REGIONAL AND SEASONAL ABUNDANCE OF THE WHITE FISH *LACTARIUS LACTARIUS* (SCHNEIDER) IN THE TRAWLING GROUNDS OFF BOMBAY — SAURASHTRA COASTS 1957-'63

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ABSTRACT

The regional and seasonal abundance of *Lactarius* in the offshore waters, heretofere unknown are studied in detail from Bombay — Saurashtra waters. Of the six regions in this zone, Kutch ranked highest in *Lactarius* fishery, both in total catch and catch rate followed by Porbunder, Dwaraka, Veraval, Cambay and Bombay regions. The fiuctuations in *Lactarius* fishery for the period 1957-'63 in the 6 subareas are discussed in detail. *Lactarius* is found to concentrate in the 20-45 m depth range, 30-35 m being optimum. The distribution pattern through the various seasons studied, showed that the depth ranges also change according to the season. The average catch rate is observed to be highest in the second quarter of the year. A gradual north-south migration of *Lactarius* from Kutch commencing in April culminates by January at Cambay.

It seems to move from the 25-40 m ranges in March-April to the 40-70 m range in May-June and the reverse movement starts in August-September.

INTRODUCTION

Lactarius lactarius, known as Perwi (Marathi), Saundala (Kannada) and Parava (Malayalam) on the west coast and Sudumu (Tamil) and Kuthippu (Telugu) on the east coast of India is a good-quality fish growing up to 25-28 cm in length. From the fishery survey data collected by the Central Marine Fisheries Research Institute it is seen that *Lactarius* has formed 0.43% (1970) to 2.37% (1959) of the total annual marine landings during the sixteen year period from 1955 to 1970*. The major part of the catch comes from the inshore fishery. The extent of the occurrence of this species in the offshore waters and its regional and seasonal abundance are not known from any of the published reports. Hence in the present work an attempt has been made to find out the regional and seasonal distribution of *Lactarius* based on the landings of the New India Fisheries bull trawlers which operated on the north-west coast of India from Bombay to Kutch during 1956-1963.

* Annual reports of the Central Marine Fisheries Research Institute, 1954-55 to 1962-70.

Annual Landings and Regional Abundance

The fishing grounds on the continental shelf off the north-west coast of India where the New India Fisheries vessels operated have been divided into areas each with 30 miles on the latitude and 20 miles on the longitude. They are either serially numbered or named by alphabets (Jayaraman *et al* 1959). The areas have been grouped into 6 regions namely Kutch (P-Z), Dwarka (K-0), Porbundar (A-J), Veraval (1-7), Cambay (8-26) and Bombay (27-52). The annual average catch of *Lactarius* from 1957-1963 (log data not available for 1959) from all the regions amounted to 2,21,243 kg forming 6.24% of the total average fish catch of 35,46,394 kg. An average effort of 4632.28 hours was expended in landing the above catch giving 47.76 kg per unit of effort (Table 1). The landings were the highest in 1960, about the annual average in 1961 and 1963, and below the average in 1957, 1958 and 1962. It will be seen from the table that the *Lactarius* catch increased steadily over the years from 1957 to 1960, then declined in the next two years and shows a rise once again in 1963. The figures for catch per hour and the percentage proportion show the same trends as the annual yields of *Lactarius*.

In respect of both the catches and catch rates of *Lactarius*, Kutch ranked first followed by Porbundar, Dwarka, Veraval, Cambay and Bombay (Table 1 & Fig. 1). The *Lactarius* catch in the Kutch region during 1957 and 1958

Table 1. *Annual catch, & Catch rate of* Lactarius *fished by bull trawlers,* 1957-1963.

Region	1957	1958	1960	1961	1962	1963	Average
Kutch	180	4554	365742	199422	127674	131706	138213
	(2.66)	(37.31)	(109.22)	(75.04)	(67.68)	(98.78)	(89.49)
							9.62%
Dwarka	12600	16416	23832	14346	6030	17478	15117
	(9.02)	(18.45)	(64.63)	(60.06)	(42.93)	(147.06)	(28.77)
							4.30%
Porbundar	82656	110682	17946	23076	19746	42138	49374
	(57.96)	(69.58)	(19.64)	(35.60)	(19.72)	(42.78)	(45.44)
							6.31%
Veraval	11461	12150	5364	11178	5112	18468	10622
	(21.86)	(17.40)	(13.97)	(27.14)	(19.37)	(47.76)	(24.18)
							3.95%
Cambay	7956	19134	1206	1944	6966	10944	8025
	(3.96)	(10.83)	(8.27)	(2.97)	(9.62)	(14.51)	(7.95)
							1.15%
Bombay	72	216	Nil	Nil	36	18	57
	(0.95)	(2.62)	(0.00)	(0.00)	(15.38)	(1.24)	(1.94)
							0.56%
Unspecified Areas	450						
	(26.61)						
Total	115375	163152	414090	249966	165564	220752	221243
	(21.16)	(32.22)	(80.24)	(54.17)	(41.58)	(41.58)	(47.76)

was very low. This was due to the fact that the vessels operated for only one and two months respectively in this region. In the subsequent years fishing was carried out more intensively. The highest catch of *Lactarius* was in 1960. In Dwarka as also in Kutch, the catch increased from 1957 to 1960

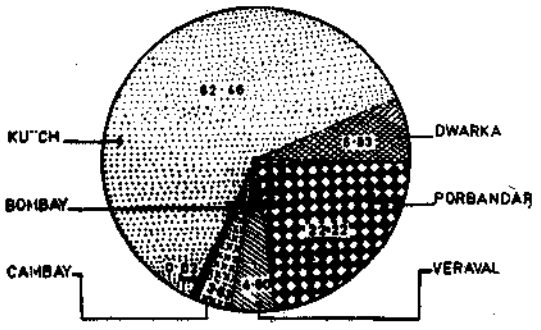

FIG. 1. Percentage of *Lactarius* catches in Bombay-Saurashtra region.

