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ON

LIVING RESOURCES *of* THE SEAS AROUND INDIA

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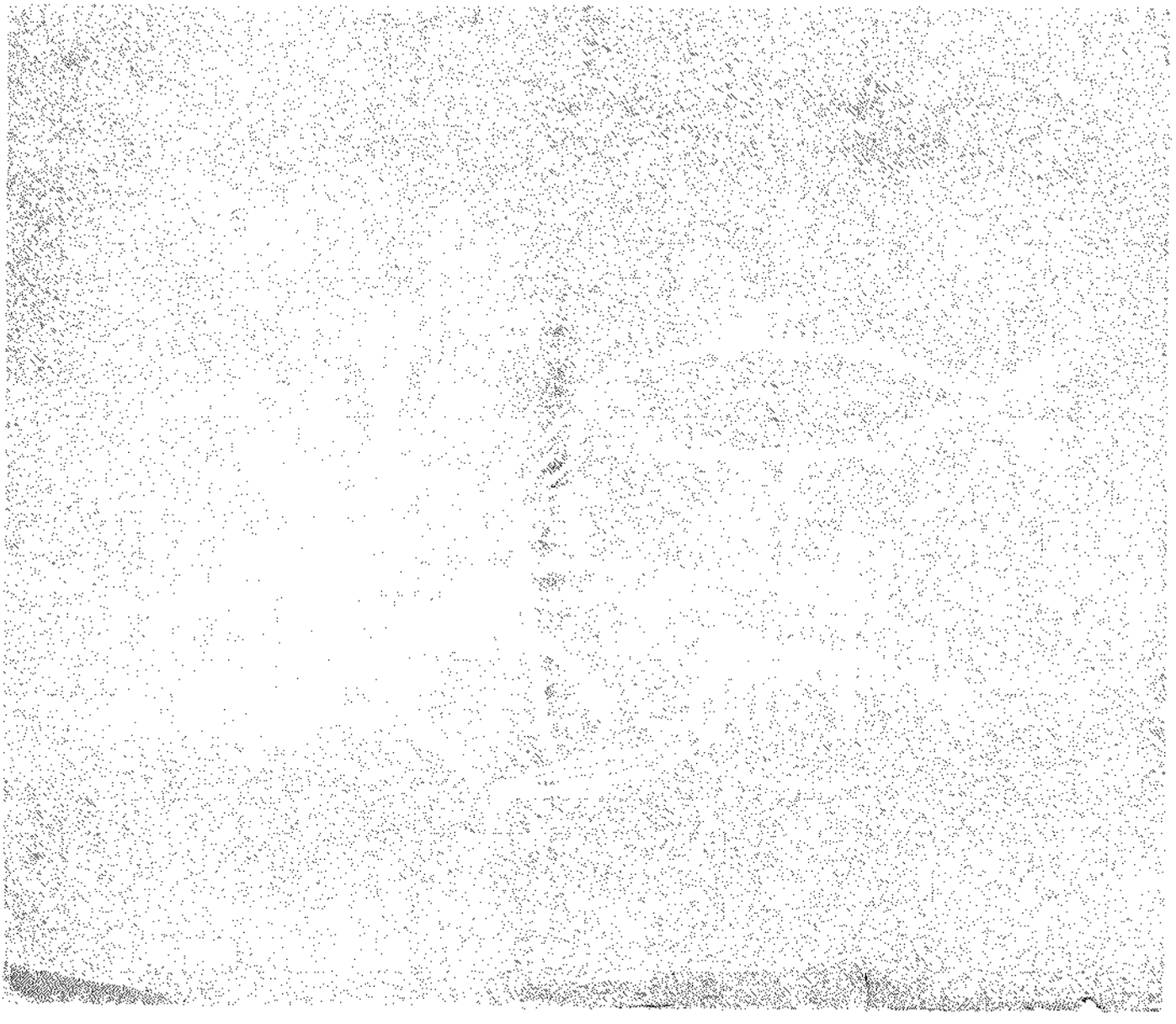

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SPECIAL PUBLICATION
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN-11
1973

PRAWN FISHERY OFF THE WEST COAST OF INDIA IN RELATION TO HYDROGRAPHICAL CONDITIONS OF THE SHELF WATERS

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ABSTRACT

Based on the hydrographic data collected on board *R. V. Kalava* and *R. V. Varuna*, the vertical distribution patterns of temperature, density (sigma-*t*) and dissolved oxygen content of sea water at five places between Cape Comorin and Mangalore were studied. In the present account an attempt is made to correlate the hydrographic data with the prawn landings in the region concerned. The prawn fishery flourishes well during the south-west monsoon period when catches are high off the Kerala coast.

