

## PRESENT STATUS OF EXPLOITATION OF FISH AND SHELLFISH RESOURCES : CROAKERS

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### ABSTRACT

The monthly as well as seasonal fluctuations in the landings of sciaenids obtained by trawlers and gill nets operated from Veraval, Bombay, Cochin and Calicut landing centres during the period 1984-88 are studied. From Veraval, Bombay and Calicut centres, the catches during the postmonsoon period are better than the premonsoon and monsoon periods, while from Cochin, sciaenid landings during the premonsoon period are more than the monsoon and postmonsoon periods.

At Veraval, peak landings are recorded during February, April and May (premonsoon). *Otolithes cuvieri*, *Johnius vogleri*, *J. glaucus*, *J. dussumieri*, *O. ruber*, *O. biauritus* and *Protonibea diacanthus* contributed to the catches. During premonsoon, *O. cuvieri*, mainly of 1 and 2 year age groups, support the fishery. In the postmonsoon fishery, however, juveniles dominate the catch. *J. glaucus* and *O. cuvieri* spawn during the postmonsoon and premonsoon seasons, while *J. vogleri*, spawns during monsoon and postmonsoon seasons. The size at first maturity for *O. cuvieri* and *J. vogleri* is found to be 160 and 168 mm respectively.

At New Ferry Wharf and Sassoan Dock, bulk of the sciaenid landings are recorded during the postmonsoon. *J. macrorhynchus*, *J. vogleri* and *O. cuvieri* contribute to the fishery in all the seasons, but during the monsoon months *N. semiluctosa*, *D. russelli*, *P. macrophthalmus* are also obtained. Juveniles of *J. macrorhynchus* are recorded during monsoon. The size at first maturity for *J. macrorhynchus* is 160 mm, for *J. vogleri* 159 mm and in *O. cuvieri* 170 mm. *J. macrorhynchus*, *J. vogleri* and *O. cuvieri* at this region are found to breed during monsoon and postmonsoon seasons.

At Cochin, major portion of the catch is registered during the premonsoon, but higher catch rates are recorded during November - December. *J. sina* mainly of 1-year group contributes to the fishery during monsoon, while *K. axillaris* and *O. ruber* of 1-year group during the postmonsoon. The peak spawning season for *J. sina*, *O. cuvieri* and *K. axillaris* is during premonsoon and postmonsoon.

At Calicut, during 1984-88, there was an increasing trend in the annual landings of sciaenids, However, the CPUE values during 1985-88 showed a decreasing trend.

The abundance of sciaenids in different seasons are correlated with the upwelling and other physical parameters such as oxygen and temperature. Feasibility of monsoon fishing for sciaenids is discussed.

### INTRODUCTION

Sciaenid fishes, popularly known as Jew fishes or croakers or drummers, form an important group among the exploited marine fishery resources of India. With an estimated average annual production of 102,900 tonnes during 1985-89, they rank sixth in terms of magnitude of the catch in the total marine fish production of the country. They are caught through out year by a variety of gears such as trawl nets, shore seines, boat seines, gill nets and hooks and lines. Often, the population exploited during monsoon months at certain centres is found contributed by smaller specimens. Exploitation of such population, it is apprehended, may adversely affect the sciaenid stocks in the long perspective of time. In this

paper, an attempt is, therefore, made to present their fishery characteristics during different seasons, with particular reference to the effect of fishing during monsoon on the resources. For the study, each calendar year has been divided into three seasons - premonsoon (February - May), monsoon (June - August), postmonsoon (September - January) periods.

### DATA BASE

Data were collected from private trawlers operating from Veraval, Bombay, Calicut and Cochin bases on effort, catch and species composition. The length data of the dominant species were processed to find the variation in size during premonsoon, monsoon, postmoon periods.

## OBSERVATIONS

*Veraval*

The commercial trawlers (14 m OAL, fitted with 87-93 H. P. engines) operate shrimp trawl nets, having cod end mesh size of 15-20 mm. These boats conduct daily fishing at a depth of 20-60 m between Mongrol and Diu. Some of the boats conduct fishing for 3-4 days in the distant areas between Jafarabad in the south and Madhavapur in the north. After monsoon season, fishing generally starts by the middle of September and ends in May. However, the boats with outboard and inboard motors operate gill nets throughout the year.

**Catch and effort** : Monthly variation of sciaenid catches as well as effort from the trawlers during the period 1984-88 is given in Table 1. It is seen that during February-May, peak landings occurred either in February or March. In the remaining period, catches varied from year to year, but generally, October-November was the period when peak landings were recorded. Excepting in 1984, CPUE values showed decreasing trend in the fishery, during February-May. In the postmonsoon fishery, however, the maximum values were recorded during October-December. The

seasonwise catch distribution of sciaenids during premonsoon, monsoon and postmonsoon months is depicted in Fig. 1. The premonsoon period was moderately productive with higher catch being realised in 1984 and lower in 1987. During monsoon, the sciaenid catch in trawlers was generally insignificant except in June 1986 and 1987 when a small quantity estimated at 0.4 and 0.9 t respectively was landed. The most productive season for sciaenid fishery at Veraval was the postmonsoon period. Among the different years, highest catch during this season was registered in 1984 and the lowest in 1985.

Monthly variation of sciaenid catches together with effort from the gill nets during the period 1984-88 is given in Table 2. Peak landings were in May and January in 1984-85; February, April and January in 1985-86; February, May and January in 1986-87; March and October in 1987-88 and in May during 1988. During 1984-85, the trends in CPUE values fluctuated with minimum value in February and maximum in March. During 1985-86, maximum value was recorded in April and minimum in August. In 1986-87, maximum values were in February and May and minimum in September and November. During 1987-88, maximum and

TABLE 1. Estimated monthly effort (units), catch (tonnes) and catch rates (kg) of sciaenids landed by trawlers at Veraval during 1984-88

Month	1984-85			1985-86			1986-87			1987-88			1988		
Season	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE
February	3977	760.4	191	4396	1289.0	293	4295	1012.5	236	6561	623.9	95	3942	750.5	190
March	5640	2190.6	388	6394	961.8	150	5518	1409.6	256	6334	435.2	69	4968	1070.7	216
April	7713	1620.3	210	6685	945.1	141	8119	648.0	80	6140	357.9	58	4787	514.4	108
May	4090	690.4	169	2125	54.0	25	6460	321.0	50	8093	388.1	48	3904	248.0	64
June	-	-	-	-	-	-	35	0.4	12	366	9.9	27	-	-	-
July	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	2114	438.6	208	-	-	-	2982	617.9	207	4715	722.9	153	-	-	-
October	5500	1508.2	274	4825	692.3	144	6069	767.4	126	6309	1305.2	207	-	-	-
November	4527	1097.5	242	5503	1059.2	193	6786	1020.1	150	5200	927.9	178	-	-	-
December	5494	2285.8	416	6081	794.7	131	4763	291.6	61	4478	683.3	153	-	-	-
January	4245	760.7	179	6062	745.5	123	6390	820.7	128	4866	1156.7	238	-	-	-
Total	43300	11352.5	262	42071	6541.6	155	51417	6909.2	134	53062	6611.0	125	-	-	-
Premonsoon	21420	5261.7	246	19600	3249.9	166	24392	3391.1	139	27128	1805.0	66	17601	2583.6	147
Monsoon	-	-	-	-	-	-	35	0.4	12	366	9.9	27	-	-	-
Postmonsoon	21880	6090.8	278	22471	3291.7	147	26990	3517.7	130	25568	4796.0	188	-	-	-

minimum values were recorded in March and October respectively. During February-May of 1988, CPUE values showed an increasing trend, in June-August of the same year, although they were at higher levels, decreased from 21 kg/unit in June to 11 kg/unit in August. During September - January of 1984-85, 1985-86, the CPUE values showed increasing trend with the highest value in January.