and declined during 1961 and 1962 to increase again in 1963. In the Porbundar region, in 1957 and 1958 the catches were high, but during 1960 and 1962 they were very moderate and in 1963 there was again a fair increase. In the Veraval region the catch was the highest in 1963, very low in 1960 and 1962 and during the rest of the years it was moderate. The catch per hour was the highest in 1963, and moderately high in all other years except in 1960 when it was the lowest. In the Cambay region the catches were very unsteady, the highest for the period being in 1958 and the lowest in 1960; the catch rates were the highest in 1963 and the lowest in 1961. The Bombay region was poorly exploited by the New India Fisheries vessels as is shown by an average of 29.30 hours only expended in this region against 439.54 hours (Veraval) to 1543.84 hours (Kutch) in the other regions. The annual average catch for Bombay was very low, being 57 kg only, which is too meagre for a study of the annual fluctuations (Table 1).

To ascertain the area-wise distribution of *Lactarius* annual averages for this species have been taken based on the catch data for three alternate years namely 1958, 1960 and 1962 in the continuous period of 5 years from 1958 to 1962. The region-wise and area-wise data on catch and catch rates are shown in Table 2. It will be seen that areas yielding high catches and catch rates are in the Kutch region; thus areas 'V', 'S', 'P', 'X' & 'R' yield a catch rate of 196.40, 177.55, 138.46, 132.12 & 105.06 kg|hour, the rest of the areas giving catch rates varying from 15.38 to 96.49 kg|hour. From the catch abundance 'R' ranked first with over 95 tonnes. In general it can be stated that 'R', 'S' and 'V' have proved to be very good areas from the point of view of catches as well as the catch rates.

TABLE 2. *Average Areawise Catch particulars of* Lactarius *for the years,* 1958, 60 & 62.

KUTCH										DWARAKA			
P	Q	R	S	T	U	V	X	Y	Z	K	L	M	N
162	19194	95472	7608	1170	10236	28344	2328	3546	18	216	60	1818	13329
(138.46)	(41.11)	(105.06)	(177.55)	(63.48)	(70.56)	(196.40)	(132.12)	(96.49)	(15.38)	(3.51)	(6.07)	(12.21)	(54.46)
PORBUNDAR										VERAVAL			
A	B	D	E	H	I					1	2	3	
26238	102	10020	8526	6858	Nil					Nil	1548	5994	
(57.71)	(2.79)	(108.57)	(32.06)	(15.61)	(0.00)					(0.00)	(7.40)	(24.96)	
CAMBAY										BOMBAY			
10	11	12	17	18	19	23	24	25		30	31	38	43
2904	4272	876	402	954	36	Nil	Nil	Nil		Nil	Nil	72	12
(17.91)	(8.16)	(15.91)	(5.59)	(12.82)	(3.55)	(0.00)	(0.00)	(0.00)		(0.00)	(0.00)	(3.86)	(1.01)

In Dwarka, of the four areas fished i.e. 'K' to 'N' the catch rates are generally poor except in 'N' which has registered over 50 kg|hr. The highest average catch for this region also has been from this area, being slightly over 13 tonnes.

Porbundar has yielded much better catches and catch rates than Dwarka. For this region the highest catch rate is over 100 kg|hr from area 'D' for a catch of over 10 tonnes. However, the highest catch of over 26 tonnes with a catch rate of about 57 kg|hr has been from area 'A'. Thus areas 'A', 'D' and 'E' are fairly productive.

In Veraval, of the three areas fished, area '3' has given the highest catch rate of only about 25 kg|hr. The catch was nil in area '1' and very moderate in area '2' with an extremely poor catch rate.

In the Cambay region the highest average catch rate has been only 18 kg|hr in area '10'. Areas '12' and '18' have registered about 16 and 13 kg|hr and in the rest of the areas the catch and the catch rate have been either nil or extremely poor.

In the Bombay region the highest catch rate has been only 4 kg|hr for an extremely poor catch of 72 kg obtained in area '38'.

Regional Depth-wise Distribution

Taking all the regions together *Lactarius* seems to be concentrated between the depth ranges of 20-25 and 35-40 m. Based on the averages of the three years 1958, 1960 & 1962 the depth range 30-35 has been found to give the highest average catch rate of 80.61 kg|hr. It is slightly less (76.22 kg|hr) in the next higher range of 35-40 m. But this depth range gives consistantly high catch rates during most of the months (January-April, ranging from 36.21 to 116.58 kg|hr and again during September-October, 187.44 & 121.25 kg|hr). The average catch rate in the lower depth range going higher because of the very high catch rate of 173.15 kg|hr in this range as compared to 12.50 kg|hr in the other, during the single month of August. The catch rates decline steadily from the 40-45 depth range to the greatest depths the trawlers fished. It can be concluded that the best catch of *Lactarius* could be made in the depth ranges 30-35 & 35-40 during February-May and August-November where the catch rate variation is from 56.04 to 173.15 kg|hr.

In the different regions in the different depth ranges there seems to be no uniformity in the extent of the availability of *Lactarius* (Table 4). In "Kutch" the most productive depth range seems to be 30-35 m. The catch rates have been found to decrease gradually on either side of this range but in the deeper ranges namely 50-55 m and 55-60 m there was again a slight rise. In "Dwarka" on the other hand the highest concentration seems to be in the 35-40 m range. A sudden and high increase in the catch rate was noticed in the 45-50 m range, but this is due to only 6 to 6½ hrs fishing effort.

TABLE 3. *Average depth-wise, monthly landings of* Lactarius *for all regions,* 1958, 60 & 62.