INTRODUCTION

BORDERING the Indian Ocean are some of the densely populated and under nourished nations who have to look to the protein resources of the seas for supplementing their food. A knowledge of the environmental conditions helps in the location of these resources. The North Indian Ocean is under the influence of the monsoon winds which change their direction from season to season. These winds exert their influence upon the ocean by causing currents and other horizontal movements of water accompanied by upwelling of the deeper waters, which are rich in nutrients and make the surface layers of the sea fertile. Consequently, the productivity of such areas is enhanced.

The prawn fishery constitutes one of the major fisheries in India particularly on the west coast. It also plays a major role in the economy of the nation by fetching a good amount of foreign exchange in view of the increasing export trade in shrimps and shrimp products.

The prawn fishery, like any other fishery, depends to a large extent upon the environmental factors particularly the hydrographical conditions of the waters. Thus a knowledge of the hydrographical condition of the fishing zones is beneficial for the assessment and predictions of the available resources from time to time.

Because of the paucity of information on the subject, the present investigation is attempted to evaluate the relationship of the prawn fishery with the hydrographical conditions of the shelf waters off the West Coast of India.

MATERIAL AND METHOD

The present study is based on the data collected by the Central Marine Fisheries Research Institute, on board *R. V. Kalava* since 1957 and *R. V. Varuna* since 1961. Vertical sections, perpendicular to the coast, regarding temperature distribution and density (sigma-*t*) have been prepared for five places along the coast off Colachel, Quilon, Cochin, Calicut and Mangalore. The average values of the hydrographic parameters at the stations falling within different depth limits up to the continental shelf and slightly beyond are taken as representative for those limits and they are plotted for drawing the isotherms and isopycnals. Isotherms are drawn at intervals of 1° C and the isopycnals at 0·5 gm/L intervals. Due to uneven distribution of oxygen data, such vertical sections could not be drawn. However, the average values of oxygen content of all the stations perpendicular to the coast at various depths for different seasons are given in Table I.

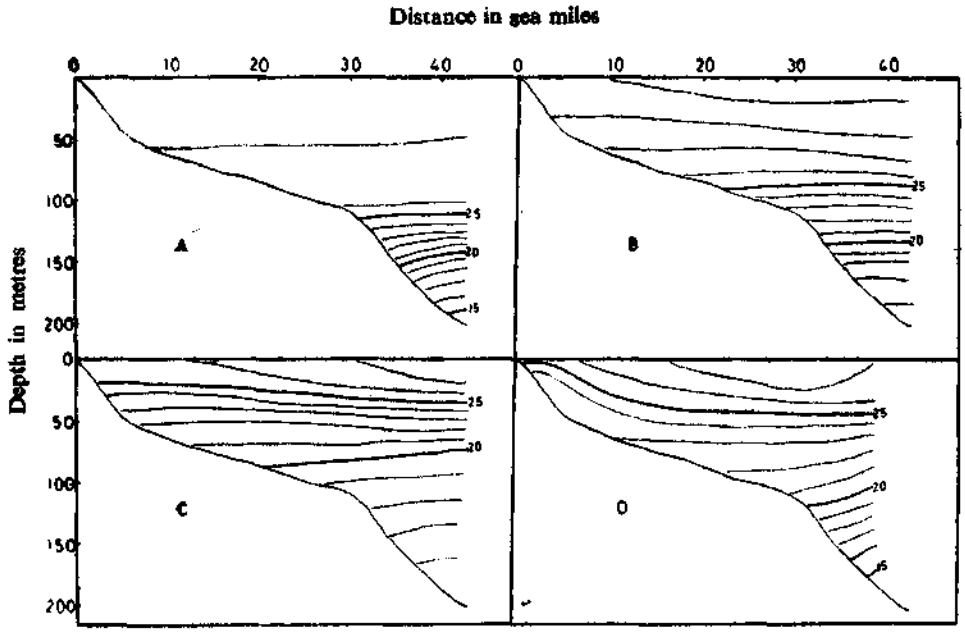
The prawn fishery data collected by the Survey Division of the Central Marine Fisheries Research Institute since 1960 till the end of 1966, have been correlated with the hydrographical condition off the West Coast of India. The prawn fishery data have been treated season-wise corresponding to seasonal pattern of the various hydrographic sections. In the present study the year is divided into four seasons, *viz.*, premonsoon (March to May), monsoon (June to August), postmonsoon (September to November) and winter (December to February).

