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STUDIES ON THE DISTRIBUTION AND ABUNDANCE OF CARANGID FISH LARVAE ALONG THE SOUTHWEST COAST OF INDIA

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ABSTRACT

Studies on the distribution and abundance of carangid fish larvae in relation to environmental parameters and to delineate the spawning area and season, were carried out based on the regular plankton collections of UNDP/FAO/PFP from the southwest coast of India during the period September 1971 to September 1975.

INTRODUCTION

INFORMATIONS on the distribution and abundance of fish eggs and larvae are very limited in Indian waters. Studies on the seasonal occurrence and abundance of fish eggs and larvae are useful in assessing the potential stock and locating their breeding places. Besides this, study on the distribution helps to evaluate the entire spectrum of physical, chemical and biological environment to which the species are adapted.

Quantitative studies on fish eggs and larvae of extensive areas were started in India during the International Indian Ocean Expedition (1960-1965) which resulted in the publications of Ahlstrom (1968), Peter (1969, 1974) and Panikkar and Rao (1973). The important contributions pertaining to the distribution and abundance of fish larvae from the northern Arabian Sea were made by Alikhan (1972). Nellen (1973) made a detailed study on the kinds and abundance of fish larvae in the Arabian Sea and the Persian Gulf.

Very few studies were made on the distribution of fish larvae in relation to hydrographic parameters in Indian waters. Bapat (1955) stated that maximum spawning of the fishes of the Gulf of Mannar area takes place during the period of low salinity and temperature. Qasim (1973) observed that fishes along the southwest coast of India largely spawn during monsoon and post-monsoon periods. Peter (1974) found that June - August was the best season for the abundance of fish eggs and larvae in the Arabian Sea. Venkataramanujam and Ramamoorthi (1974) stated that fish eggs and larvae at Porto Novo coastal waters were found at a temperature range 25.0° C to 28.5° C and salinity range of 15.5‰ to 25.5‰. A systematic survey involving a long time series was conducted in Indian waters by the UNDP/FAO Pelagic Fishery Project (1971-1978). Informations on the general distribution and abundance of fish eggs and larvae along the southwest coast of India have been presented by George (1979). The main objective of this paper is to present a comprehensive account on the distribution and abundance of carangid fish larvae along the southwest coast of India.

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Materials and Methods

The materials for the present study were obtained from plankton net hauls made along the southwest coast of India during the period from September 1971 to September 1975 as a part of the programme of the UNDP/FAO Pelagic Fishery Project, Cochin. On the southwest coast samples were collected from 6 profiles at Cape Comorin, Quilon, Cochin, Kasaragod, Karwar and Ratnagiri. Collections from a profile of Turicorin (southeast coast) are also included. Few collections were also made along some additional profiles drawn through Calicut, Coondapur and Vengurla. Each profile covered with 5 to 10 stations and the maximum number of stations in each profile was within the continental shelf at a distance in between 10 nautical miles and the remaining stations located beyond the continental shelf were 10 to 30 nautical miles apart. During the above period collections were made once in every six or seven weeks from each station to study the hydrography as well as the plankton. Standard profiles and stations worked out has been published by the Pelagic Fishery Project (Anon 1976).Research vessels 'Sardinella' and 'Rastrelliger' were deployed for the present investigation.

The plankton collections were made with two standard sampling gears *viz.* BCF Bongo nets, Bongo 20 (with 20 cm ring diameter) and Bongo 60 (with 60 cm ring diameter) with filtering cloths of same mesh size of 0.505 mm and with calibrated flow meters. A David Hempel neuston net (0.3 mm mesh) was also used for few surface samplings. Oblique hauls were made, while the ship moved at a speed of 2 to 3 knots. The towing speed was regulated as 20 metre per minute. In near shore stations the towing depth of the net was usually between 10 and 0 m. During 1972 the maximum collection depth was limited from 25 to 50 m, but later this was extended to 100 m depth and further increased to 150 m occasionally. During the period a total of 1284 standard plankton stations were worked out and collected 2686 samples, but carangid fish larvae were present only in 531 samples. The samples were preserved in 4% formalin. Altogether 3284 carangid larvae of various species of different stages were sorted out and this accounted 7% of the total larvae collected. The abundance/density of the larvae was found out by following the methods of Dragesund (1970). The calculations were made using the formula, number of larvae per $m^2 = \frac{N \times D}{V}$, where N is the actual number of larvae at the station, V is the volume of water filtered (m^3) and D is the depth of tow. In the present case N is taken as the mean number caught in both the filtering cones of the Bongo net.