Depth range	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
20-25	18	Nil		738					Nil	3474	5607	207	6444
	(0.24)	(0.00)		(134.43)					(0.00)	(63.07)	(147.16)	(7.01)	(63.30)
25-30	783	8496	11238	3987	Nil			1764	369	11727	7485	13706	46211
	(7.52)	(49.54)	(132.06)	(125.49)	(0.00)			(100.28)	(27.21)	(135.12)	(64.44)	(55.13)	(69.09)
30-35	2622	5718	10621	10878	3744	27	Nil	3141	26198	3780	5706	3198	65841
	(20.97)	(56.04)	(110.16)	(98.64)	(70.89)	(3.79)	(0.00)	(173.15)	(158.37)	(83.70)	(60.18)	(30.61)	(80.61)
35-40	9786	12300	26966	11928	6024	189	90	1170	26172	9657	3120	3974	96919
	(36.21)	(60.49)	(116.58)	(105.40)	(70.27)	(2.28)	(9.82)	(12.50)	(187.44)	(121.24)	(58.33)	(14.21)	(76.22)
40-45	918	3210	3240	1134	8598	750	1458	1530	1548	1782	72	764	21101
	(21.94)	(134.31)	(10.60)	(48.38)	(21.53)	(5.54)	(12.04)	(4.24)	(15.21)	(21.63)	(28.80)	(22.52)	(27.45)
45-50	72	180	72	558	1125	1350	1320	192	198	18		Nil	4044
	(21.05)	(73.47)	(3.27)	(60.85)	(38.53)	(18.88)	(8.72)	(4.38)	(5.95)	(1.62)		(0.00)	(12.45)
50-55			36	Nil	3798	198	48	294	162	90			3168
			(5.12)	(0.00)	(75.18)	(4.01)	(0.07)	(4.84)	(2.56)	(3.63)			(12.66)
55-60				252	144	54	174	112	90	198			984
				(8.79)	(16.65)	(4.11)	(1.85)	(1.69)	(2.67)	(3.30			(3.87)
60-65				81	2142	18	90	225	Nil	126			2520
				(1.96)	(55.94)	(0.74)	(1.50)	(1.05)	(0.00)	(8.08)			(11.60)
65-70					126	234	198	Nil	18	18			354
					(3.15)	(13.64)	(6.17)	(0.00)	(0.71)	(2.63)			(6.41)
70-75					18	18	Nil	Nil					18
					(15.65)	(0.63)	(0.00)	(0.00)					(1.50)
Total	14199	29904	52173	29556	25719	2838	3378	8428	54755	30870	21910	21849	247604
	(24.61)	(57.76)	(69.80)	(79.89)	(56.47)	(7.05)	(6.12)	(9.52)	(89.74)	(66.07)	(72.08)	(57.24)	(55.64)

TABLE 4. *Depth-wise catch and catch per hour of* Lactarius *in different regions* (1958, 60, 62)

Regions|Depth	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75
Kutch	16308	101592	139560	189414	41850	2592	5742	772	108	—	—
	(80.37)	(89.25)	(116.73)	(101.09)	(60.49)	(39.32)	(62.82)	(100.78)	(49.54)		
Dwaraka	3024	8640	5242	24152	2232	2988	—	—	—	—	—
	(35.40)	(18.39)	(15.33)	(54.68)	(41.52)	(403.78)					
Porbundar	Nil	27824	45342	58704	11086	4788	558	54	18	Nil	—
	(0.00)	(90.39)	(71.99)	(68.34)	(13.88)	(10.28)	(4.22)	(0.91)	(1.26)	(0.00)	
Veraval	Nil	522	4680	10350	4140	216	1836	648	234	Nil	Nil
	(0.00)	(22.92)	(26.89)	(50.72)	(14.72)	(1.27)	(7.73)	(3.31)	(2.00)	(0.00)	(0.00)
Cambay	—	54	2700	8136	3942	1512	1224	1422	7200	1062	54
		(3.02)	(25.76)	(18.83)	(10.93)	(6.09)	(4.41)	(3.38)	(13.91)	(6.86)	(1.55)
Bombay	—	—	Nil	Nil	54	36	144	54	Nil	Nil	—
			(0.00)	(0.00)	(2.69)	(2.20)	(10.35)	(3.10)	(0.00)	(0.00)	

In "Porbundar" the concentration is found to be the highest in 25-30 m range, the catch rates declining gradually both in the shallower and deeper ranges unlike in "Kutch". In "Veraval" also the same pattern of concentration as in "Kutch" and "Porbundar" is shown except that the highest catch rate has been from the 35-40 m range as in "Dwarka". The pattern of distribution of *Lactarius* in the "Cambay" region is the same as that of "Kutch" but the decline of the catch rate in the deeper ranges is gradual except for a rise in the 60-65 m and 65-70 m ranges. In "Bombay" region the fish has been obtained in the 40-45 to 55-60 m depth ranges only, during the infrequent operations of the trawlers.

Out of the 35 areas covered in all, five areas have been fished for less than an hour or a few hours only, and even though such areas have given high catch rates they have not been discussed in the following account of depth-wise distribution in different areas as they fail to give a correct picture of the distribution pattern of the species in time and space. Only areas which have been fished for over 10 hours have been taken into account for the purpose of this study.

In the Kutch region the eight areas 'Q', 'R', 'S', 'T', 'U', 'V', 'X' and 'Y' fished for a significant length of time, have given constantly high catch rates. They have been higher in the shallower — 20-25 to 35-40 m depth ranges than in the deeper ones. In the former ranges the catch rates have generally been 100 kg|hr or more (the highest of 589.67 kg|hr being in the area 'S') while in the latter they have been less than 70 kg|hr except in the depth ranges 55-60 and 60-65; 45-50 and 50-55; and 40-45 m ranges in the areas 'R', 'V' & 'Y' where they have been above 100 kg|hr (Table 5).

