HYDROLOGICAL STUDIES IN THE INSHORE WATERS OF MANGALORE DURING 1964-1973

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ABSTRACT

Observations on the hydrological conditions over a decade of the inshore waters of Mangalore are presented and discussed, with an emphasis on the effects of the southwest monsoon in modifying the hydrographic characteristics. The annual variation of temperature was bimodal with peaks occurring prior to the two monsoon periods, and the minimum occurring during the monsoons. The salinity and pH indicated a sharp fall during the southwest monsoon period, and the phosphate and silicate contents exhibited a remarkable increase during the same period. The dissolved oxygen contents also showed a decline during the southwest monsoon period.

INTRODUCTION

Environmental factors play a vital role in the productivity of the sea. Prevalence of favourable hydrographical conditions is a prerequisite for optimum primary and secondary productions on which depends the fish production. Earlier investigations at Karwar (Noble 1968, Ramamurthy 1963, and Annigeri 1968) and Calicut (George 1953, Kasturirangan 1951 and Subrahmanyan 1959) have contributed to our knowledge of the hydrological conditions of the inshore waters of this region. Though the Mangalore zone is noted for the commercially important pelagic fisheries viz. Sardine and Mackerel, no detailed information is available on the hydrological features of the inshore area. Such investigations in the inshore waters of Mangalore were initiated in 1964 and the data collected during 1964-1973 have been analysed and presented in this paper.

MATERIAL AND METHODS

Mangalore (12° 52' N and 74° 53' E) is bounded on the north, south and west by two rivers viz. Nethravathi and Gurpur which form a confluence before joining the sea. Water samples were collected once a week from two stations A and B located at a distance of about 2 and 7 km respectively off Ullal, a fishing village lying 4 km south of Mangalore (fig. 1) The depths at A and B were 8 and 16 meters respectively and the Sand bar lies midway between Mangalore and Ullal. Surface samples were collected from both the stations and

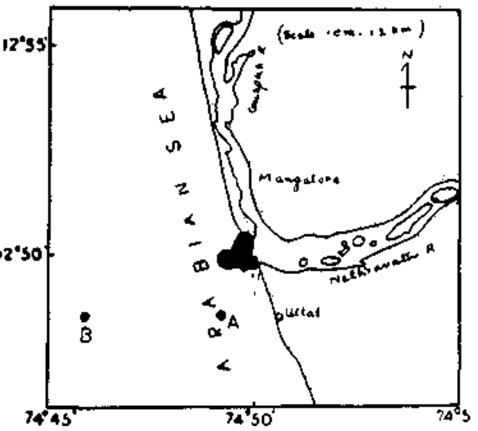

FIG. 1. Map showing the location of sampling stations A and B.

bottom samples only from station B. The rainfall data for Mangalore was obtained from the Meteorological Department of India. Procedures followed by Oxner and Knudsen as described by Harvey (1945) were adopted for the salinity estimations. Hellige comparator with cresol red and bromthymol blue (depending on the range) was used for determination of pH. Winklers method was followed for estimating dissolved oxygen. The method described by Robinson and Thompson (1948a and b) was made use of for the estimation of inorganic phosphate and silicate.

Results and discussions

Station A

The mean monthly values of temperature, salinity and rainfall are shown in fig. 2 and values of pH, dissolved oxygen, inorganic phosphate and silicate are shown in fig. 3.

Temperature

The surface temperature fluctuations revealed a bimodal pattern. From the winter minimum (December/January) a steady increase in temperature was observed upto the summer maximum (April/May). After May a decreasing trend was observed and the second minimum was recorded in July/August. Thereafter a rising trend culminating in a secondary peak during October/November was perceptible. From this secondary peak the temperature falls to the winter minimum. Thus, the two minima of the annual temperature variations of the surface waters occured during the two monsoons, while the two maxima preceded the monsoons. However the range between the maximum and minimum associated with the southwest monsoon is much greater than that of the Northeast monsoon.

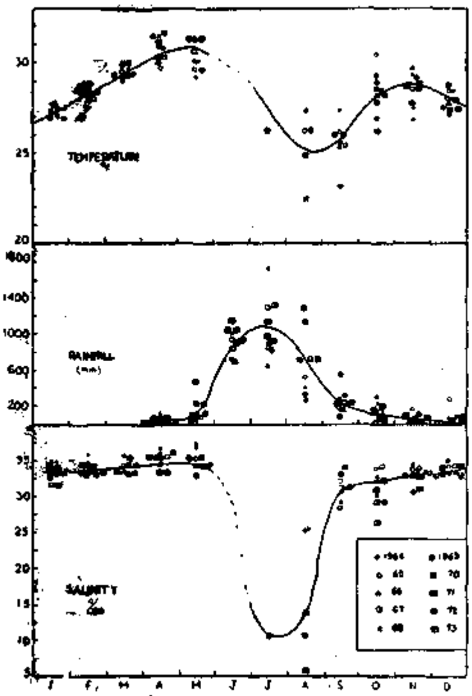

FIG. 2. Hydrological factors (Physical) of the surface waters in the inshore area (Station A) at Mangalore.

Rainfall

During the period under study, Mangalore had an average annual rainfall of 337 cm and practically no rainfall was recorded during January-March. The major part of the rainfall (about 80%) was confined to a short period of 3 months (June-August) under the influence of the southwest monsoon. Usually the month of July had the heaviest rainfall. Gradual decrease in rainfall was observed during September-December period.