Abundance of sciaenid catch in gill net fishery during premonsoon, monsoon and postmonsoon seasons is shown in Fig. 1. The gill net catches in the premonsoon period in different years showed an increasing trend from 1984 to 1986. In 1987, it decreased only to increase again in 1988. In the monsoon months (June-August) of 1984, the total catch of sciaenids was only 0.3 t. In the subsequent years, it increased gradually to reach the highest catch of 67.5 t in 1988 monsoon season. Although the sciaenid catch in the postmonsoon period was lower than those in the same period of 1985-86, 1986-87 and 1987-88, it was 150.6 t in 1984-85 when the estimated catch in the premonsoon months was only 81.4 t.

**Species composition :** The important species contributing to the catches at this centre are *Otolithus cuvieri*, *Johnius vogleri*, *Johnius glaucus*, *J. dussumieri*, *O. biauritus* and *Protonibea diacanthus*. The percentage contribution of sciaenids in the total catches in the trawlers and gill nets and species composition are shown in Figs. 1, 3 and 4 respectively. The percentage contribution of sciaenids in the total fish catch was more during September - December in each year than in the other months. The species such as *O. cuvieri*, *J. glaucus* and *J. vogleri* were abundant during this period. In the monsoon period, in the gill nets, *P. diacanthus*, *O. cuvieri* and *O. ruber* mainly contributed to the fishery.

**Spawning season :** The spawning habits of *J. glaucus*, *O. cuvieri* and *J. vogleri* were studied by Rao (1985 a, b, c). The spawning period of *J. glaucus* was during December - April and from November - April for *O. cuvieri*. *J. vogleri* exhibited two spawning seasons, one during June-July and the other from October to December.

**Size distribution :** The size distribution of *O. cuvieri* obtained by trawl nets in different seasons during 1984-85 is given in Table 3. During the premonsoon, fishes of size range 125-365 mm,

consisting of mainly 1 and 2 year groups, contributed to the fishery while during the postmonsoon seasons, particularly in October and November, juveniles and smaller fishes of size range 75-115 mm, along with adults (0, 1, 2 year) supported the fishery.

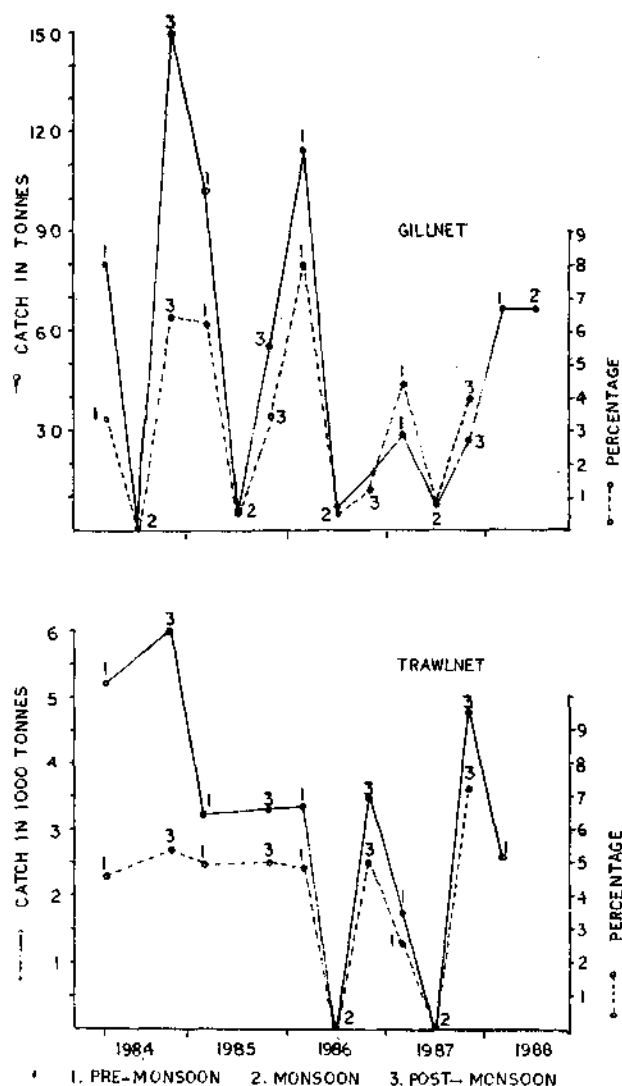


Fig. 1. Seasonal abundance of sciaenids from the trawlers and gill nets during 1984-88 at Veraval.

**Size at first maturity :** From the maturity studies made by Rao (1984), it was inferred that *O. cuvieri* and *J. vogleri* attain first maturity at 160 mm and 168 mm respectively.

### Bombay

About 400 mechanised vessels for New Ferry Wharf and 350 boats from Sassoon Dock (10.5 m

TABLE 2. Estimated monthly effort (units), catch (tonnes) and catch rates (kg) of sciaenids landed by gill nets at Veraval during 1984-88

Month Season	1984-85			1985-86			1986-87			1987-88			1988		
	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE
February	3069	7.4	2	2817	38.2	14	3494	44.2	13	1861	7.9	4	3118	11.5	4
March	4182	14.0	3	3374	19.8	6	2437	4.0	2	3417	10.7	3	2662	9.6	4
April	3125	9.3	3	3717	38.9	11	2522	23.1	9	2967	4.7	2	2882	19.3	7
May	3226	50.7	16	2987	6.9	2	3436	45.0	13	3040	6.8	2	3200	27.1	9
June	12	-	-	860	2.5	3	460	4.8	10	1586	5.9	4	1665	34.4	21
July	92	-	-	588	0.7	1	2257	3.8	2	1962	-	-	369	3.9	10
August	316	0.3	1	2964	0.4	0.1	-	-	-	1976	3.0	2	2633	29.2	11
September	2481	6.0	2	2203	0.8	0.3	1988	0.2	0.1	2475	5.8	2			
October	2394	13.3	6	1837	0.6	0.4	2743	5.7	2	3447	2.0	0.6			
November	3194	30.8	10	2791	12.3	4	3048	0.1	0.1	2874	6.2	2			
December	3387	40.6	12	2674	13.1	5	2083	0.6	0.3	3107	5.6	2			
January	4790	59.9	13	2015	30.0	15	3074	11.5	37	1662	7.9	5			
Total	30268	232.3	8	28837	164.2	6	27542	143.1	5	3.374	66.5	2			
Premonsoon	13602	81.4	6	12895	103.8	8	11889	116.3	10	11285	30.1	3	11862	67.5	6
Monsoon	420	0.3	1	4412	3.6	1	2717	8.6	3	5524	8.9	2	4667	67.5	15
Postmonsoon	16246	150.6	9	11530	56.8	5	12936	18.2	1	13565	27.5	2			