In Dwarka the areas fished were 'K' to 'N'. In the first three areas the catch rates in general have been poor, varying from 0.00 to 42.98 kg|hr; in area 'N' they varied from 4.86 to 69.64 kg|hr. There has been an unusually high catch rate of 468.29 kg|hr in this area in the 45-50 m for an effort of 6.15 hours.

The areas 'A', 'B', 'D', 'E' and 'H' which form part of the Porbundar region have been fished from 20-25 to 60-65 m ranges. Of these 'B' yielded no *Lactarius* in the 30-35 to 45-50 m depth ranges. In the remaining ranges the catch rates varied from 3.24 to 12.00 kg|hr. In the rest of the areas the catch rates have been better in the shallower depth ranges of 25-30 to 35-40 m. They varied from 46.78 to 156.61 kg|hr as against 0.00 to 26.69 kg|hr in the deeper ranges, exception being in area 'D' in the 40-45 m range with a catch rate of 94.21 kg|hr.

In the Veraval region areas '2' and '3' have been fished for an appreciable length of time. In these areas also the catch rates have been higher, being 24.07 to 103.30 kg|hr in the shallower than in the deeper ranges where it varied from 1.16 to 34.26 kg|hr.

TABLE 5. *Depth-wise distribution of* Lactarius *in the different areas* (1958, 60 & 62)

Area|Depth range	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75
1	2	3	4	5	6	7	8	9	10	11	12
A	—	12330	24660	37296	3258	1008	198	—	—	—	—
		(110.06)	(71.91)	(65.88)	(26.69)	(7.70)	(2.80)				
B	—	—	Nil	Nil	Nil	Nil	234	54	18	—	—
			(0.00)	(0.00)	(0.00)	(0.00)	(8.19)	(12.00)	(3.24)		
D	—	7164	11556	9218	2052	Nil	—	—	—	—	—
		(90.90)	(102.55)	(156.61)	(94.21)	(0.00)					
E	Nil	8424	4338	9218	3132	2556	90	Nil	Nil	—	—
	(0.00)	(69.53)	(51.66)	(46.78)	(14.42)	(17.53)	(4.94)	(0.00)	(0.00)		
H	—	—	4896	4950	2610	1224	36	—	—	—	—
			(55.74)	(27.61)	(6.10)	(7.10)	(2.71)				
K	Nil	36	450	54	Nil	—	—	—	—	—	—
	(0.00)	(0.62)	(6.29)	(1.36)	(0.00)						
L	—	Nil	162	18	Nil	Nil	—	—	—	—	—
		(0.00)	(26.38)	(2.35)	(0.00)	(0.00)					
M	2916	1098	1368	Nil	—	—	—	—	—	—	—
	(22.94)	(42.98)	(19.92)	(0.00)							
N	36	7488	2650	22694	2250	2988	—	—	—	—	—
	(4.86)	(69.33)	(13.98)	(62.05)	(69.64)	(468.29)					
P	—	—	—	162	—	—	—	—	—	—	—
				(138.46)							
Q	12546	7740	4482	10800	13410	1944	774	—	—	—	—
	(97.68)	(47.60)	(21.72)	(21.64)	(43.57)	(66.44)	(59.40)				

TABLE 5. (*Continued*)

1	2	3	4	5	6	7	8	9	10	11	12
R	936 (120.77)	43902 (91.22)	117090 (122.20)	95778 (106.82)	20448 (73.09)	900 (27.41)	810 (55.86)	5256 (119.45)	702 (106.69)	108 (49.54)	—
S	—	—	2376 (108.64)	19188 (589.67)	666 (25.78)	108 (9.29)	482 (13.14)	—	—	—	—
T	1170 (63.48)	—	—	—	—	—	—	—	—	—	—
U	720 (19.01)	18828 (77.39)	6156 (112.68)	5004 (54.42)	Nil (0.00)	—	—	—	—	—	—
V	576 (130.32)	11880 (211.76)	60480 (233.10)	10656 (132.37)	144 (24.66)	1044 (100.38)	252 (107.69)	—	—	—	—
X	360 (144.00)	—	6228 (163.85)	126 (57.14)	108 (15.81)	72 (66.67)	18 (16.67)	72 (65.45)	—	—	—
Y	—	2952 (105.96)	288 (50.70)	234 (42.39)	2934 (117.41)	666 (78.35)	—	—	—	—	—
Z	—	—	—	—	—	18 (15.38)	—	—	—	—	—
I	—	—	—	—	—	Nil (0.00)	Nil (0.00)	—	—	—	—
1	—	—	—	—	—	—	—	—	—	—	Nil (0.00)
2	Nil (0.00)	—	—	344 (103.30)	432 (5.42)	90 (1.16)	1098 (9.29)	270 (1.81)	316 (0.33)	Nil (0.00)	—
3	—	522 (24.07)	4680 (41.95)	9390 (52.35)	1854 (13.96)	36 (0.43)	738 (6.19)	90 (2.32)	198 (34.26)	—	—
10	—	—	—	72 (12.08)	72 (2.21)	990 (22.77)	792 (8.13)	504 (11.51)	6030 (70.38)	90 (8.44)	Nil (0.00)