RESULTS

Distribution of temperature

Temperature distribution at the five places is presented in Figs. 1 to 5. In general, the coastal surface waters are relatively colder than the offshore waters during the premonsoon and post-monsoon while they are warmer during winter. However, the effect of the winter cooling added to the effect of cooling by intense evaporation in winter and the summer heating in the premonsoon season are clearly seen from data shown in Figs. 1 to 5 in the upper layers. The discontinuity layer is deepest during winter ranging from 110 to 80 M. By premonsoon the thermocline tilts upward and by monsoon reaches almost the surface layer. During postmonsoon period the thickness of the upper mixed layer increases.

Generally, the range of temperature down the shelf is noticed to be less than the temperature difference between the surface and bottom waters in the offshore region during premonsoon and monsoon seasons while the reverse conditions prevail during the rest of the year.



A—Winter, B—Premonsoon, C—Monsoon, D—Postmonsoon.

FIG. 1. Distribution of temperature in °C off COLACHEL.

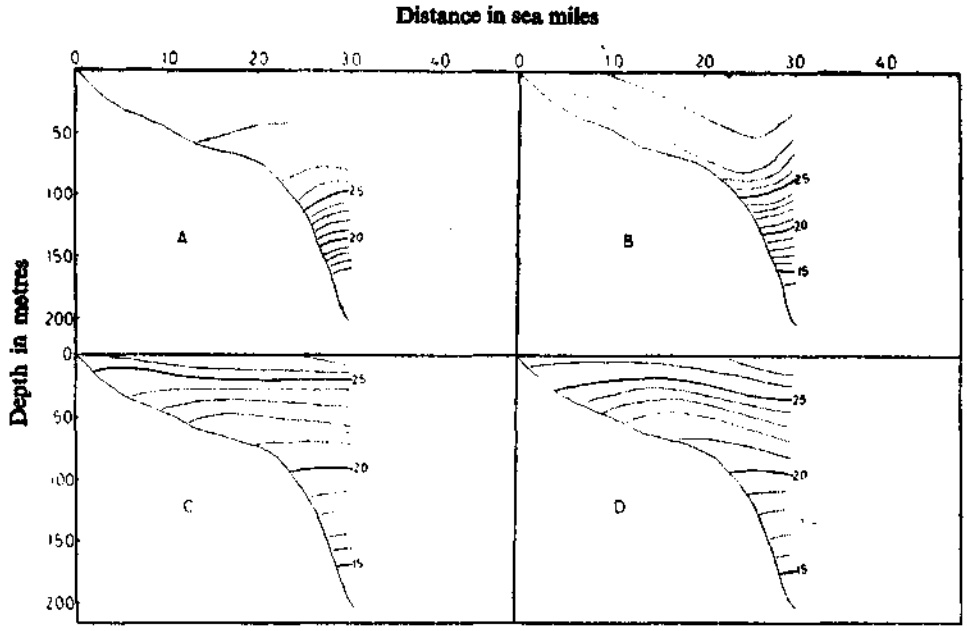


FIG. 2. Distribution of temperature in °C off QUILON.

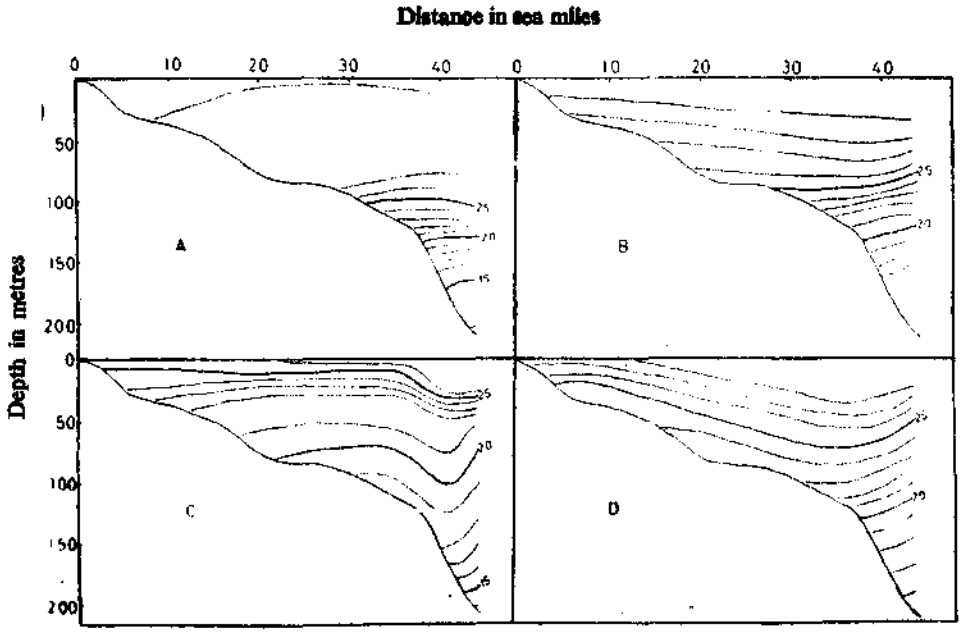


FIG. 3. Distribution of temperature in °C off COCHIN.