TABLE 3. Size range and modal lengths of *O. cuvieri* obtained by trawl nets at Veraval in different seasons during 1984-88

Season month	1984-85		1985-86		1986-87		1987-88	
	Size range	Modal lengths	size range	Modal lengths	Size range	Modal lengths	Size range	Modal lengths
<i>Premonsoon</i>								
February	125 - 305	155, 205 & 265	155 - 235	185	115 - 365	175 & 295	125 - 205	155 & 175
March	125 - 315	175 & 275	155-325	195	125 - 285	175 & 245	165 - 295	175, 215 & 285
April	145 - 215	175	125 - 365	225, 295 & 325	-	-	-	-
May	175 - 305	215	215 - 325	245 & 295	-	-	-	-
<i>Monsoon</i>								
June	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	-	-
August	-	-	-	-	-	-	-	-
<i>Postmonsoon</i>								
September	185 - 335	235	-	-	185 - 325	235 & 295	-	-
October	105 - 345	135 & 175	75 - 325	145 & 255	115 - 275	195 & 265	-	-
November	105 - 345	185 & 265	105 - 345	145, 165 & 265	105 - 325	135 & 185, 255	-	-
December	115 - 335	155	125 - 325	185, 205 & 255	105 - 345	135 & 305		
January	145 - 355	185 & 275	115 - 315	145	95 - 165	115	115 - 365	135, 255 & 285

OAL, 80-100 H.P. and 4 t fish hold capacity) are employed in the fishery at this region. From New Ferry Wharf, generally, boats go for fishing for 40-60 hrs duration in the fishing grounds extending from Ratnagiri in the south to Dahanu in the north

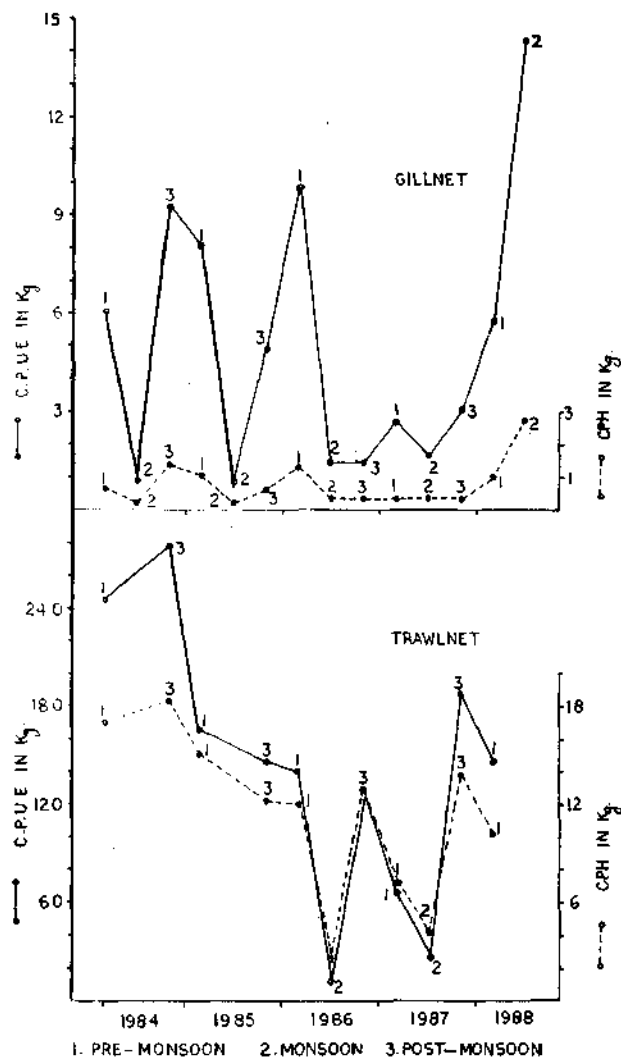


Fig. 2. Seasonal variation of catch per unit effort and catch per hour (kg/hr) values of sciaenids from the trawlers and gill nets during 1984-88 at veraval.

upto a depth 70 m, some of the boats go upto Gujarat Coast. Commonly otter trawl nets of length between 16 and 23 m with cod end mesh size of 20 mm are used. The fishing activity during the monsoon period at the New Ferry Wharf is found to be lean while at Sassoon Dock, it is carried out throughout the year.

**Catch and effort :** The monthwise catch and catch per unit of effort in respect of sciaenids from the

New Ferry Wharf for the period 1984-88 is given in Table 4. In 1984-85, the catches during March-May showed a decreasing trend. With the onset of monsoon in June, the landings declined steeply and remained low upto August. After the monsoon in September, the catches improved considerably and were comparatively high. However, a decreasing trend was observed from October '84 to January '85. Catch per unit values also showed similar trends. In 1985-86, the trends in the catch and catch rates were similar to those of 1984-85, while in 1986-87, the production during February-April showed a decreasing trend and in September-January, a fluctuation between 403 t and 180 t. In 1987-88, the monthly catches during February-September fluctuated, but from October to January showed decreasing trend. Similar fluctuating trends were also seen in the catches of 1988 also. The trends in the CPUE values were more or less same as catch trends.

The monthly variation of catch and rates of sciaenids from Sassoon Dock for the period 1984-88 is given in Table 5.

The peak landings at this centre were recorded usually in February and November while the CPUE values showed wide fluctuations.

Seasonal variation of catch and CPUE values for the period 1984 - 88 from the New Ferry Wharf and Sassoon Dock are given in Tables 4 and 5 respectively. It is seen that both at N. F. Wharf and Sassoon Dock higher landings were registered in the postmonsoon period followed by premonsoon and monsoon periods. Similar trends were observed in the CPUE values also during all the years excepting during 1984-85.

**Species composition :** Species composition of sciaenids for different seasons during 1984-85 is given in Table 6. Ten species contributed to the fishery, of which *J. macrorhynchus*, *J. vogleri* and *O. cuvieri* supported over 70% of the total sciaenid catches at N. F. Wharf in all the seasons. However, during monsoon months *N. semiluctuosa*, *D. russelli* and *P. macrophthalmus* were also found. *J. sina* which was the dominant species till 1986 was replaced by *J. elongatus*.

