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OBSERVATIONS ON THE HYDROGRAPHICAL FEATURES OF THE COASTAL WATERS OF NORTH KANARA DURING 1956-1966

G. G. Annigeri

*Central Marine Fisheries Research Institute, Cochin-682 018**

Abstract

Observations on the hydrographical features of the coastal waters of North Kanara during 1965-1966 showed that the annual temperature values exhibited a bimodal distribution with the primary and secondary peaks in April/May and October/November periods and their falls during August/September and December/January respectively. An abrupt fall in salinity was noticed during the southwest monsoon period, followed by a steady rise till May. The pH values varied around 8.2. The dissolved oxygen showed two peaks and two falls during a year, the peaks occurring in July/August and November/January and the falls during August-December and March/April-June respectively. Inorganic phosphorus recorded the maximum in September/October and the minimum in February/March with a single annual peak. The nitrite distribution was so random that no annual rhythm could be seen in its distribution. The silicate concentration was high during the period June to September and low values were registered in the pre-monsoon months.

Introduction

It is well known that in Fisheries Oceanography, the study of the physico-chemical properties of the environment is as important as the study of the life in it, since the variations in the former exert a profound influence on the latter. The role of nutrients in limiting the distribution and abundance of plankton on which the fish thrive is also well understood. Since the coastal waters of North Kanara support an important fishery for the Indian mackerel, investigations on the hydrographical features were initiated at Karwar in 1954 and two reports covering the period upto 1964 have appeared elsewhere (Ramamurthy, 1963; Noble, 1968). This paper embodies the results of the study of the region for the years 1965 and 1966.

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*Present address: Karwar Research Centre of CMFRI, Karwar.

Material and Methods

The topography of the area and the location of the four station *viz.* Karwar, Chenida, Ankola and Kumta are given by Ramamurthy (1963) and Noble (1968). While the stations at the latter three centres were roughly the same as those reported in the earlier works, for Karwar it was at station 4 (Ramamurthy, 1963) in the Bay. The distance of the stations from the shore and the depths were about 3 km and 7-11 m respectively. The study was restricted to the surface waters and the samples were collected between 0600 and 0700 hrs, weekly twice at Karwar and fortnightly ones at the other centres. The salinity determinations were made by Mohr's method and dissolved oxygen by Winkler method. The dissolved nutrient salts were estimated by the methods of Robinson and Thompson (1948 a, b, c).

RESULTS OF INVESTIGATIONS

Temperature: The monthly mean values of temperature at the different stations for 1965 and 1966 are shown in Fig. 1.

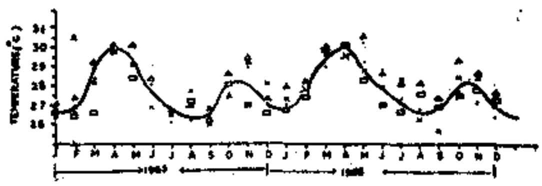

Fig. 1. Seasonal variation of temperature (°C) at various centres during 1965 and 1966.

During the year there is a bimodal pattern in the surface temperature distribution in the region (Fig. 1), with primary maximum (about 30°C) occurring in April/May and a secondary maximum (about 28°C) occurring in October/November. The minimum are around 27°C occurring in August/September and December/January intervening the two maxima. Though some points deviate, the general trend of oscillation (shown by a continuous curve) appears to be common to the entire area of observation.

Hydrogen ion concentration : During the monsoon months the pH values were lorwe than 8.2 and during pre and post monsoon months the values were higher than 8.2. The annual average was about 8.2 for both years of study.

Salinity: (Fig. 2) Salinity attains its maximum (35‰) in September/October and remains steady for a long duration, till April/May. From June it rapidly falls to its minimum (12±2‰) in July/August. It rises from its minimum to maximum within almost the same short period. Karwar seems to be influenced more by the incursion of freshwater of Kali River which is primarily responsible in bringing down the salinity lower than rest of the centres.

Dissolved oxygen : The mean monthly values of dissolved oxygen for 1965 and 1966 are presented in Fig. 3. It is seen from the figure that the oxygen content varied from 4–5 ml/l,

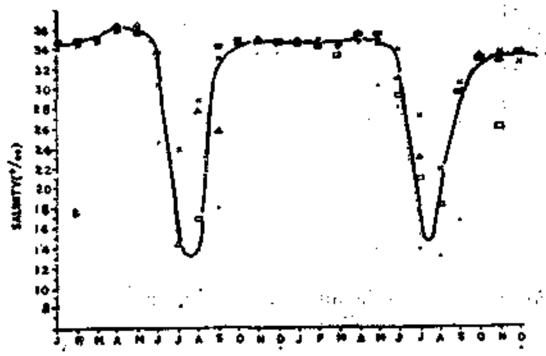

Fig. 2. Seasonal variation of salinity (‰) at various centres during 1965 and 1966.

with a few exceptions. There is perhaps, an inverse relationship between the dissolved oxygen and the temperature, the temperature minima coinciding with the occurrence of oxygen maxima. The incidence of the primary and secondary peaks and the bimodal annual feature, is quite common during both the years, although secondary peak and fall seem to be relatively feeble.