Distribution and Abundance

The quantitative data obtained have been made use of to study and to draw a realistic picture on the distribution and abundance of this larval group in (1) Seasonal distribution and abundance, (2) Spatial distribution and abundance, (3) Horizontal distribution and abundance and (4) Vertical distribution and abundance.

Seasonal distribution and abundance

It has been observed that the pattern of distribution of the larvae of carangid fishes have direct relation with the seasonal variations of the physical factors such as temperature, salinity, dissolved oxygen, light and water currents. They were present almost throughout

the year. There is a gradual increase in abundance from the pre-monsoon period to monsoon period, the month of May showed a steep rise in abundance and reaching the peak in July (Fig. 1) which coincide with the southwest monsoon. This is the season of

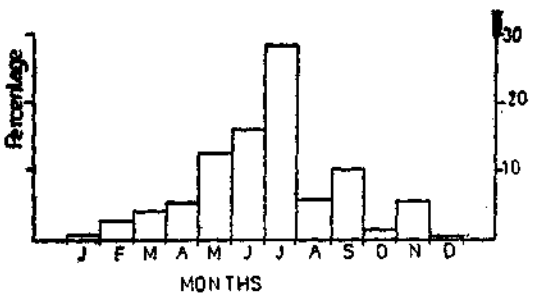

FIG. 1. Monthwise average abundance of total carangid fish larvae.

upwelling in the area, followed by high productivity on the shelf waters conducive for survival and growth of larvae. During August to October some fluctuations are noticed. The months of December and January showed values less than 1% (Table 1).

It is seen from the present study that carangid fish larvae in general prefer warmer water within the range of 27.00°C to 30.00°C (Fig. 2). This range appeared during pre-monsoon to

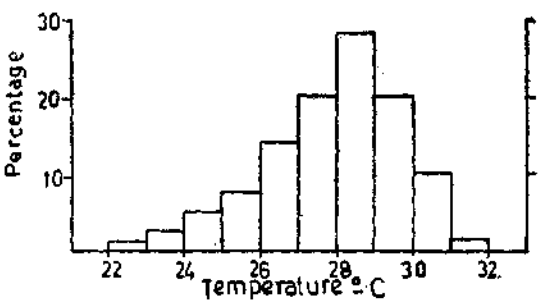

FIG. 2. Distribution of carangid fish larvae in relation to temperature.

the beginning of monsoon period which is also associated with the maximum abundance of larvae. In the case of surface salinity, the widest range tolerated by the larvae was between 33.00 ‰ to 37.00 ‰ which is again observed during pre-monsoon period. However oxygen values did not show much significance in the distribution and abundance. Majority of the larvae were caught at values ranging between 4.0 and 5.0 ml/l. It is observed that the larval numbers of carangid fishes show much variations from year to year during the period of study. Out of 3284 larvae the maximum abundance (32.5%) was observed during 1975 and the year 1973 being next in abundance (29.6%). During 1974, 23.6% were obtained, followed by 10.6% in 1972 and 3.7% in 1971 (Fig. 3).

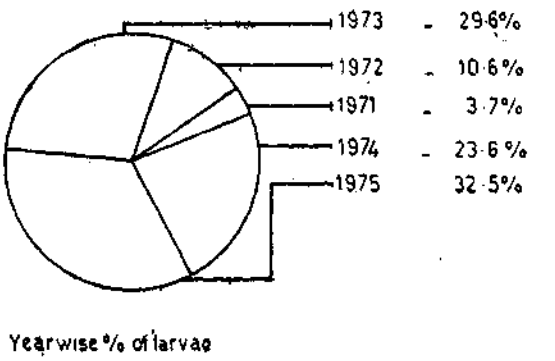

FIG. 3. Percentage of carangid fish larvae during 1971 to 1975.