**Size distribution :** Size distribution of *J. macrorhynchus*, *J. vogleri* and *O. cuvieri* in different seasons shows that during the monsoon season, only smaller fishes of less than 140 mm of

TABLE 4. Estimated monthly effort (units), catch (tonnes) and catch rates (kg) of sciaenids landed by trawl nets at New Ferry Wharf Jetty during 1984-88

Month/Season	1984-85			1985-86			1986-87			1987-88			1988		
	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE
February	2338	2630	113	2187	311.3	142	2904	340.5	117	3001	568.6	190	3002	308.3	106
March	2487	319.9	129	2300	382.4	166	2712	290.4	107	3176	558.0	176	2672	314.6	118
April	2208	238.3	108	2195	281.5	128	2638	377.4	143	2762	440.0	159	3143	504.4	161
May	1490	135.7	91	1252	157.0	126	1989	317.3	160	2594	418.8	161	1446	65.3	45
June	310	14.2	46	290	14.1	48	597	69.6	117	595	63.0	106	630	49.6	79
July	279	7.6	27	503	17.5	35	735	70.5	96	477	82.9	174	460	54.3	118
August	877	64.3	73	523	52.9	101	875	135.5	155	837	201.5	241	586	65.3	111
September	3025	447.5	148	3113	300.4	97	2967	668.8	225	3243	673.7	208	-	-	-
October	3627	802.4	221	3025	548.7	181	3451	1389.8	403	3775	895.5	237	-	-	-
November	2455	563.0	229	2271	391.6	172	2782	1115.4	401	3459	723.3	209	-	-	-
December	2142	405.0	189	2633	194.6	74	3116	561.9	180	3379	656.2	194	-	-	-
January	2373	312.2	132	2411	296.4	123	3206	649.3	203	3503	532.4	152	-	-	-
Total	23611	3573.1	151	22703	2948.8	130	27972	5986.4	214	30801	5813.9	189	-	-	-
Premonsoon	8523	956.9	113	7934	1132.6	143	10243	1325.6	129	11533	1685.4	146	10263	1202.6	117
Monsoon	1466	86.1	59	1316	84.5	64	2207	275.6	125	1909	347.4	182	1676	169.2	101
Postmonsoon	13622	2530.1	186	13453	1731.7	129	15522	4385.2	283	17359	3481.1	201	-	-	-

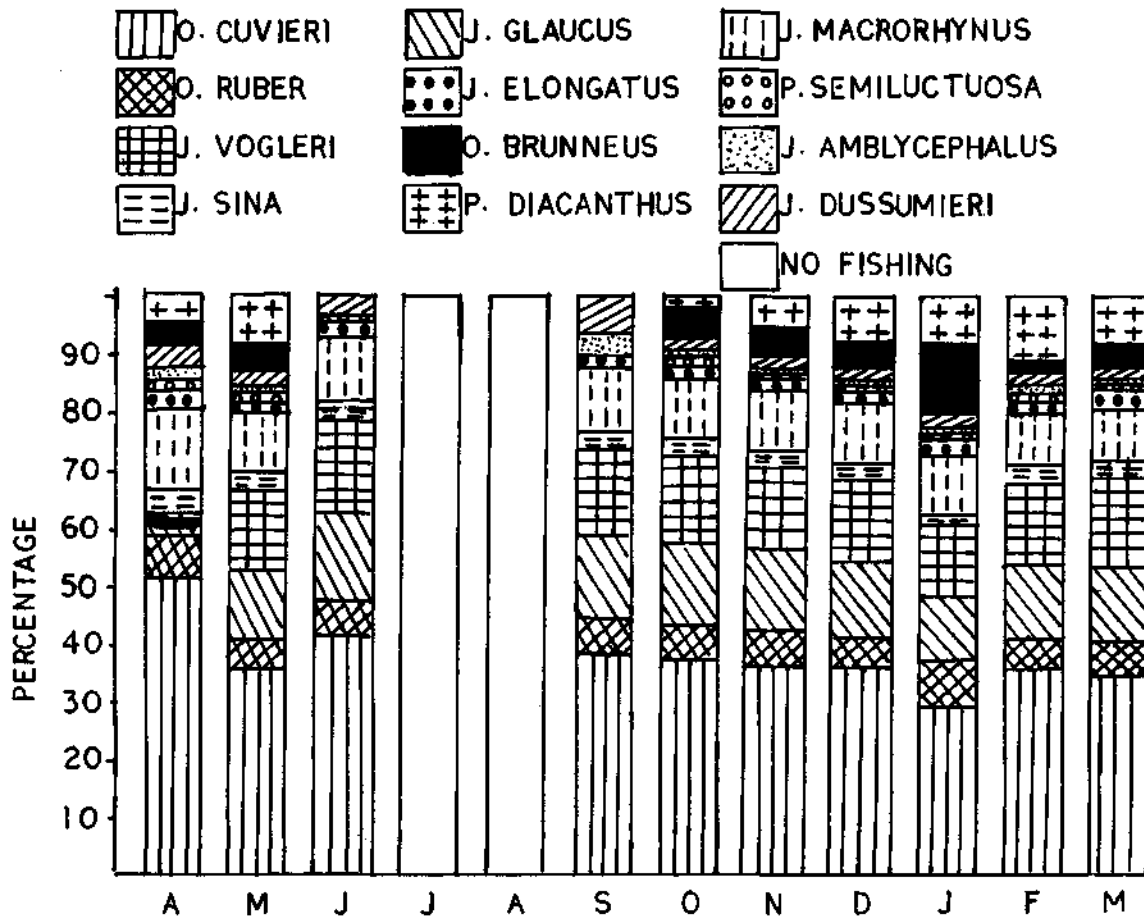


Fig. 3. Species composition of sciaenids from the trawlers during 1984-88 at veraval.

