Dwarka.

Miscellaneous fishes : Chirocentrus dorab, Lutjanus spp., *Argyrops spinifer, Lactarius lactarius, Trichiurus* spp., *Harpodon nehereus, Caranx* spp., *Cynoglossus, Scomberomorus* etc. formed a high proportion of this lot of fishes. They formed a very high proportion of the catches from Kutch, Porbundar, Bombay and Veraval. The catch rates were the highest for this group from Kutch followed by Porbundar ; they were moderately high from Veraval and Dwarka, but low from Bombay and Cambay.

From the foregoing account, it is seen that Kutch is the most productive region for the total catches in Bombay-Saurashtra waters. Taking the catch per hour of trawling as the criterion for judging the fishery potential of the grounds, Kutch has ranked either the first or the second for most of the high quality fishes and

others except in respect of *Doma*, *Wam*, *Kati* and prawns and even the later four groups occur in fair abundance.

The present note is a preliminary report of the general conclusions drawn in regard to region-wise abundance of fish groups. Detailed analysis of areawise, seasonwise and depthwise distribution of the different fish species in the landings by bull trawlers is in progress. The authors express their sincere thanks to the New India Fisheries Limited, Bombay, for making available the original log data of the skippers, which formed the basis of this report.

REFERENCES

ANON, 1965. New India Fisheries Limited : Report and Accounts for the year ending 31st March 1965.

HEFFORD, A. E. 1949. *Report on the work of 'William Carrick'*. Government Press, Bombay.

JAYARAMAN, R., SESHAPPA, G., MOHAMED, K. H., AND BAPAT, S. V. 1959. Observations on the Trawl-Fisheries of the Bombay and Saurashtra waters, 1949-50 to 1954-55. *Indian J. Fish.* 6 : 58-144.

KAGWADE, P. V. 1964. Prawn catches by mechanised vessels in the trawling grounds of Bombay and Saurashtra, *Symposium on Crustacea, Marine biol. Assn. of India*, (in press).

NAYAK, (MISS) P. D. 1959. Some aspects of the fishery biology of *Polydactylus indicus* (Shaw). *Ibid.*, 6 : 280-297.

———. 1964. Studies on the biology and fishery of *Polynemus heptadactylus* C. & V. Thesis for Ph.D. degree of the University of Bombay. (Unpublished).