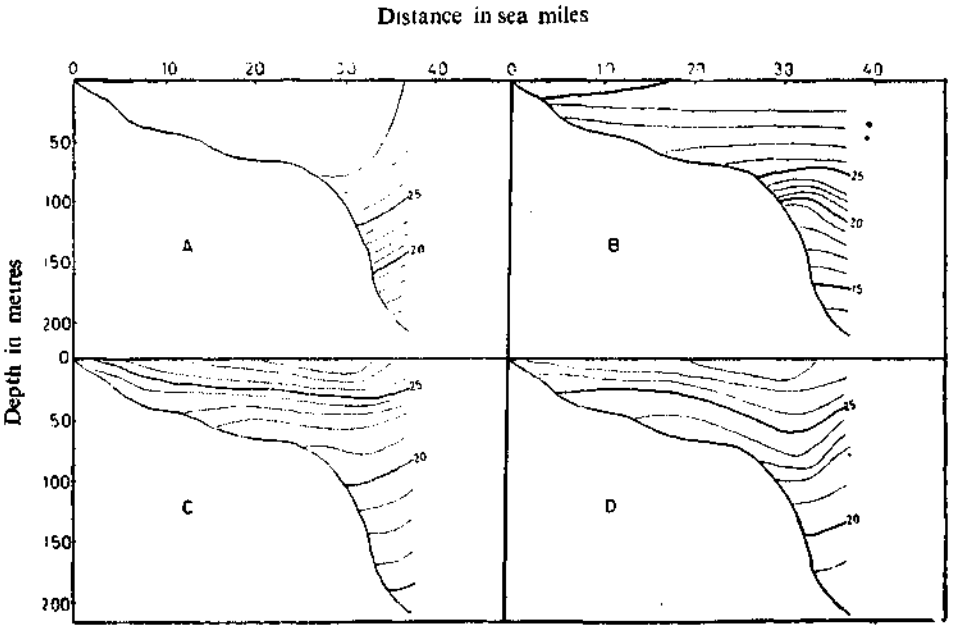


FIG. 4. Distribution of temperature in °C off CALICUT.

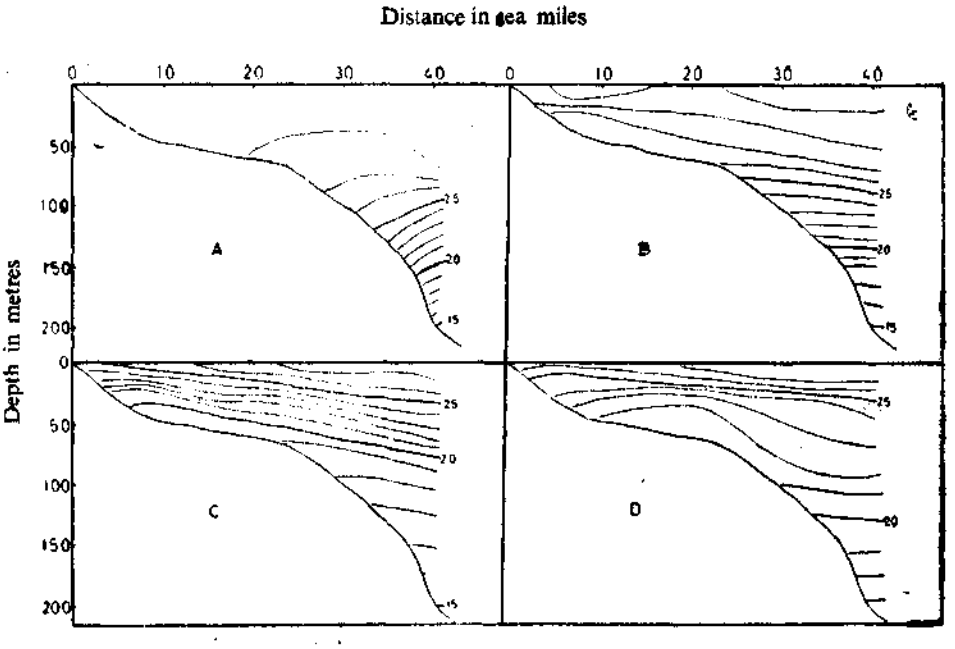


FIG. 5. Distribution of temperature in °C off MANGALORE.