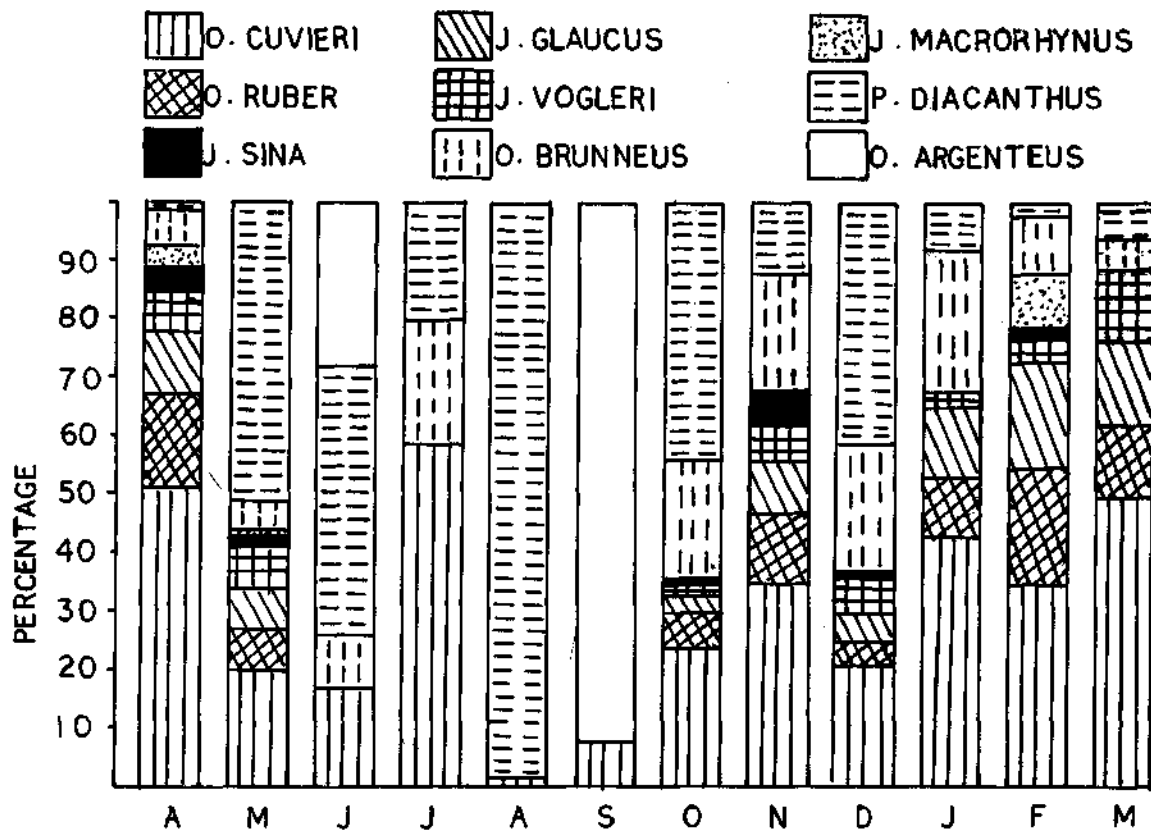


Fig. 4. Species composition of sciaenids from the gill nets during 1984-88 at veraval.

TABLE 5. Estimated monthly effort (units), catch (tonnes) and catch rates (kg) of sciaenids landed by trawl nets at Sasoon Dock (Bombay) during 1984-88

Month/Season	1984-85			1985-86			1986-87			1987-88			1988		
	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE
February	1510	73.3	49	1897	137.2	72	2051	279.6	136	1515	162.0	107	1618	158.9	98
March	1412	92.1	65	1594	158.6	100	1689	178.8	106	1260	147.8	117	1605	129.7	81
April	1156	72.3	63	2025	134.6	67	1453	159.6	110	1376	113.6	83	1733	109.6	63
May	1829	147.8	81	1538	183.2	90	1741	151.1	87	1802	129.4	72	1977	142.3	72
June	1156	82.8	72	673	105.6	157	969	77.1	80	1115	111.5	100	1687	140.9	84
July	1819	111.9	62	1727	114.5	66	1686	141.1	84	1565	125.7	80	2006	203.2	101
August	1903	108.8	57	1869	195.5	105	1648	159.8	97	1528	101.3	66	2586	213.2	83
September	2173	137.1	63	1880	242.4	129	1642	1689.1	103	1743	145.9	84	-	-	-
October	2276	194.9	86	1439	312.3	217	1776	212.5	120	1359	157.6	116	-	-	-
November	1967	249.6	127	1590	262.5	165	1776	212.5	120	1359	157.6	116	-	-	-
December	1822	195.3	107	1699	230.4	136	1866	249.8	122	1868	2276	122	-	-	-
January	1824	162.3	89	1927	344.1	178	1884	224.2	119	1833	265.9	145	-	-	-
Total	23611	3573.1	151	22703	2948.8	130	27972	5986.4	214	30801	5813.9	189	-	-	-
Premonsoon	5907	385.5	65	7054	613.6	87	6934	769.1	111	5953	552.8	93	6933	540.5	78
Monsoon	4878	303.5	62	4269	415.6	97	4303	378.0	88	4208	338.8	81	6279	557.3	89
Postmonsoon	10062	939.2	93	8545	1391.7	163	8908	1119.7	126	8644	1077.5	125	-	-	-

TABLE 6. Species composition of sciaenids (tonnes) in different seasons at New Ferry Wharf during 1984-88 (Average Values) (Figures in parenthesis indicate individual percentage in total sciaenid catches)