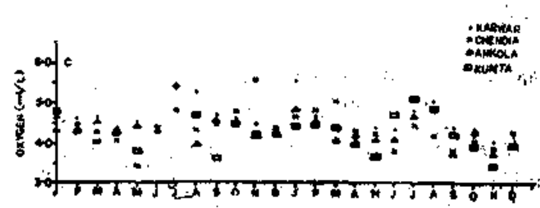

Fig. 3. Seasonal variation of dissolved oxygen (ml/l) at various centres during 1965 and 1966.

Phosphates : The seasonal fluctuation in the inorganic phosphorus content during 1965 and 1966 is shown in Fig. 4.

Inorganic phosphorus content is characterised by a single annual oscillation, the maximum being in September/October and the minimum in February/March. There is a shift in the peak of the annual cycle from 1965.

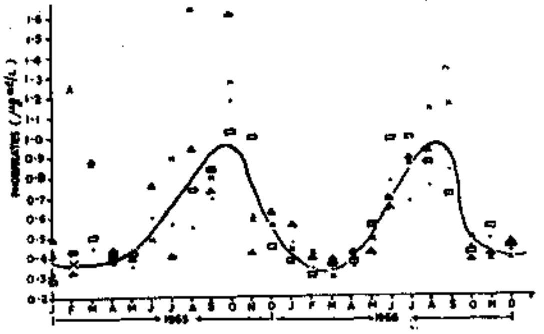

Fig. 4. Seasonal fluctuation of phosphates (µg at/l) various centres during 1965 and 1966.

The maxima for these years lie around 0.9/µg at/l and the minima around 0.3µg at/l.

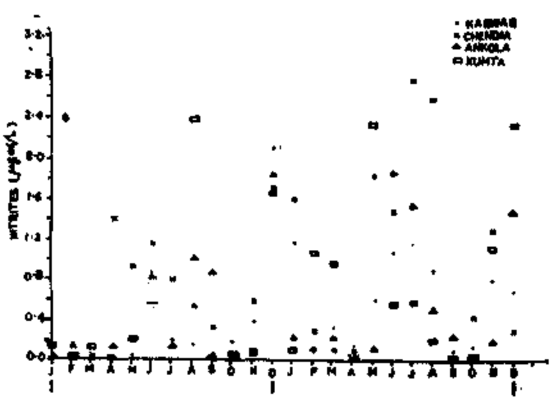

Fig. 5. Seasonal fluctuation of nitrites (µg at/l) at various centres during 1965 and 1966.

Nitrites: The values of nitrites presented in Fig. 5 indicate an irregular scattered distribution so that no seasonal cycle can be predicted for this nutrient.

The occurrence of the values of high concentration appear to be subjected to large variations between the years and the places as seen by the scatter. It may be seen from Fig. 5 that nearly 64% of the values lie between 0.0 and 0.6 µg at/l, 23% between 0.8 and 1.50 µg at/l and only 13% between 1.6 and 2.75 µg at/l. The nitrite values show no clear annual cycle exhibited and its concentration may depend on regeneration and consumption by the phytoplankton.

Silicates: The silicate content of the coastal waters is shown in Table 1.

The seasons in the above Table are arbitrarily selected. The variations between centres seem to be negligible except for the apparent gradation during the monsoon season. In the entire region, the premonsoon values are the least (6 µg at/l), the monsoon values are the highest (>48 µg at/l) and the post monsoon values are moderate (13 µg at/l).

Discussion

As noticed by the earlier workers on waters off the southwest coast of India (Banse, 1959; Subrahmanyan, 1959) and North Kanara waters (Ramamurthy, 1963; Noble, 1968) the surface temperature along this coast shows seasonal annual bimodal oscillation. The temperature during this period generally varies from 25°C to 31°C. According to Noble (1968) the observed pattern of temperature distribution is mainly due to the upwelling cold water invading the coastal area, while Rama-