Distribution of density (sigma-t)

Figures 6 to 10 represent density variations in the vertical sections along the coast. The surface density shows a very wide annual variation with high values in monsoon period and low values in winter. The vertical gradients of density are very strong during the monsoon period, particularly

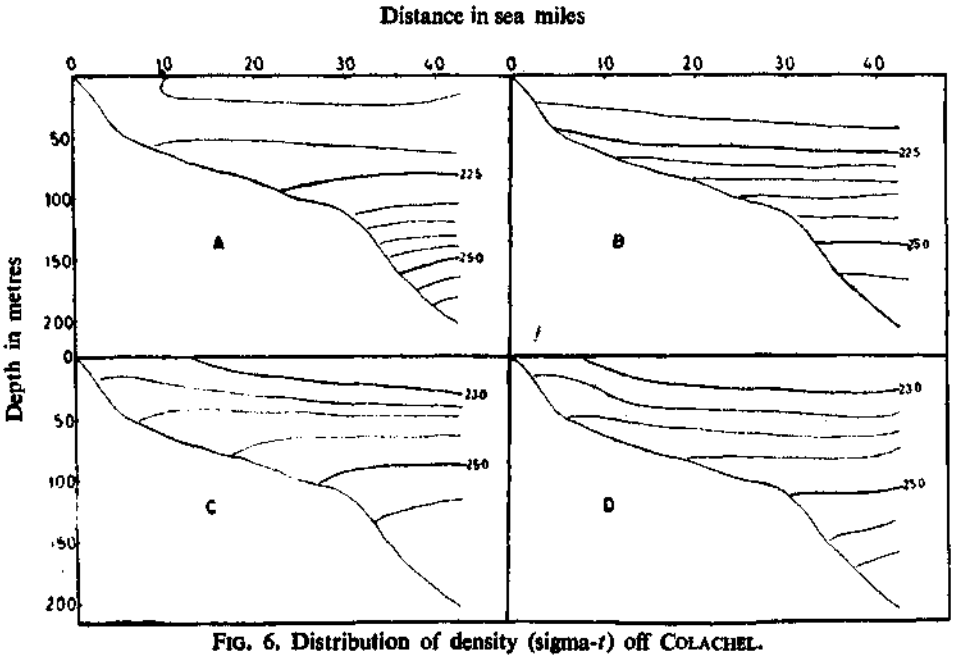


FIG. 6. Distribution of density (sigma-*t*) off COLACHEL.

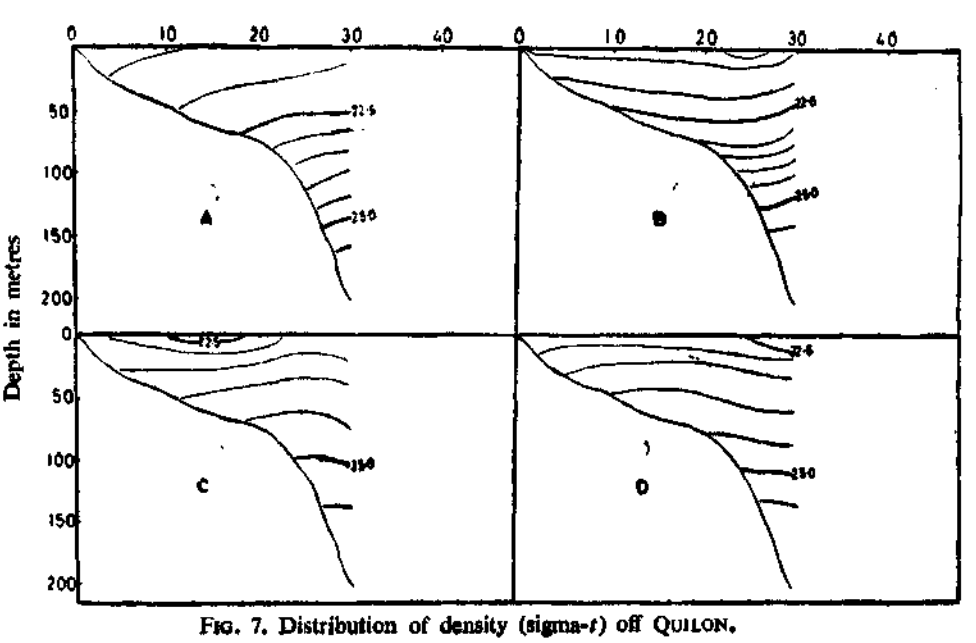


FIG. 7. Distribution of density (sigma-*t*) off QUILON.