11	—	—	342 (23.90)	5832 (19.63)	3708 (13.47)	486 (3.99)	270 (2.64)	414 (2.27)	720 (3.88)	432 (5.10)	Nil (0.00)
12	—	Nil	630 (42.71)	1692 (14.29)	306 (10.80)	Nil (0.00)	—	—	—	—	—
17	—	—	—	—	Nil (0.00)	36 (5.29)	Nil (0.00)	198 (2.40)	396 (4.76)	306 (9.78)	36 (5.11)
18	—	18 (9.00)	918 (18.40)	630 (21.49)	324 (10.95)	Nil (0.00)	18 (0.94)	Nil (0.00)	Nil (0.00)	18 (15.38)	—
19	—	36 4.82	Nil (0.00)	—	—	—	—	—	—	—	—
23	—	—	—	—	—	—	—	—	—	—	Nil (0.00)
24	—	—	—	Nil (0.00)	Nil (0.00)	—	Nil (0.00)	—	Nil (0.00)	Nil (0.00)	Nil (0.00)
25	—	Nil (0.00)	—	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—	—	Nil (0.00)	—
31	—	—	—	Nil (0.00)	—	—	—	—	—	—	—
38	—	—	Nil (0.00)	Nil (0.00)	54 (3.01)	18 (1.66)	126 (12.00)	Nil (0.00)	—	—	—
43	—	Nil	Nil (0.00)	—	18 (7.20)	18 (4.63)	Nil (0.00)	Nil (0.00)	—	—	—

Eight areas were fished in the Cambay region. Here as in Dwarka the catch rates were rather poor, the highest being 70.38 kg|hr only. In the two areas '11' and '18' the catch rates were comparatively better. The only difference from the other regions and areas being that the catch rates did not vary very much from the shallower to deeper ranges.

In Bombay region only four areas have been fished but the effort spent and the catch rates obtained have been insignificant. The only catch obtained has been from the 40-45 to 50-55 m ranges in the areas '38' and '43'.

Season-wise, Depth-wise Regional Abundance

The season-wise abundance of *Lactarius* for all regions considered together shows that catches were high during the first two quarters; then they dropped down to nearly one half during the third, and rose again in the fourth quarter. In the first two quarters the average catch rates were 56.32 kg|hr and 57.06 kg|hr respectively, but in the third quarter the catch rate was low being 25.70 kg. In the fourth quarter it was again fairly high (52.43 kg). The catch trends seem to be fairly steady round the year except during the monsoon period corresponding to the third quarter of the year (Fig. 2).

In Kutch the second quarter has given the highest catch rates. It declined in the third and fourth quarters and was lowest in the first quarter. In the southern region of Dwarka the catch was the highest in the third quarter, but dropped steeply in the fourth quarter, was the lowest in the first quarter and showed a significant rise in the second quarter. In the still more southern region of Porbundar the highest catch rate was in the fourth quarter. The decline in the catch rates during the second and third quarters was appreciable. In Veraval the catch rate was the highest during the first quarter and declined during the second and third quarters. In Cambay the variations in the catch rates were the same as in Veraval in the different quarters.

Thus the gradual shifting of the highest value of the catch rates from the second quarter in the morthernmost region of Kutch to the III quarter in Dwarka, then to the IV quarter in Porbundar, to the first quarter in the still southern regions of Veraval and Cambay seems to indicate a southward movement of *Lactarius* from April of the previous year to March of the next from Kutch to Cambay.

The pattern of distribution of *Lactarius* in the different depth ranges varied with the seasons. As can be made out from the catch rates (Table 3) the concentration was more in the 25-40 m ranges during March and April. In May and June the fish seems to move to greater depths — (30-55 m). In July the catch was generally poor but much better in the 40-70 m ranges, thus indicating the movement of the fish to the deeper waters during the monsoon. In August-September the fish returns back to relatively shallower waters as the