Salinity

The annual variation of salinity indicates a situation which is different from the bimodal annual temperature variations. Judging from the general trend, there is a slight but steady rise in salinity from September to May, and thereafter there is a sudden fall of salinity corresponding to the southwest monsoon rainfall. The annual variation of rainfall is inversely related to the salinity variation in the inshore waters.

Hydrogen ion concentration

The general trend of pH values does not show any significant variation from October to May. However, there is a sharp fall of the same during the southwest monsoon period coinciding with the peak period of the rainfall.

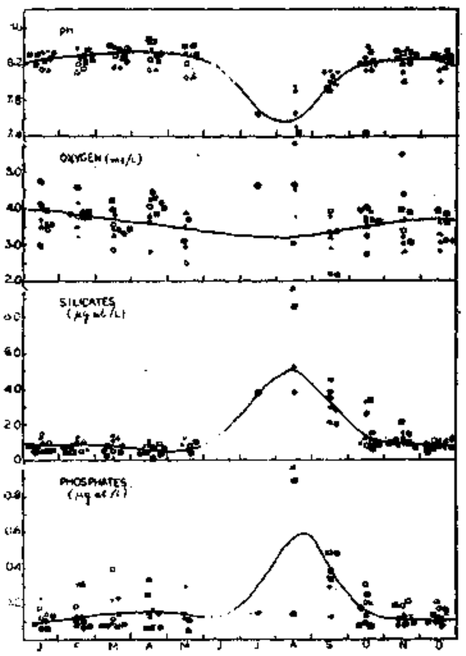

FIG. 3. Hydrological factors (Chemical) of the surface waters in the inshore area (Station A) at Mangalore.

Dissolved oxygen

The monthly mean values of dissolved oxygen at surface showed a slight declining trend during the southwest monsoon period. However, the oxygen values during these years remained between 3 and 4.5ml/L.

Phosphate

The general trend of inorganic phosphate indicated low values during December/January period with slight increase during the premonsoon period. The maximum phosphate values were observed during the southwest monsoon period.

Silicate

The trend of silicate distribution revealed a gradual depletion during January-May. Replenishment was observed after the onset of southwest monsoon due most probably to the influx of freshwater from the rivers and this feature was found to raise the silicate content of the inshore waters from the nearly depleted condition during May to the peak values observed during August.

Station B

The mean values calculated for the 10 year period for temperature, salinity, pH, dissolved oxygen content, phosphate, and silicate for the surface and bottom waters are given in table 1.

The general trend of temperature distribution of the surface waters at station B is similar to that of the Station A. During summer (March-May) the surface waters are warmer than the bottom ones, whereas during the winter months (November-January) the bottom waters are slightly warmer. The general trend of salinity variation at station B is also similar to that at station A. During October and November the bottom salinity was slightly higher than that of the surface. No significant variation in pH was noticed between surface and bottom. The dissolved oxygen content of the surface and bottom layers showed appreciable differences. During late May (Summer) the bottom waters were rich in oxygen whereas in October the trend was reversed. During the rest of the period of observation the features in surface and bottom waters were more or less comparable. Higher silicate contents were observed at the surface in May, October and November. It appears that the surface waters were maximum rich in silicate during the southwest monsoon period, indicating the influence of runoff from the rivers. The values were generally higher at the bottom than at surface.

The present study reveals a marked decline in temperature, salinity and pH and an increase in silicate and phosphate contents after the onset of the

TABLE 1. *Hydrological factors for the surface* (a) *and bottom* (b) *waters at Station* B.

	Temperature		Salinity %		pH.		Dissolved oxygen ml./L.		Silicates ug.at/L.		Phosphates ug.at/L.	
	s	b	s	b	s	b	s	b	s	b	s	b
January	27.54	27.58	33.84	33.80	8.28	8.28	4.0	4.0	7.99	7.86	0.15	0.16
February	28.21	28.21	34.16	34.16	8.27	8.27	3.9	3.9	7.74	8.05	0.16	0.20
March	29.31	29.15	34.64	34.55	8.28	8.28	3.6	3.8	7.03	7.57	0.16	0.16
April	30.50	30.10	35.43	35.14	8.29	8.31	3.8	3.7	7.14	7.65	0.14	0.17
May	30.35	29.88	35.63	35.60	8.25	8.25	2.9	3.1	8.18	6.66	0.13	0.14
June to September				No data								
October	27.64	26.94	31.63	33.14	8.16	8.08	4.1	2.8	15.13	11.33	0.17	0.27
November	28.61	28.67	33.01	33.40	8.29	8.32	3.5	3.3	11.32	10.09	0.14	0.18
December	28.00	28.14	33.56	33.66	8.28	8.27	3.7	3.8	7.52	7.75	0.12	0.14

southwest monsoon. Such features have been reported from Karwar by various authors (Ramamurthy 1963 and Annigeri 1968) and from Calicut also, (George 1953, Subrahmanyan 1959 and Seshappa and Jayaraman 1956). Ramamirtham and Rao (1973) observed intense upwelling in the region off Mangalore during the southwest monsoon period. The rapid cooling of the sub-surface waters to the very low temperature by August, indicate the effect of the latter phenomenon. From the persent observations also, the effect of the south-west monsoon in modifying the inshore hydrographic characteristics could be observed to a good extent.

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