Month	<i>J. macrorhynchus</i>	<i>J. vogleri</i>	<i>O. cuvieri</i>	<i>O. ruber</i>	<i>J. dussumieri</i>	<i>J. elongatus</i>	<i>N. semiductosa</i>	<i>D. russelli</i>	<i>J. sina</i>	<i>P. macrophthalmus</i>	Total
<i>Premonsoon</i>											
February	71.0 (26.9)	53.7 (20.3)	52.0 (19.7)	11.6 (4.4)	21.6 (8.2)	9.5 (3.6)	6.6 (2.5)	-	21.0 (7.9)	17.1 (6.5)	264.1
March	74.7 (25.3)	57.8 (19.6)	75.8 (25.7)	7.7 (2.6)	10.8 (3.7)	16.4 (5.6)	3.1 (1.1)	0.3 (0.1)	34.5 (11.7)	13.6 (4.6)	294.7
April	77.3 (21.9)	82.6 (23.4)	62.3 (17.6)	22.9 (6.5)	22.8 (6.5)	7.4 (2.1)	14.7 (4.2)	-	32.1 (9.1)	30.8 (8.7)	352.9
May	43.2 (20.8)	41.9 (20.2)	50.2 (24.2)	15.0 (7.2)	15.4 (7.4)	7.6 (3.6)	10.8 (5.2)	0.3 (0.1)	13.7 (6.6)	9.7 (4.7)	207.8
Total	266.2 (23.8)	236.0 (21.0)	240.3 (21.5)	57.2 (5.1)	70.6 (6.3)	40.9 (3.7)	35.2 (3.1)	0.6 (0.1)	101.3 (9.0)	71.2 (6.4)	1119.5
<i>Monsoon</i>											
June	9.4 (21.70)	7.7 (17.9)	8.3 (19.2)	0.3 (0.7)	4.8 (11.2)	0.3 (0.6)	1.5 (3.4)	0.7 (91.6)	5.4 (12.5)	4.8 (11.2)	
July	11.0 (23.0)	10.1 (21.0)	11.7 (24.4)	0.9 (1.8)	1.7 (3.6)	0.6 (1.3)	2.0 (4.1)	1.4 (2.9)	4.9 (10.2)	3.7 (7.7)	48.0
August	20.5 (20.3)	17.9 (17.8)	25.0 (24.8)	-	7.4 (7.3)	5.3 (5.3)	7.3 (7.3)	3.4 (3.4)	9.3 (9.2)	4.7 (4.6)	100.8
Total	40.9 (21.3)	35.7 (18.6)	45.0 (23.4)	1.2 (0.6)	13.9 (7.3)	6.2 (3.3)	10.8 (5.6)	5.5 (2.8)	19.6 (10.2)	13.2 (6.9)	192.0
<i>Postmonsoon</i>											
September	133.5 (24.3)	130.6 (23.8)	113.9 (20.7)	44.8 (8.1)	54.4 (9.9)	14.0 (2.5)	8.4 (1.5)	8.4 (1.5)	16.8 (3.1)	25.2 (4.6)	550.0
October	220.4 (25.5)	209.9 (24.3)	185.7 (21.5)	28.8 (3.3)	37.7 (4.4)	-	37.4 (4.4)	17.4 (2.0)	97.7 (11.3)	28.6 (3.3)	863.6
November	139.7 (21.0)	163.4 (24.5)	117.8 (17.7)	59.6 (9.0)	37.2 (5.6)	9.0 (1.3)	14.1 (2.1)	18.8 (2.8)	69.8 (10.5)	36.9 (5.5)	
December	111.2 (24.4)	119.9 (26.4)	98.0 (21.6)	30.4 (6.7)	18.1 (4.0)	8.2 (1.8)	-	4.9 (1.1)	37.9 (8.3)	25.9 (5.7)	454.5
January	81.5 (21.8)	114.7 (30.7)	93.5 (25.0)	17.0 (4.5)	18.0 (4.8)	13.3 (3.6)	6.7 (91.8)	-	21.1 (5.7)	7.8 (2.1)	373.6
Total	686.3 (23.6)	738.5 (25.4)	608.9 (20.9)	180.6 (6.2)	165.4 (5.7)	44.5 (1.5)	66.6 (2.3)	49.5 (1.7)	243.3 (8.4)	124.4 (4.3)	2908.0
* Grand total	993.4 (23.5)	1010.2 (23.9)	894.2 (21.2)	239.0 (5.7)	249.9 (5.90)	91.6 (2.2)	112.6 (2.7)	55.6 (1.3)	364.2 (8.6)	208.8 (5.0)	4219.5

\* Total for 3 seasons (Premonsoon, Monsoon and Postmonsoon).



*J. macrorhynchus* were recorded, while adults of *J. macrorhynchus*, *J. vogleri* and *O. cuvieri* contributed to the fishery during other seasons.

**Size at first maturity :** From the maturity studies conducted on three important species, Chakraborty (1988) showed that in *J. macrorhynchus*, the size at first maturity is 160 mm, for *J. vogleri* and *O. cuvieri* the sizes are found to be 159 mm and 170 mm respectively. Muthiah (1982) observed that *J. vogleri* attained maturity at 159 mm.

**Spawning :** Chakraborty (1988) indicated that ripe specimens of *J. macrorhynchus* were found during June-August and November-December and spent ones during June-July and November-December. Ripe and spent specimens of *J. vogleri* were observed during June - July and November - December. For *O. cuvieri*, ripe females were encountered during May - July and November - December and spent ones during June-July and in December. He further indicated the possibility of two breeding seasons - one during monsoon period and other during postmonsoon period.

#### Cochin

The commercial trawlers based at this centre are of 28-32' OAL and generally operate within 45-50 m depth region. Undertaking daily fishing they take 2-3 hauls each of about 2 hours duration and return to the landing centre in the evening.

**Catch and effort :** The estimated fishing effort, catch and catch rates of sciaenids for the period 1984-85 to 1988-89 are given in Table 7. During 1984-85, the effort increased from 4561 units in February to 5050 units in May, while in the other months it fluctuated from 1010 to 4916. As in 1984-85, the effort in 1985 - 86 showed increasing trend from February to April and again from November to January. The catches were also seen fluctuating in all the years except during November-December of 1984-85, 1985- 86; September-January of 1987-88 when it showed an increasing trend.

The seasonal variation of effort, catch and catch rates of sciaenids for the period 1984-88 is given in Table 7. During 1984-88, the average annual estimated effort was 39404 units. Maximum effort (46943 u) was expended during 1987-88 and minimum of 30344 u in 1985-86. Maximum number of trawlers was operated during premonsoon (Average : 18,600 u) forming more

than 47% of the annual trawling effort. It was observed that the effort expended during the monsoon was moderate, while the number of units operated during the postmonsoon period was comparatively less (9105 u) forming 23% of the annual effort.

The average annual landings of sciaenids was about 616 t during the period 1984-88. The annual sciaenid catches increased from 390.6 (1984-85) to 717.6 t (1987-88). During 1984-85, peak landings were obtained during premonsoon period followed by monsoon period. In 1985-86, 468 t of sciaenids which formed 81.6% of annual sciaenid catches were obtained during premonsoon period while during postmonsoon and monsoon seasons, they contributed to 13.4% and 5.0% respectively. During 1986-87 bulk of the catches were obtained during premonsoon period (40.2%) followed by postmonsoon (30.3%) and monsoon periods (29.6%). But during 1987-88, 46.7% of sciaenid catches were realised during the postmonsoon. This was followed by monsoon when 34.2% of sciaenid catches were obtained. Thus better catches were landed during the premonsoon period (about 49.3%) followed by monsoon (30.1%) and postmonsoon (20.6%) periods.

As in the case of catches, the catch rates ranged from 10 kg/u (1984- 85) to 19 kg/u (1985-86) with an average value of 15.6 kg/u. It was during the postmonsoon period of 1984-85, highest catch rate (31.9 kg/u) followed by monsoon (4.7 kg/u) and premonsoon (4.7 kg/u) was registered. During 1985-86 highest catch rate was recorded in premonsoon (30.3 kg/u) followed by postmonsoon (8.9 kg/u) and monsoon period (4.7 kg/u). Again during 1986-87 and 1987-88 the highest catch rate was observed in postmonsoon followed by monsoon and premonsoon periods. In general, the postmonsoon period recorded highest catch rates, followed by premonsoon and monsoon periods.