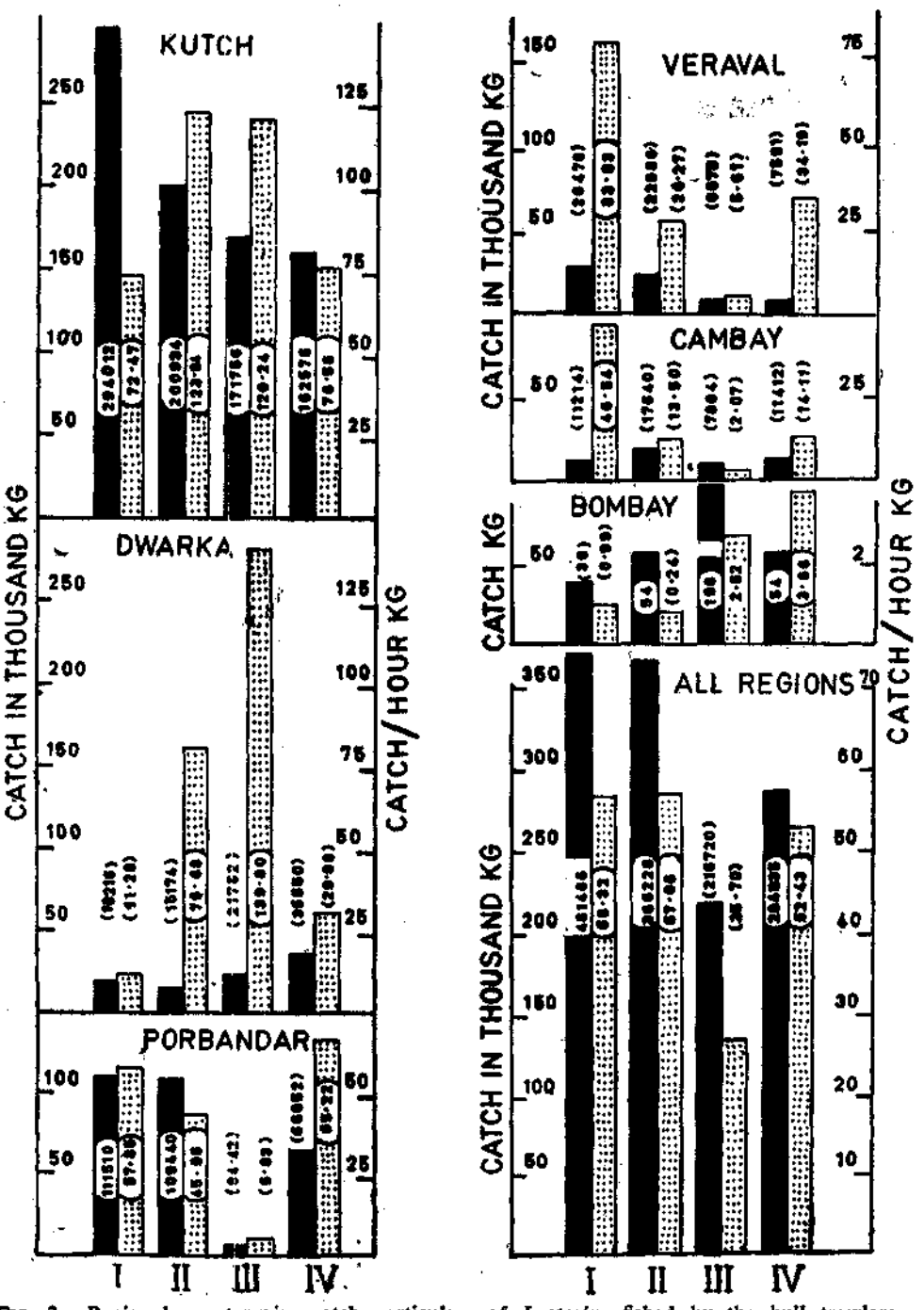

FIG. 2. Regional quarter-wise catch particulars of *Lactarius* fished by the bull trawlers, 1957-63 (Block columns catch in kg; stippled column catch rate).

catch rates are once again higher in the 30-35 to 40-45 m ranges; during October-January the fish moves to still shallower depth range 20-40 m; it is again available in larger quantities in the medium depth ranges in February. During May-September the fish is obtained from all the depth ranges from 25-30 to 70-75 m. In the last three months as in the first four months, there is a good concentration of *Lactarius* in the shallower regions. Unfortunately there is no data of fishing being carried out in the deeper ranges during the first and fourth quarters and hence it is difficult to assess the relative abundance of the fish in the deeper and shallower waters during the respective quarters.

In the Kutch region area 'R' was fished during all the twelve months and *Lactarius* was landed in every month except July. During the first four and the last four months fishing was restricted to the 25-45 m range and only in May was the extended range of 30-65 m fished. The catch rates were comparatively poor in the depth ranges fished in January, June-August and December. The catch rates were consistantly good in all the depth ranges during the rest of the months. 'Q' was fished in all the months except July. There were no *Lactarius* landings in September. Fishing was restricted to the shallower depth ranges of 20-45 m during most of the months, only in May was the deeper range of 50-55 m exploited. The catch rates in all the months in all the depth ranges were not as high as in area 'R', but the monthly fluctuations in the catch rates in the depth ranges were the same as in 'R'. Area 'U' was fished for nine months in the shallower — 20-45 m range. The catch per hour was more than 100 kg|hr in the 30-35 m range during February and in the 25-30 m range in March, August and October. Areas 'S' and 'V' were exploited for eight months. In 'S' the depth range of 30 to 55 m was fished; while in 'V' it was from 20 to 60 m. In the former, fishing was mostly in depths of 30-40 m but in May and July it was in 45 to 55 m range and in August in 30 to 60 m range. In the latter, the deeper ranges were operated during August and September, and the shallower ones in the rest of the months. Area 'S' gave exceptionally good catch rates in the 35-40 m range in September and October. Area 'V' in the 30-35 m range in February, March, August, September and November and in the 45 to 55 m range in September and in the 20 to 30 m ranges in April, October and November has given very good catch rates. Areas 'X' and 'Y' have each been operated for four months only. In 'X' the deeper ranges were fished during May, and the shallower ones in April, September and November. The depth ranges 30-35 m in April and September, 45-40 m and 55-60 m in May have also shown appreciaiy high catch rates. In 'Y' the fishing operations were restricted to the shallower range of 25 to 50 m; and except for January the catch rates were fairly high in the ranges where fishing was carried out. Areas 'Z' and 'P' have been fished for only a single hour each and 'P' gave a fairly high catch rate.

In Dwarka, area 'N' only has been fished for 10 months, there being no fishing during July and August. During June a single depth range 45-50 m

was fished with a high catch rate of 468.29 kg|hr. In other months fishing was carried out from 20 to 45 m range. In May and September in the depths of 35 to 45 m and in October in 25 to 35 m range very high catch rates were obtained. Though 'K' has been fished for eight months in depths from 20-45 m, the yield was nil, except in March, April and December when it was poor. In area 'M' 20 to 40 m depth range only were fished during the six months January-March, and October-December. Except for the two months of October and November when fairly good catch rates were obtained in the 20 to 35 m range, the yield was uniformly poor in all the other months. Area 'L' was worked for four months in the depth ranges of 35 to 50 m. The catch rate was poor in all the months in all the depths except in the 30-35 m range in December when the catch rate was about 48 kg|hr.

In Porbundar area 'A' has been fished for all the twelve months but no *Lactarius* were landed during September and October. The deeper depths were worked from June to August though the yield was very poor. In the other months operations were restricted to 25 to 40 m ranges. The yield was above 100 kg|hr in the depth range of 40-45 m during February, in the 30-35 m in November and in 25-30 m range in December. During the remaining months the yields were uniformly moderate. Area 'E' fished for eleven months yielded no *Lactarius* during August and September, even though all the ranges from 30-35 to 60-65 m were covered in July there was no yield of *Lactarius* except in the 45-50 m and 50-55 m ranges. During the remaining months when the 20 to 45 m ranges were fished the yield was moderate in all the ranges except in the 25-30 m range in November, when the catch rate was above 100 kg|hr. Area 'D' was fished in all the months except July and October. No *Lactarius* was obtained during August and September. The depth ranges in which *Lactarius* was found were 25 to 45 m. Except for the range 30-35 m in March and December all the depth ranges yielded fairly good quantities of *Lactarius*. Area 'H' was fished for nine months; in September there was no catch of *Lactarius*. The deeper ranges were worked during July and August; during the earlier six months, the operations were carried out in the depth ranges of 30-35 to 40-45 m. The catch rates were nil in 30-35 m and 35-40 m in June and in the 50-55 m range in August. They were very good being over 100 kg|hr in 30-35 m range in April and August. In the rest of the depth ranges the catch rates were moderate. Area 'I' was fished only in July covering two depth ranges, 45-50 m and 55-60 m with no yields.