Spatial distribution and abundance

General distribution pattern showed that larvae of carangid fishes were abundant in the entire shelf area almost throughout the year. The total concentration of the larvae was delineated into two areas as south and north the larval abundance being more towards southern section than the northern part (Fig. 4). Maximum larval percentage was observed from Cochin section (23.9%), Cape Comorin being the next area of abundance (20.1%) followed

TABLE 1. *Total number of carangid fish larvae obtained from different profiles in different months*

Months	Total hauls	hauls with carangid larvae	No. of carangid larvae in different profiles										Total carangid larvae
			Tuticorin	Cape Comorin	Quilon	Cochin	Calicut	Kasaragod	Coondapur	Karwar	Vengula	Ratnagri	
January ..	71	19	4	8	1	1	2	1	—	4	—	3	24
February ..	96	41	3	25	10	3	—	3	6	24	11	41	124
March ..	155	48	4	16	23	23	—	28	31	4	—	12	141
April ..	125	49	3	12	61	12	64	6	—	15	—	16	189
May ..	116	80	14	180	42	152	—	19	—	9	—	20	433
June ..	96	50	15	72	40	37	321	57	—	19	—	11	572
July ..	114	65	6	315	239	255	22	29	—	60	—	—	926
August ..	126	48	10	21	5	73	3	35	—	23	—	33	215
September ..	110	70	10	13	181	90	7	39	—	33	—	23	386
October ..	76	18	4	11	12	29	—	—	—	12	—	—	68
November ..	127	31	1	5	19	108	1	33	—	4	—	12	183
December ..	72	12	—	9	4	2	—	3	—	—	—	5	23

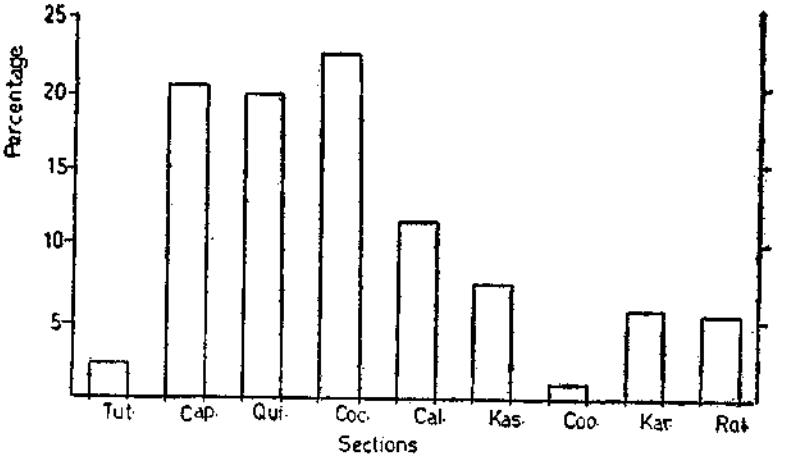

FIG. 4. Abundance of carangid fish larvae in different sections.

by Quilon (19.4%). Towards north, it is in the order of Calicut (12.9%), Kasaragod (7.7%), Karwar (6.2%) and Ratnagiri (5.4%) (Table 2).

Horizontal distribution and abundance

For charting the annual pattern of horizontal distribution and abundance of carangid fish larvae, the average larval numbers per m^2 for

each station in different sections are worked out. The larval abundance was maximum between 10 and 40 miles area. But occurrence in moderate level was noticed upto 70 miles and thereafter the occurrence was scarce. Offshore occurrence was more seen in Ratnagiri and Karwar stations. In general, larval abundance was more towards the south (Fig. 5).