in the surface layers, showing the stratification of the waters, while they are weak during winter. The vertical spacing of the isopycnals is almost uniform in the premonsoon period. Postmonsoon period seems to be the transition period for the stability variation. They indicate upward movement from winter to premonsoon period and continue to do so till the monsoon sets in whereas a downward shift takes place thereafter.

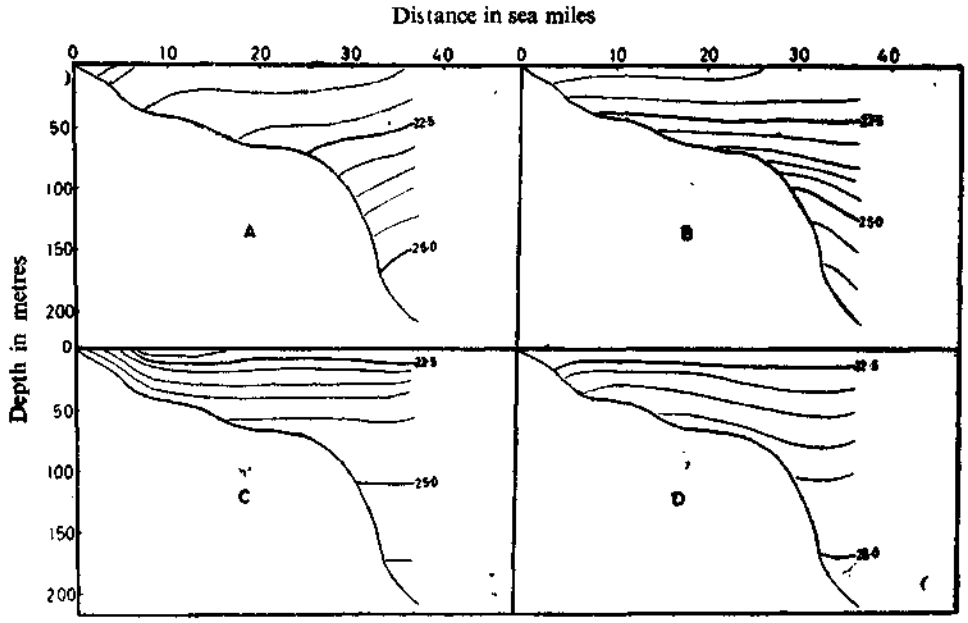


FIG. 8. Distribution of density (sigma-t) off COCHIN.

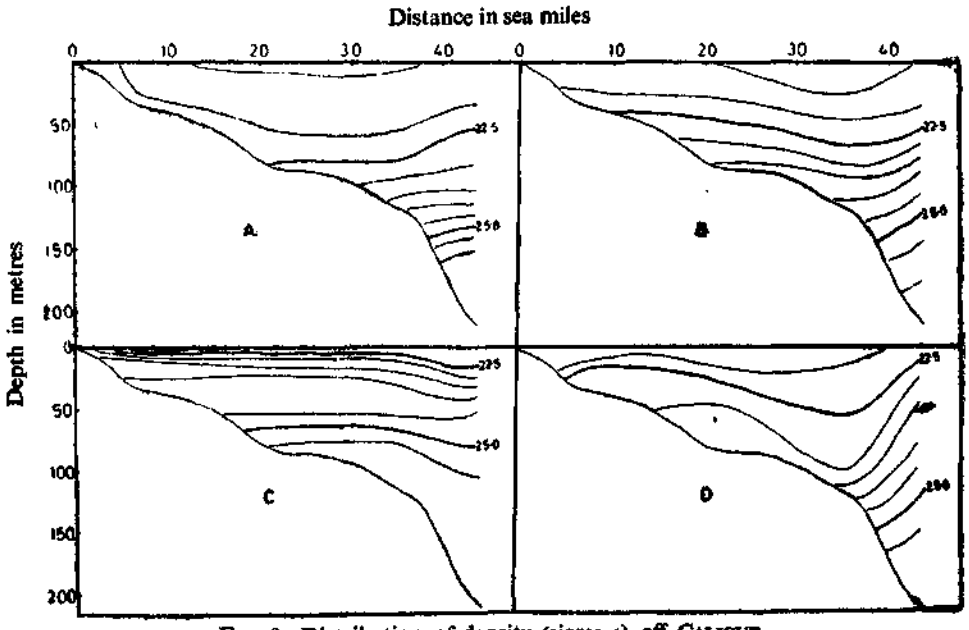


FIG. 9. Distribution of density (sigma-t) off CALICUT.