In Veraval area 1 was fished during July only, in the 70-75 m range and yielded no *Lactarius*. Area '2' was fished for six months with yields only from the deeper ranges of 35 to 70 m. There were no *Lactarius* catches in the 45-50 m range during May, in the 50-55 m and 65-70 m ranges in July and in the 50-60 m ranges in August. Fishing was carried out during the twelve months in area 3. No *Lactarius* were landed in June and October; nor were the landings appreciable from the 40-45 m range in September or the

35-40 m range in November. In July too, only two ranges 40-45 m and 60-65 m gave low catch rates while the rest of ranges from 30-35 m and deeper had none. During the remaining months fairly good yields were obtained from the 25-45 m ranges.

In the Cambay region in all the depths the catches and catch rates of *Lactarius* were very poor. In areas '23' to '25' the effort expended was low and in all the depths fished the catch was nil. Area '19' was fished in October only to give a catch rate of less than 5 kg|hr in the 25-30 m range, and none in the 30-35 m range. Area '18' was fished a little more intensively for seven months. The highest catch rate was 34.2 kg|hr, in the 35-40 m range in October. 30-35 m, 40-45 m and 50-55 m ranges in October and 65-70 m range in May gave catch rates varying between 13.5 and 19.2 kg|hr. In the other depth ranges the catch rates were either extremely poor or nil. In area 17 the highest catch rate was 22.8 kg in May in the 65-70 m range. Depth ranges 45-50 m in August, 60-65 m and 70-75 m in May yielded catch rates between 11 and 15.6 kg|hr; the other depth ranges did not record even moderately high catch rates. Area '12' proved to be slightly better than '17' where the catch rates were upto about 57 kg|hr in the depth range of 30-35 in October, and in 35-40 m in January. Area '11' was fairly intensively fished. Fairly high catch rates between 32.17 and 54.83 kg|hr were obtained in January in the 30-35 m range, in February in 35-40 m and in March in the 35-45 m ranges. Moderate catch rates varying between 10.11 and 29.59 kg|hr were obtained in the depth range 35-40 m in August, October and November; in the 40-45 m range in February, August and October; in the 45-50 m range in April. Though area '10' had been fished for 10 months the catch rates were not very high except in the depth ranges of 50-55 to 65-70 m in May and in the 45-50 m range in February, where it varied from 78.36 to 22.84 kg|hr. The depth range 45-50 m recorded an extremely high catch rate of 354.93 kg|hr in April but the effort spent was only one hour.

As stated already *Lactarius* landings were too meagre in the Bombay region to merit any comparison with the other regions.

General Considerations

Jayaraman *et al* (1959), assessing the regional abundance of catches in Bombay-Saurashtra waters up to Dwarka, stated that the latter region was the richest for the total landing and also for quality fishes. It has been noted by them that *Dara* and *Koth* fisheries were the highest in Dwarka, and *Wam* from Veraval; while *Ghol* was obtained in considerable quantities from all regions, *Karkara* occurred mainly from Porbundar and Dwarka. Rao (1967) has stated that the New India Fisheries vessels covered, in addition, the Kutch region which has been found to be far better than any other region on the continental shelf of India, from the point of view of extremely high catch returns for all fish, with a preponderence of quality fishes.

TABLE 6. *Catch per hour returns of* Lactarius *and other fishes landed by bull trawlers in the different regions.*

	Koth 1	Dara 2	Karkara 3	Ghol 4	Dhoma 5	Eels 6	Catfish 7	Wam 8	Prawn 9	Lactarius 10
Kutch	4.45	16.08	144.32	64.55	99.06	133.12	83.89	44.97	2.58	89.49
Dwarka	59.07	99.96	58.94	38.40	58.47	83.13	46.86	41.33	2.05	28.77
Porbundar	4.07	1.43	36.84	50.03	209.70	75.78	72.91	38.80	4.07	45.54
Veraval	1.78	0.81	13.16	21.15	150.40	95.62	30.07	34.19	5.77	24.18
Cambay	1.26	0.29	7.49	13.08	173.99	124.05	31.27	216.44	10.70	7.95
Bombay	1.46	0.63	21.39	8.55	75.27	46.05	40.57	74.66	7.56	1.80

Columns 1 to 9 after Rao, *et. al* 1967.
Column 10 Based on *Lactarius* catch for 1957-'63.

Table 6 (Rao *et al* 1967) shows the catch rates of some of the fishes obtained in the six regions. It will be seen from this, that the Kutch region gave the best yields in respect of *Lactarius* also. A comparison with other fishes shows that the catch rates of *Larctarius* were lower than those of "Karkara", "Doma" and Elasmobranchs. In Dwarka all other groups except prawns have given better catch rates than *Lactarius*. In Porbundar this species was better than "Koth", "Dara", "Karkara", "Wam" and Prawns. In Veraval the catch rates for "Doma", "Wam", catfishes and elasmobranchs exceeded those of *Lactarius*, while in Cambay the catch rates for *Lactarius* were higher than those for "Koth", "Dara" and "Karkara". In Bombay the catch rates were the lowest.