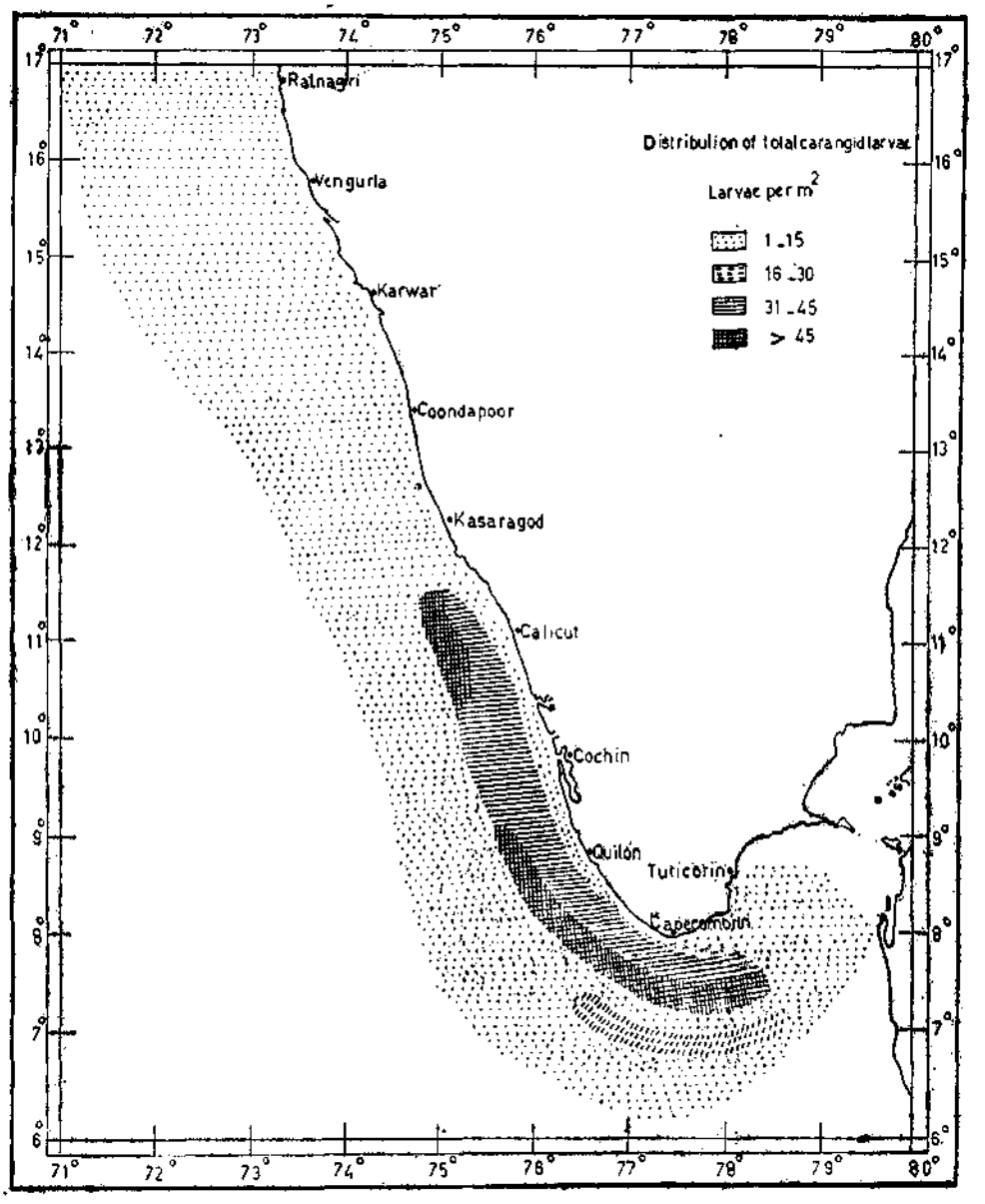

FIG. 5. Spatial and quantitative distribution of carangid fish larvae.

TABLE 2. *Total number of carangid fish larvae obtained from diffeent profiles in different years*

Profiles	No. of hauls		No. of carangid fish larvae in different years					Total carangid larvae
	Total hauls	Hauls with carangid larvae	1971	1972	1973	1974	1975	
Tuticorin ..	77	36	—	—	18	22	34	74
Cape Comorin ..	141	75	—	—	55	233	399	687
Quilon ..	173	85	1	95	116	64	361	637
Cochin ..	236	98	104	100	156	306	119	785
Calicut ..	55	24	—	28	392	—	—	420
Kasaragod ..	176	79	5	48	72	72	56	253
Coondapur ..	7	7	—	—	37	—	—	37
Karwar ..	206	67	11	53	62	29	49	204
Vengula ..	5	3	—	—	11	—	—	11
Ratnagiri ..	208	57	—	23	63	50	40	176

Vertical distribution and abundance

For this particular study, the materials collected during day and night were segregated. It was seen that the carangid fish larvae in general do not show much response to the variations in light intensity (Table 3). The results of the analysis are as follows: of the total 531 plankton collections, nearly 59.4% of the samples were obtained during day and 40.6% during night; 67.9% of the larval materials were obtained in the daily collections and the rest 32.1% in night sampling.