Table 1. *Average seasonal values (in µg at/l) of silicate at different centres*

	Karwar		Chendia		Ankola		Kumta		Regional mean
	1965	1966	1965	1966	1965	1966	1965	1966	
S. W. monsoon season (June-Sept.)	74.52	76.94	40.16	47.96	44.33	40.62	27.50	34.0	48.26
Post-monsoon season (Oct.-Jan.)	14.40	22.47	11.22	12.14	9.85	11.06	10.60	14.9	13.34
Pre-monsoon season (Feb.-May)	5.26	8.83	5.64	6.11	5.60	6.78	5.72	7.51	6.43

murthy (1963) relates the summer and winter maxima and the intervening minima to the two monsoons. Subrahmanyan (1959) attributes the secondary fall of temperature in December-January period to the influence of Bay of Bengal waters brought by the coastal currents to the west coast in a north westerly direction which view finds agreement with the observations of Noble (1968) also. However, since the sampling stations on the North Kanara Coast were rather near shore it is rather doubtful whether the influence of Bay of Bengal waters can be felt at these northern centres of the Kanara Coast. The general fall in temperature but not in salinity during December-January months may, on the other hand, reflect only the winter conditions here and are of purely local nature.

The fall in surface salintiy during June-September may be attributed to the effect of rainfall and run off during this period (south-west monsoons). During the rest of the year the salinity is steadily maintained at $35 \pm 2‰$. It is noteworthy that there is only one fall in salinity during the year : no fall corresponding to N.E. monsoons. Noble (1968) has observed that the secondary fall of salinity occurs only in certain years. The lowest and the highest salinity values during this period were 1.47 and 36.90 ‰ respectively. The values indicated by Noble were 0.77 and 37.54‰ which are very close to the above obtained values.

During the present investigation the monthly mean values of pH varied from 8.2 – 8.4 during November - May and from 7.9 to 8.2 during June - September. In these two periods Ramamurthy (1963) recorded the range as 8.4 – 8.5 and 7.4 – 8.3 and Noble (1968) 8.2 – 8.4 and 7.8 – 8.3 respectively. It is clear that the range in the first period is invariably from 8.2 – 8.5 and in the second from 7.4 to 8.3. The decline in pH values during July to September at Karwar was more marked than those at other centres, because of the influx of Kali River water into the Bay.

The mean monthly range of dissolved oxygen was from 3.4 to 5.6 ml/l as against 2.8 – 5.3 ml/l and 3.0– 5.6 ml/l recorded by Ramamurthy (1963) and Noble (1968) respectively. There are favourable conditions like low temperature and low salinity during the south west monsoon for the waters to become supersaturated (Ramamurthy, 1963), but such a condition is observed only during the post monsoon months. During the present study, supersaturation was observed only thrice at Karwar in the months of May, January and August.

A close examination of Fig. 4 reveals that the concentration of phosphates at Karwar is lower than that at other centres. This may be due to the freshening effect of river water which contains lower phosphate content. Ramamurthy (1963) also made a similar observations. Noble (1968) however, obtained a double seasonal oscillation of inorganic phosphorus in the North Kanara coastal waters. Subrahmanyan (1959) observed a range of 0.13 to 1.68 µg at/l at Calicut and comparing the phosphate content of the different parts of the world, has shown that our coastal waters are very rich in PO_4 : P. The ranges given by Noble (1968) and observed during the present study are from 0.22 – 2.06 µg at/l and 0.11 – 2.44 µg at/l respectively and these values appear to indicate a richer phosphate content along the North Kanara Coast than along the Calicut area.

As stated earlier no seasonal cycle is shown by nitrites. Earlier workers (Ramamurthy, 1963; Noble, 1968) have indicated a bimodal picture in the nitrite content, the first peak occurring during May-August and the second in December–January period. It is observed during the present investigation that there is too much (wider) scatter in its distribution even among a single station observations. The range in minimum and maximum average values in the present investigation was 0.01 – 2.75 µg at/l whereas those given by Ramamurthy (1963) and Noble (1968) are 0.0 – 3.59 and 0.0 – 4.49/μg at/l respectively.

Silicate showed high concentration from June to September with its peak either in July or August (Table 1). The values at Karwar during the southwest monsoon remain very high than the other centres due to influence of freshwater from Kali River. The regional mean value varies from 6 to 48μg at/l during the year. In the south west monsoon this nutrient is distributed uniformly in both the years at all the centres except at Kumta where lower concentration is in 1965 than in 1966.

It is well known that due to upwelling during the southwest monsoon months the hydrographical features of coastal waters are subject to quite large amount of changes like fall in temperature, enrichment of dissolved nutrients and depletion of dissolved oxygen (Sewell, 1965; Banse, 1959; Carruthers *et al.*, 1959; Sastry, 1959; Qasim, 1965). While the former two features were noticed during the present study, the samples analysed during the monsoon months showed increased dissolved oxygen. Since it was seen that the bottom layers were actually characterised by low oxygen (Annigeri, MS) it is possible that in the nearshore waters, mixing by wind action might have contributed for the rich oxygenated surface layer.

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