Regarding the depth-wise distribution of trawl fishes Jayaraman *et al* (1959) state that "Dara" and "Koth" are concentrated in the shallower waters up to 36 m; *Ghol* in all depths but best available from deeper zones of 36-45 m; *Wam* and *Karkara* from deeper zones of 41-50 m and 36-55 m zones respectively. Dealing with the seasonal variations they state that good catches of "Dara" are available from December to April, "Koth" in November-March, "Karkara" in April-May, "Wam" in June-October and "Ghol" almost throughout the year.

In the present study on *Lactarius* a catch return of 100 kg|hr and above is considered "very good", between 50 and 99 kg|hr as "good", 25 to 49 kg|hr as "fair" and 24 kg|hr and below as "poor". The depth ranges are grouped under two categories, namely "Shallower" ranging from 20 to 45 m, and the "Deeper" ranging form 45 to 75 m. On this basis area-wise, depth-wise and season-wise occurrence of *Lactarius* is shown in Table 7. It may be seen that in the Kutch region the shallow-water areas 'P', 'R', 'U', 'V', 'X' and 'Y' have given "very good" catch rates in most of the months. In general the catch rates in 'S' and 'Q' are either "fair" or "poor". In the deeper ranges, areas 'Q', 'R', 'V' and 'Y' alone have given "very good" or "good" catch returns in some months. In the rest of the areas the catch rates were either "fair" or "poor".

TABLE 7. *Area-wise relative abundance of* Lactarius *in shallower & deeper depth ranges in different months.*

Depth 1	Catagory 2	January 3	February 4	March 5	April 6	May 7	June 8	July 9	August 10	Sept. 11	October 12	Nov. 13	Dec. 14
Kutch Region													
20.0 to 45.0	V. Good	—	P,R,U,V	R,U,V	R,V,X	—	—	—	U,V,Y	R,S,V,X,Y	R,S,U,V	Q,V,X	—
	Good	V	—	—	Y	Q,R	—	—	—	—	Q,T	U	Q
	Fair	S	S	S	U	—	—	—	—	—	—	—	—
	Poor	Q,U,Y,	Q	Q	Q	X	Q,R	—	Q,R,S	Q,U	—	R	T,U
50.0 to 75.0	V. Good	—	—	—	—	—	—	—	—	V	—	—	—
	Good	—	—	—	—	Q,R	—	—	—	Y	—	—	—
	Fair	—	—	—	—	S,X	Q	—	—	—	—	—	—
	Poor	Y	—	—	—	Z	—	R,S	R,V	—	—	—	—
Dwarka Region													
20.0 to 54.0	V. Good	—	—	—	—	N	—	—	—	N	N	—	—
	Good	—	—	N	—	—	—	—	—	—	—	—	—
	Fair	—	—	—	N	—	—	—	—	—	M	M,N	L
	Poor	K,M,N	K,L,M,N	K,L,M	K	—	—	—	—	—	K	K,L	K,M,N
50.0 to 75.0	V. Good	—	—	—	—	—	N	—	—	—	—	—	—
	Poor	—	—	—	—	—	—	—	—	—	—	—	L
Porbundar Region													
20.0 to 45.0	V. Good	—	—	—	—	D	—	—	—	—	—	D	D
	Good	A,D,E	A,D,H	A	D,E,H	A,E	D	—	—	—	—	A,E	A
	Fair	H	—	—	A	—	—	A	H	—	—	—	E
	Poor	B	E	D,E,H	—	H	A,E,H	B,E,H	A,D,E	A,D,E,H	A	—	—

50.0 to 75.0	Fair	—	—	—	—	H	—	—	—	—	—	—	—
	Poor	—	—	—	A	—	A,B,E,H	A,B,E,H,I	A,D,E,H	D,E,H	—	—	—
Veraval Region													
20.0 to 45.0	V. Good	2	—	—	3	—	—	—	—	—	—	—	—
	Good	—	3	—	—	—	—	—	—	—	—	—	—
	Fair	3	—	3	2	—	—	2	—	—	—	—	3
	Poor	—	—	—	—	2,3	2,3	3	2,3	3	3	3	
50.0 to 75.0	Good	—	—	—	—	2,3	—	—	—	—	—	—	—
	Poor	—	—	—	2	—	2,3	1,2,3	2,3	—	—	—	—
Cambay Region													
20.0 to 45.0	Fair	11	11	11	—	—	—	—	—	—	—	—	—
	Poor	—	28,24	10,18	10,11	10,11	10,23	—	10,11,18	11,12,18,24	17,25	11,12	11,12,18
50.0 to 75.0	Good	—	10	—	10	10	—	—	—	—	—	—	—
	Poor	10	—	11	11	11	10,11	10,11	10,11	11	11	—	—
Bombay Region													
20.0 to 45.0	Poor	—	31,38,43	38,43	—	38,43	—	—	—	38,43	—	38	—
50.0 to 75.0	Poor	—	—	38	38	38,43	—	30,38	43	38,43	43	—	—

In Dwarka, area N alone has given "very good" yields both in the shallower and deeper waters. 'K', 'L' and 'M' have given yield rates either "fair" or "poor".

In Porbundar in shallower ranges area 'D' alone gave "very good" catch rates in a few months; 'A', 'D', 'E' and 'H' gave "good" catch rates in several months. In the deeper ranges the areas fished have given either "fair" or "poor" catch returns.

In Veraval in the shallower waters "very good" catch rates have been obtained from areas '2' and '3' in only a few months. In general these areas and also area 1 have given "poor" catch rates in most of the months in both the shallower and deeper waters.

In Cambay the catch rates have not been good except in area '10' in the deeper ranges in a few months. Areas '11', '12', '17', '18', '19' and '23' to '25' have given either "fair" or "poor" catch rates in most of the months.

In the Bombay region all the areas in all the months fished both in the shallower and deeper ranges have given only poor catch rates.

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