TABLE 3. *Day and night collections of carangid fish larvae*

Year	Station worked		Number of larvae	
	Day	Night	Day	Night
1971 ..	10	1	120	1
1972 ..	53	24	263	84
1973 ..	75	50	606	367
1974 ..	82	54	514	262
1975 ..	95	87	726	341
Total ..	315	216	2229	1055

DISCUSSION

As stated earlier, the importance of the abundance and distribution study of the larvae in relation to area, season and depth is that it helps to evaluate the entire spectrum of physical, chemical and biological environment to which the species are adapted. This will also help to project a detailed picture on the availability of fish larvae in relation to environmental parameters and to delineate the spawning area and season.

The large volume of larval material collected during the survey programme helped to confirm many earlier observations. A gross analysis of the fish larvae collected showed the following species composition, 21% clupeidae, 16% scombroidae, 7% carangidae and the rest belonged to other families (Fig. 6). It was also observed that these fishes spawn on the shelf mainly in the area, where they form a regular fishery. Several authors have indicated the relation between the upwelling and plankton production and its impact on the abundance and distri-

bution of ichthyoplankton. According to the findings of the UNDP/FAO/Pelagic Fishery Project (Anon., 1974), the zooplankton density along the west coast tend to rise from April-May towards a peak in July, which coincide with the peak of upwelling and thereafter a fairly uniform concentration. In the observations of David Raj and Ramamirtham (1982), the hydrographic features, plankton biomass and abundance of fish eggs and larvae are closely inter-related along the west coast

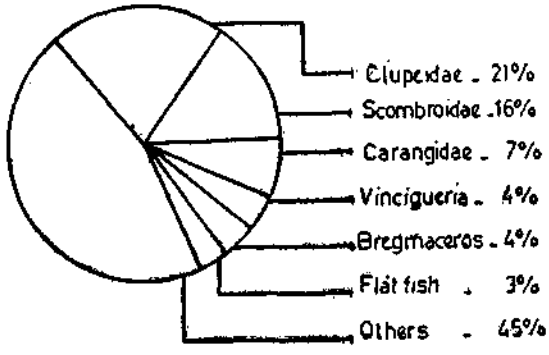

FIG. 6. Percentage of carangid fish larvae in comparison with other groups.

of India. The present study also emphasize that the distribution of carangid larvae have direct relation with the seasonal variations. The larvae are obtained from the entire shelf area almost throughout the year with maximum abundance during May to September. The peak period of abundance noticed in July with a secondary peak in November. The post-monsoon season is found to be a lean period for larval abundance. The peak spawning season of carangid fishes and the apparent peak seasons of zooplankton productivity are found to be well matched along the west coast.

Spatial distribution showed that carangid larvae in general are delineated into two areas as south and north as in the cases of zooplankton. Larval abundance was found to be more towards the southern region i.e. from Cochin, Quilon and Cape Comorin region than at Calicut, Kasaragod and Ratnagiri area.

The observations on horizontal distirbution showed that maximum concentration within 10 to 40 mile stations, but occurence upto 70 mile also noticed and thereafter the larvae were scarce. Offshore occurrence of the larvae were more seen towards Kasaragod, Karwar and Ratnagiri areas. A comparative study in this regard is difficult owing to the limited work and publications in the field.

The distribution of fish larvae during day and night have been discussed by various authors ; majority of them reported the occurrence of higher number of larvae in the night collections. Ahlstrom (1959) found no consistant difference in the day and night catches of *Trachurus symmetricus* larvae in the California and Baja California waters. George (1979) reported that average catch of fish larvae for night station was 1.4 times higher than the day catch. In the present study, carangid larvae is found to be more in the day collections, though individual species varied in their dial changes.

The correlation of hydrography with the abundance of carangid larvae have shown that they preferred warm waters within the range of 26.00°C to 30.00°C. The maximum salinity variation of 33.00‰ to 36.00‰ observed in the region under study. However, the oxygen value did not show much variations and it was between 4 and 5 ml/l.

Summarising the data on larval carangid fishes certain regularity has been observed in their occurrence and distribution in the region under study. On the basis of the larval distribution it has been possible to delineate the spawning area and season. Two areas of concentration, major one from the south of Cochin to Cape Comorin and another from Calicut to Ratnagiri are observed along the

south west coast. The larval abundance indicated highest spawning activity during the south west monsoon season. Seasons, immediately prior to and after the monsoon also showed much influence in spawning. December to January is the lean period for larvae, which is also correlated with less abundance of plankton.

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