Seasonal Variations in the Hydrological Conditions in the Coastal Waters of Ratnagiri

by
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Studies on the seasonal variations in the hydrological conditions of seawater constitute an important aspect of fishery research especially in view of the fact that chemical environment exerts a considerable influence on the marine life. Such type of work has not attracted much attention from Indian hydrographers and information available on the seasonal variations in important parameters such as temperature, salinity, oxygen etc. is very scanty. A review of literature reveals that some information is available through works of Chidambaram and Menon (1945) on the Malabar Coast, Jayaraman (1951) on Madras waters, Chacko et al. (1954) on Gulf of Mannar, Prasad (1957) on Mandapam waters, Vishwanathan (1959) on Madras waters, Ganapathy and Murthy (1954), La Fond (1954, 1950) on the East Coast and Thirupad and Reddy (1959) on Madras waters. It will thus be seen that most of the work is restricted to South West and South East coast of India. Work done on the North-West coast is that of Bal et al. (1954) and on Bombay Waters by Gogate (1960).

Material and Methods

The water samples were collected, from a fixed point off Mirkarwada Jetty, once a week during the period from September 1968 to March 1970. Only surface samples were collected. The temperature was recorded in the field. The salinity was determined by Mohr’s method, the dissolved oxygen was estimated by Winkler’s method and the inorganic phosphates were estimated by Denige’s method as described by Barne (1959).

Results

The monthly mean values of all the parameters determined are given in Table 1 and are shown in Figure 1, 2 and 3 (a) & (b).

![Graph showing mean monthly values of Salinity & Temperature for Ratnagiri waters.](image)

FIG. 1. Mean monthly values of Salinity & Temperature for Ratnagiri waters.

101
Temperature

The fluctuations in the monthly mean temperature indicate that it was lowest (26°C) in the beginning of the calendar year 1969. It then steadily increased to a highest level (28.5°C) in May. After this summer maxima the average temperature recorded a decrease in June (27.2°C) and July (26.7°C) but again showed a slight increase in August (27.2°C). This was followed by a decrease in temperature in September (26.3°C) and then a secondary maxima in the month of October (27.5°C). The highest values of temperature recorded in the secondary maxima were considerably lower than those in the primary maxima in summer. The average temperature recorded a decrease after October and by January 1970 the temperature was lower (26.5°C). During the course of investigation the monthly mean average temperature varied between 26°C to 28.5°C, lowest in the month of January and highest in the month of May 1969. In 1970, however, lowest monthly mean temperature was observed in the month of March (26.0°C). There was considerable variation in the temperature from month to month and also during the same month from year to year (Table I). The deviations of monthly mean surface temperatures from the annual mean temperature for the year 1969 are shown in Fig. 2. From the figure the two maxima are seen clearly, one during May and other during October. The magnitude of deviation is greater in the positive direction (+ 1.29°C) than in the negative side (−1.21°C).

Salinity

The monthly mean salinity values show a steady increase from January to May when highest salinity (35.57‰) was recorded. This coincides with the steady increase in temperatures during the same period. After the onset of monsoon the salinity rapidly decreases to a lowest level (25.10‰) in July and remains low till September after which there is a rapid increase and a secondary maxima is reached in November (32.60‰ in 1968 and 35.50‰ in 1969) in both the years.

Oxygen

In general the oxygen values go on decreasing from January (5.50 ml/l) to June (2.34 ml/l) though a slight increase is observed in April and May.
From June to November two peaks are seen one in July and a second in October (also seen in Oct. '68). From November onwards the values steadily increase till February in 1970 instead of January (as in 1969) and then goes on decreasing.

The values of percentage saturation of oxygen also shows a similar trend throughout the course of investigation. Very high values of percentage saturation are observed during the period from October to January in both the years, probably indicating phytoplankton blooms.

**Phosphate**

Mean monthly values of P-PO₄ steadily increase from January to March where as from March onwards a decrease in P-PO₄ was observed till July. From July the values again steadily increased and reached the maxima (.210 micro gm. atm/l) in November '69, subsequently decreasing till January. From January to March, increase in P-PO₄ values were recorded. Maxima in 1968 was observed in month of the October, when maximum concentration of .9/micro gm. atm/l was recorded. It is interesting to note that throughout the course of investigation a steady decline in P-PO₄ values was observed.