**Species composition :** Different species that contributed to the fishery are given in Table 8. In 1986-87, during the premonsoon period, *J. sina* (63.4%) was the principal species supporting the fishery, besides *O. ruber* (15%) and *K. axillaris* (14.4%). In the monsoon period, *J. sina* was the predominant species constituting 85.5% of the catches while *O. cuvieri* and *K. axillaris* contributed to 9.5% and 2% respectively. During the postmonsoon period, *K. axillaris* formed 73% while *J. sina* 21.9%. Thus

TABLE 7. Estimated monthly effort (units), catch (tonnes) and catch rates (kg) of sciaenids landed by trawl nets at Cochin during 1984-88

Month/Season	1984-85			1985-86			1986-87			1987-88			1988		
	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE
February	4561	53.0	12	3512	105.4	30	4919	71.3	14	3259	40.0	12	4146	126.6	31
March	4565	56.6	12	4025	148.2	37	3553	40.2	11	3980	28.8	7	5141	117.1	23
April	4779	22.1	5	4327	102.1	24	5184	59.6	12	5554	38.6	7	3730	104.0	28
May	5050	31.1	6	3594	113.0	31	6681	102.2	15	6900	28.7	4	4895	206.0	42
June	4373	9.1	2	3531	26.3	7	6585	198.8	30	6081	121.0	20	5445	55.0	10
July	4916	17.3	4	2320	1.2	1	5218	2.4	0.4	5372	122.0	23	772	6.0	8
August	3803	-	-	359	0.2	1	3115	-	-	2984	3.0	1	2629	39.0	15
September	-	-	-	-	-	-	235	-	-	390	3.0	7	-	-	-
October	-	-	-	-	-	-	-	-	-	1676	18.3	11	-	-	-
November	1010	25.5	25	234	3.8	16	3109	11.9	4	3298	55.6	17	-	-	-
December	2652	48.1	18	3852	27.2	7	2889	135.6	0.5	3820	103.9	27	-	-	-
January	2332	79.7	34	4590	46.4	10	4683	57.9	12	3629	154.7	43	-	-	-
Total	38041	390.6	10	30344	573.8	19	46171	679.9	15	46943	717.6	15	-	-	-
Premonsoon	18955	162.8	9	15458	468.7	30	20337	273.3	13	19693	136.1	7	17912	553.7	31
Monsoon	13092	26.4	2	6210	27.7	5	14918	201.2	13	14437	246.0	17	8846	100.0	11
Postmonsoon	5994	153.3	26	8676	77.4	9	10916	205.4	19	12813	335.5	26	-	-	-

TABLE 8. The estimated species composition by weight of sciaenids (tonnes) at cochin during 1986-89 (percentage in parenthesis)

	<i>J. sina</i>	<i>J. dussumieri</i>	<i>O. ruber</i>	<i>O. cuvieri</i>	<i>K. axillaris</i>	<i>J. carutta</i>	<i>J. macrorhynchus</i>	Others
1986-87								
Pre monsoon	165 (60.4)	-	41 (15.0)	6 (2.2)	39 (14.4)	14 (5.1)	8 (2.9)	-
Monsoon	171 (85.5)	-	6 (3.0)	19 (9.5)	4 (2.0)	-	-	-
Postmonsoon	45	-	5 (2.4)	-	150 (73.3)	5 (2.4)	-	-
1987-88								
Premonsoon	86 (63.2)	-	19 (14.2)	7 (5.1)	9 (6.6)	12 (8.8)	1 (0.7)	2 (1.4)
Monsoon	177 (72.8)	16 (6.5)	31 (13.5)	4 (1.6)	6 (2.4)	6 (2.4)	1 (0.4)	1 (0.4)
Postmonsoon	102 (30.7)	47 (14.1)	73 (22.2)	1 (0.3)	45 (13.5)	60 (18.0)	-	4 (1.2)
1988-89								
Premonsoon	270 (48.8)	35 (6.3)	84 (15.2)	18 (3.3)	84 (15.2)	57 (10.4)	3 (0.5)	2 (0.3)
Monsoon	68 (71.5)	2 (2.1)	10 (10.5)	1 (1.0)	13 (13.9)	-	-	1 (1.0)
Average								
Premonsoon	174 (54.2)	12 (3.7)	48 (14.9)	10 (3.1)	44 (13.7)	28 (8.9)	4 (1.2)	1 (0.3)
Monsoon	139 (76.7)	6 (3.3)	16 (8.8)	8 (4.4)	8 (4.4)	2 (1.9)	1 (0.6)	1 (0.6)
Postmonsoon	73 (27.0)	24 (8.8)	39 (14.4)	1 (0.3)	98 (36.7)	33 (12.2)	0	2 (0.6)

it is seen that *J. sina* mainly contributed to the catches both during the premonsoon and monsoon periods while *O. ruber* occupied the second position during the postmonsoon period.

**Size composition :** In 1986-87, in the premonsoon months *J. sina* of 125-135 mm along with the juveniles (75-90 mm) dominated the catch while in the monsoon period, the fishes with dominant modal size at 130 mm contributed to the fishery. Similar size distribution pattern was observed in the fishery of 87-88. In 1988-89, *J. sina* of modal length 100, 115 and 130 mm, and during the monsoon one year old fish of 130 mm modal size contributed to the fishery. Thus during the period under review, it is seen that fishes of the size range 110-140 mm dominated the catches both during premonsoon and monsoon periods while during the postmonsoon period juveniles also contributed to the fishery.

**Maturity :** The seasonal abundance of mature fishes of *J. sina* during premonsoon, monsoon and postmonsoon seasons for the period 1986-87 to 1987-88 is given in the Table 9. The percentage occurrence of gravid and spent fishes in different seasons indicated prolonged spawning nature of the species.

#### Calicut

At Calicut, trawlers are operated throughout the year excepting during June-September. The

catch details of sciaenids landed by trawlers in different years are given in Table 10. The total effort expended in 1984-85 was 3646. There was an increasing trend from 3597 to 4418 in the subsequent years although the catch as well as CPUE values showed decreasing trend except in 1987-88.

**Catch and effort :** The monthly variation of catches and catch rates during the period 1984-88 is given in Table 10. No definite trends can be observed either in the catches or catch rates in any year. Seasonal variation of sciaenids in different years (Fig. 5 & 6) showed that during premonsoon period the catches ranged from 1.7 t (1988) to 12.3 t (1985). Similar trend was seen in CPU values with mini-

TABLE 9. Sex ratio and the gonadial condition of the females of *Johnnieops sina* for the period 1986-87 to 1988-89

Sex ratio/maturity	Season						
	Premonsoon		Monsoon		Postmonsoon		
	No.	%	No.	%	No.	%	
Male	144	47.2	110	41.9	119	52.6	
Females	161	52.8	152	58.1	152	47.4	
Immature	I	16	9.9	35	23.0	10	9.3
	II	22	13.7	20	13.1	31	28.9
Resting	II	5	3.1	30	19.7	21	10.6
Developing	III-IV	58	36.0	13	8.5	18	16.8
Gravid	V-VI	28	17.4	29	19.0	12	11.2
Spent	VII	32	19.9	25	16.7	15	14.2
Total	305		262		226		

TABLE 10. Estimated monthly effort (units), catch (tonnes) and catch rates (kg) of sciaenids landed by trawl nets at Calicut during 1984-88