Mostly, denser waters prevail over the continental shelf all along the coast. The isopycnals are oriented down towards the coast during winter. At most of the places they show an inclination towards the surface as they approach the coast in premonsoon and monsoon periods.

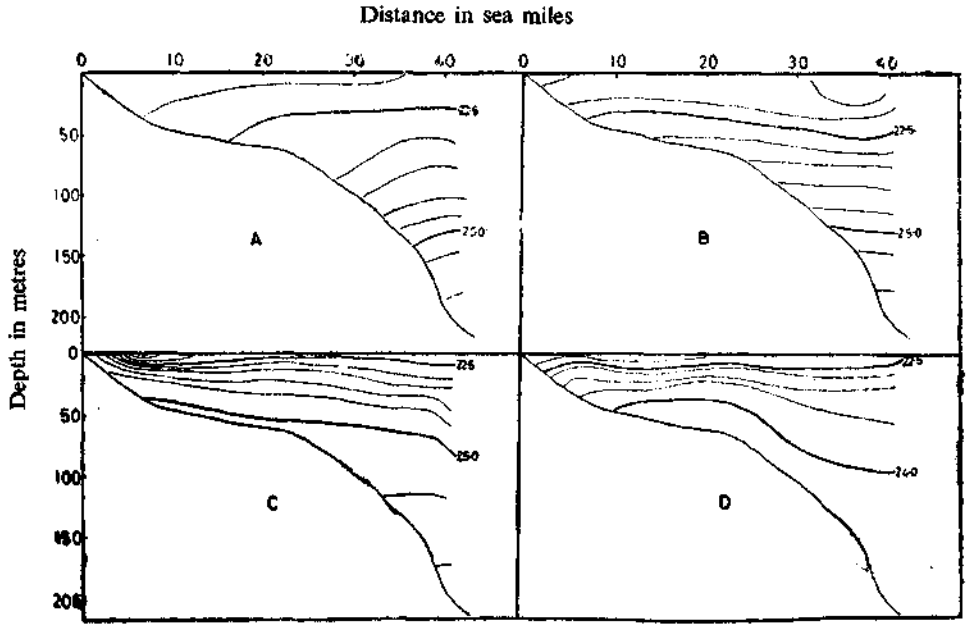


FIG. 10. Distribution of density (sigma-t) off MANGALORE.

Distribution of dissolved oxygen content

The average content of the dissolved oxygen for different seasons is given in Table I. At all the places, highly oxygenated water penetrates to deeper layers in the winter. By premonsoon, water with less concentration of oxygen extends from deeper layers towards the surface. Dissolved oxygen content is low below the depth of 20 M during the monsoon while the condition of these waters with regard to oxygen concentration improves by the postmonsoon season.

Distribution of prawn landings

The prawn landings at all the five places for different seasons are presented in Table II. For all the places the landings are maximum during the monsoon. At Colachel and Mangalore the minimum catches are during premonsoon whereas they are in winter at the rest of the places. In general, there is a sharp fall in catch from postmonsoon to winter. The annual catch is relatively more at Calicut and Quilon and it is minimum at Colachel. Taking into consideration, the catch per sea mile length of the coast, the annual catch at Cochin region is more than the catch at Mangalore region, though the total catch is more at Mangalore.

TABLE I

Distribution of dissolved oxygen content in ML/L.