**Discussion**

The data presented in the paper represents the coastal surface water conditions as related to general water movements in the open sea. As no rivers are present in this area to discharge their waters, the hydrological conditions are purely influenced by the general water mass movements and the meteorological conditions.

At many places in the seas around India, the surface temperature conditions show a double oscillation during the course of a year (Sewell 1929). Considering the temperature variations in the coastal waters of Ratnagiri it can be said that a similar pattern of double oscillation is exhibited in the course of the year, there being two maxima, one in May and another in October corresponding to two dry hot seasons and two minima in the period of South-West and another in North-East monsoons respectively. Similar phenomena have been observed by previous workers. (Menon 1954, Ramamurthy 1953, Chacko et. al 1954, La Fond 1957 and Gogate 1960).

Seasonal fluctuations in salinity are quite marked. Low salinity is observed during July to September on account of heavy monsoon in this area causing dilution. Post monsoon increase in salinity starts from September onwards till January after which it remains fairly constant till May. Similar observations have been made by Gogate (1960) in Bombay waters. Changes in the salinity appear to be quite different on South-East coast as observed by Thirupad and Reddy (1959), Jayaraman (1931), Ramamurthy (1953), La Fond (1954) and Ganapathy and Rao (1955).

According to these authors the lowering of the salinity takes place during September to October in Vishakapatnam, October to December in Madras and December to January in Palk Bay and Gulf of Mannar. These differences in the periods of low salinities have been attributed to southerly current along the East coast of India.

Wide fluctuations in the oxygen contents observed during the present investigation can be attributed to the turbulence and photosynthetic activities. The percentage saturation of
FIG. 3(a). Mean monthly values of P-PO₄ for Ratnagiri waters.

FIG. 3(b). Mean monthly values of dissolved Oxygen & percentage saturation of Oxygen for Ratnagiri waters.
oxygen above 100% was observed during September to February and was generally low during March to August. More or less similar trends in changes in the oxygen contents have been observed by Gogate (1960) in Bombay waters, Vishwanathan (1959) in Gulf of Mannar and Palk Bay, and Udayavarman et al. (1960) in Madras coastal waters. It is interesting to note that during the period of supersaturation from September to February a downward trend is observed in 1968-69 whereas an upward trend is found during 1969-70.

The seasonal fluctuations in the phosphate contents are usually associated with photosynthetic activity. High phosphate values during July to November (showing an increasing trend) and low values during December to June (showing a decreasing trend) observed during the present investigations show a similar pattern of fluctuations found by Jayaraman (1951) and Thirupad and Reddy (1959). However, it is interesting to note that a continuous downward trend in the phosphate values is observed in the present investigations.

Considering the general characteristics of the coastal waters of Ratnagiri, especially during the period from July to October it can be inferred that this period constitutes the period during which upwelling takes place. This is evident from the observations of sudden high values of salinity, high phosphate contents and low temperature and oxygen contents in the coastal waters.

Summary

1. Hydrological conditions of coastal waters of Ratnagiri during 1968 to 1970 are presented.

2. Temperature condition shows double oscillation during the course of investigation like as other places on coasts of India.

3. Marked fluctuations in salinity were observed. High salinity was observed during January to May while low salinity period seems to be from June to September. Similar observations were recorded by Gogate in Bombay waters.

4. Fluctuations in oxygen (dissolved) can be attributed to the turbulence and photosynthetic activities. Percentage saturation was above 100% in September to February while it was below 100% during March to August.

5. Phosphate values were high during July to November i.e. in post monsoon period and low during December to June.

6. From general characteristics of water, July to October period seems to be the period of active upwelling for Ratnagiri coastal waters.

Acknowledgments

I am very much grateful to the Director of Fisheries, Maharashtra State for permitting me to undertake this work.

I take this opportunity to express my sincere thanks to Dr. M. R. Ranade, Research Officer, Marine Biological Research Station, Ratnagiri for his keen interest and guidance throughout the course of investigation.
References


Thirupad P. U. & Reddy, G. V. G. 1959. Seasonal Variations in Hydrological factors of Madras Coastal Waters. *Indian Fish.* 6 (2) : 298-305.


106
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<th>Month</th>
<th>Water Temperature Average Temp. °C</th>
<th>Annual Temp. °C</th>
<th>Deviation from mean temperature</th>
<th>Salinity Average %</th>
<th>Oxygen Average ml/l</th>
<th>Oxygen Percentage Saturation</th>
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