Month/Season	1984-85			1985-86			1986-87			1987-88			1988		
	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE	Units	Catch	CPUE
February	457	4.2	9	628	4.6	7	580	4.0	7	4009	4.9	5	414	1.3	3
March	305	2.5	8	764	7.2	9	700	2.6	4	555	0.7	1	128	0.3	3
April	412	0.9	2	460	0.4	0.9	505	3.1	6	197	0.4	2	8	0.02	3
May	638	0.3	0.5	212	0.1	0.5	332	0.04	0.1	547	0.6	1	49	-	-
June	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-
July	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
August	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
September	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October	352	0.6	2	-	-	-	-	-	-	-	-	-	-	-	-
November	483	7.6	16	403	2.2	5	192	1.6	9	463	0.6	1	-	-	-
December	358	0.03	0.1	477	5.9	12	665	5.9	9	938	14.9	16	-	-	-
January	641	22.1	35	653	7.2	11	1046	5.0	5	709	14.6	21	-	-	-
Total	3646	38.2	10	3597	27.6	8	4029	22.2	6	4418	36.7	8	-	-	-
Premonsoon	1812	7.9	4	2064	12.3	6	2117	9.74	5	2308	6.6	3	599	1.62	3
Monsoon	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-
Postmonsoon	30.33	16	1533	15.3	10	1903	12.5	7	2110	30.1	14	-	-	-	-

imum of 2.8 kg/u and maximum of 5.9 kg/u 1988 and 1985 respectively. During June-September, no trawlers were operated as the fishing was suspended during these months. The catches during the postmonsoon period in general were comparatively better than the premonsoon period. However during 1984-85 to 1986-87 the catches decreased from 30.4 to 12.6 t, but subsequently increased to 30.1 t. The catch and catch rates followed a similar trend as the maximum CPU of 16.6 kg/u and minimum of 6.6 kg/u were recorded in 1984 and 1986 respectively. Further a secondary peak of 14.3 kg/u was recorded in 1987.

### DISCUSSION

Maximum catches as well as highest CPUE values were recorded in 1984-85 and during the subsequent years they decreased. It was also seen that total catches of 'all fishes' was also maximum during 1984-85. The catches from gill nets were comparatively less, but they contributed to the fishery to a great extent during monsoon. In the gill nets, as in the case of trawlers, during 1984-85 to 1987-88, the sciaenid catches as well as CPUE values decreased gradually, but higher landings were recorded generally during February, April and May. The percentage composition of different species of sciaenids in the monsoon season varied from the other seasons since larger species such as *P. diacanthus* and *O. biauritus* contributed to the gill net catches to greater extent.

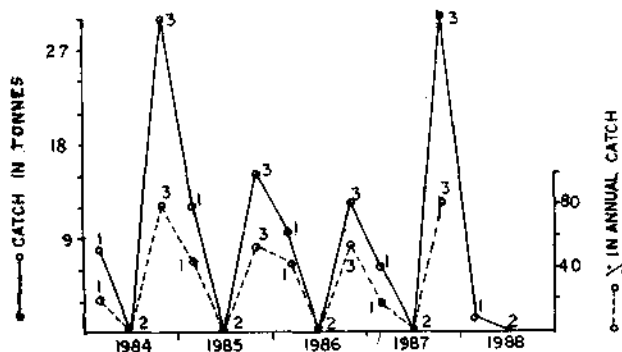


Fig. 5. Seasonal variation of sciaenid catches at Calicut during 1984-88.

At Bombay, New Ferry Wharf landing centre contributed to 65% of total sciaenid catches. Higher catch rates were also observed at this centre. From Sasoon Dock, as in N. F. Wharf, bulk of the landings were obtained during postmonsoon. This might be due to the fact that after the monsoon

when normal conditions in the sea prevail, the number of trawlers and the effort expended is increased leading to higher yield of sciaenids particularly during November-December.

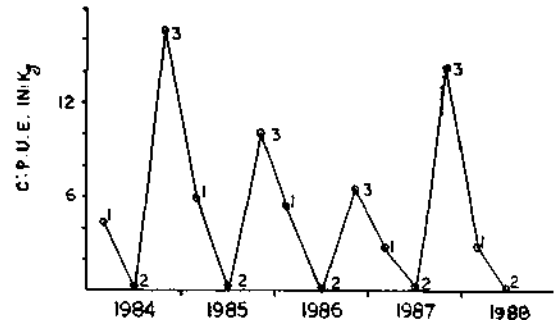


Fig. 6. Seasonal variation of catch per unit effort values (CPUE) of sciaenids during 1984-88 at Calicut.

It is reported that along the Bombay Coast, peak spawning season for the major species of sciaenids is during the monsoon period. Thus there is every possibility that high percentage of ripe and mature fish would be caught if trawling is conducted during monsoon period particularly with shrimp trawl net. Further some species like *D. russelli* and *N. semiluctosa* are seasonal and occur only during the monsoon. Besides, higher percentage of immature sciaenids are also caught during the monsoon months. It is, advisable that the fishes below the size of first maturity are not exploited so as to give them a chance to grow and breed to contribute to the process of recruitment.

At Cochin the bulk of the landings were recorded during the premonsoon period followed by postmonsoon and monsoon seasons. However, the highest catch rates were noticed during the postmonsoon period particularly during November-December. *J. sina* mainly of 1-year age group contributed to the fishery during monsoon. During the postmonsoon, *K. axillaris* and *O. ruber* dominated the catches. The peak spawning period for the common species of sciaenids was found to be during premonsoon and postmonsoon seasons and shrimp trawling operations during the monsoon was opined to be not adversely affecting the spawning stock. The abundance of sciaenids and rainfall at Cochin did not show any relationship between them.

From the exploratory surveys conducted along the Kerala Coast, it is known that during the

monsoon *J. sina*, *O. cuvieri* and *K. axillaris* occur in inshore areas where the shrimp trawlers conduct fishing for prawns, threadfin breams and lizard-fishes. Although fishing during monsoon along this coast appears to be profitable, it must be ensured that the trawling should be restricted beyond 20 m depth as envisaged in the Kerala Marine Fishing Act so as to avoid conflicts with the local fishermen who operate artisanal gears. It may be noted that the artisanal fishing sector which contributes to about 2110 t or 25.7% of annual sciaenid catches of the State conducts fishing during monsoon within 20 m depth zone.

Along the Karnataka, Maharashtra and Gujarat Coasts, the fishing activity by trawlers during monsoon months is generally lean. However, at Veraval some fishing operations by gill nets in the nearshore waters are seen during this season.

It is now well known that the upwelling and associated environmental factors during the latter half of the premonsoon and monsoon months affect the distribution of the demersal resources in the continental shelf regions, along the west coast of India by pushing some of the stocks to offshore waters and some close to the shore. After the south-west monsoon when normal, sea conditions set in, the demersal fishes reappear and colonise the usual fishing grounds (Banse, 1959, 1968; Carruthers, 1959). Besides this physico-biological phenomenon, the cessation of trawling during the monsoon would greatly help for the conservation of the spawning and juvenile population of several demersal fishes.

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