Depth	Colachel				Quilon				Cochin				Calicut				Mangalore			
	Win.	Pre. M.	M.	P.M.	Win.	Pre. M.	M.	P.M.	Win.	Pre. M.	M.	P.M.	Win.	Pre. M.	M.	P.M.	Win.	Pre. M.	M.	P.M.
0	4.56	4.57	4.69	4.55	4.70	4.53	4.77	4.94	4.58	4.21	4.80	4.77	4.39	4.54	4.65	4.82	4.45	4.73	4.58	4.63
10	4.67	4.53	4.52	4.31	4.67	4.36	3.94	4.37	4.48	4.19	4.25	4.04	4.48	4.49	3.99	3.69	4.42	4.74	4.05	3.95
20	4.78	4.56	3.86	4.37	4.52	4.36	2.49	3.81	4.48	4.00	3.44	3.38	4.34	4.33	3.36	2.78	4.42	4.94	3.05	2.56
30	4.50	4.49	3.20	3.63	4.21	4.45	1.88	3.41	4.16	4.20	2.08	2.58	4.23	4.54	2.44	2.45	4.54	4.78	2.53	2.09
50	4.70	4.31	1.82	2.71	..	4.24	1.56	2.61	4.01	3.56	0.98	1.26	4.22	4.18	0.84	1.33	4.28	4.38	1.57	2.75
75	4 52	3.54	1.29	1.92	..	3.34	1.22	1.42	3.49	2.90	0.97	1.26	3.78	3.02	0.76	0.50	4.03	2.42	1 36	2.62
100	4.55	2.03	1.30	1.35	..	1.82	0.99	1.22	2.68	2.02	0.92	0.96	2.88	1.84	0.69	0.60	2.78	2.06	0.46	2.00
150	0.75	1.18	1.02	..	..	0.78	0.81	0.70	0.75	0.75	0.60	0.92	0.60	0.74	0.68	0.37	0.58	0.65	0.78	1.00
200	0.55	0.65	..	..	..	..	..	..	..	1.15	0.50	0.55	0.85	0.35	..	..	0.50	0.35	0.15	..

Explanation of abbreviations: Win.—Winter, Pre.M.—Premonsoon, M.—Monsoon, P.M. —Postmonsoon.

TABLE II

Prawn landings in tonnes

Station	Winter	Premonsoon	Monsoon	Postmonsoon	Annual landings	Annual landings per sea-mile coast length
Colachel	146.04	122.23	295.39	285.14	848.80	17.57
Quilon	404.51	803.99	2,368.19	1,474.58	5,051.27	76.27
Cochin	161.42	1,187.27	1,585.47	665.47	3,599.63	51.33
Calicut	1,270.88	1,300.04	2,800.64	2,531.13	7,902.69	81.14
Mangalore	577.03	209.51	1,896.32	1,659.07	4,341.93	48.76

DISCUSSION

A comparison of the prawn catch with the hydrographic conditions of the waters off the West Coast of India reveals that the catch is more when colder denser waters prevail. Such conditions exist across the continental shelf during the monsoon period. The low temperature during this season is the after effect of the vertical circulations of these waters evidenced by the upward shift of the isopycnals and the thermocline (Sharma, 1966; 1968). The prawn fishery is predominant off the Kerala coast particularly off Calicut and Quilon. The formation of the mud banks in that region is offered to be one of the reasons for the flourishing prawn fishery. During the period 1956–1960, the landings at Alleppey showed maximum catches during the south-west monsoon period (George, 1961). This is in agreement with the report of Kurian (1965). Thus it may safely be concluded that the prawn fishery flourishes when the colder and denser waters prevail along the coast.

Banse (1959, 1968) discussed to a certain extent the effect of the low oxygen on the demersal fishery in general and concludes that this fishery is very poor when the low oxygen waters are present in the shelf waters off the West Coast of India. The data presented here do not support the conclusion in respect of the prawn catches. It is found that the maximum catches at all the places are only during the monsoon period when the oxygen content is very poor. The authors however, feel that it is too early to conclude whether the low oxygen content is a limiting factor for the prawn fishery unless the actual oxygen requirement for the species is known as stated by Subrahmanyan (1972). From the available data it may be inferred that this may not be a set back for the fishery to flourish under the existing oxygen condition off the West Coast of India during the monsoon season.

A close examination of the fishery data presented in Table II indicates that the time difference between maximum and minimum catches is maintained almost the same at all the places of their occurrence. It seems that the catches follow the sinesoidal curve giving scope to predict the ensuing fishery season from the date of declination of the catch.

The isothermal layer and the gradient of temperature appear to play a major role in the distribution of the prawn fishery. The fluctuations in prawn fishery are in phase with the vertical movements of the depth of thermocline. At Colachel and Mangalore where the prawn catch minimum takes place they are in contrast in their thermal structure from the rest of the places. The detailed study of the topography of the depth of thermocline by Sharma (1966) serves to be a good clue for the places of good catch, as the depth of thermocline varies with the vertical

circulations of the waters which are important for the nutrient distribution and the fishes also congregate at the places of lesser depths of thermocline.

Summary and Conclusion

The prawn fishery off the West Coast of India was studied in relation to the hydrographical features. It was found that the fishery flourished when the colder, denser water prevailed along the shelf during the monsoon period. The prawn landings were relatively much higher off Calicut and Quilon than in the northern and southern regions of Kerala.

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