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HYDROLOGICAL CHARACTERISTICS OF THE BOMBAY HARBOUR BAY*

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ABSTRACT

Hydrological characteristics such as temperature, salinity, inorganic phosphate and dissolved oxygen contents of sea water determined near CIRUS Jetty for the year June, 1967 to May, 1968 are presented in this paper. The inorganic phosphate content is low during monsoon (2.20 μg-at $P-PO_4$/L value averaged over the season) reaches a maximum during winter (9.53 μg-at $P-PO_4$/L value averaged over the season) and then falls slightly in summer (7.49 μg-at $P-PO_4$/L value averaged over the season). Similar distribution is noticeable for dissolved oxygen content. The phosphate-oxygen distribution trend well agrees with the productivity trend for this region as reported by Krishnamurthy and Vishwanathan (1968). Surface salinity—temperature correlations are also discussed.

INTRODUCTION

THE hydrological parameters such as temperature, salinity, inorganic phosphate, and dissolved oxygen content of sea water were studied during the year June 1967 to May 1968 at Canada India Reactor Jetty (CIRUS Jetty) in the Bombay Harbour Bay (Fig. 1) Estimations of dissolved oxygen and inorganic phosphate were carried out by Gogate (1960) at two other locations *i.e.* Light ship and Light house. Light ship is situated away from the coast while Light house and CIRUS Jetty are situated near the coastline within the harbour. Thus the data available at the three sites are useful for studying the surface distribution of inorganic phosphate and dissolved oxygen in the Bombay Harbour Bay.

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MATERIAL AND METHODS

The surface sea water samples were collected using a Nansen reversing water bottle, from the caisson end of the CIRUS Jetty which is approximately one kilometre from the shoreline. Surface sea water temperatures were recorded from the readings of protected thermometer attached to Nansen bottle.

Sea water samples for dissolved oxygen and inorganic phosphate dissolved oxygen were determined as described by Strickland and Parsons (1960).

Chlorinity was determined by the Mohr's technique as modified by Oxner and Knudsen (1920). Copenhagen standard seawater was used as the reference standard.

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The results obtained by titrations were converted to salinity values by using Martin Knudsen's (1901) hydrographical Tables.

RESULTS AND DISCUSSION

Figure 1 is the location map of Bombay Harbour Bay showing the sampling sites *i. e.* CIRUS Jetty, Light house and Light ship.

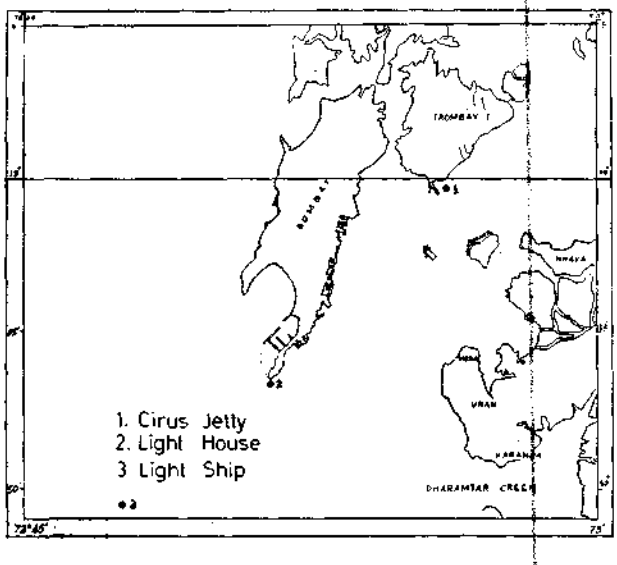

Fig. 1. Map of the Bombay harbour Bay showing sampling site locations.

The annual fluctuations in the inorganic phosphate and dissolved oxygen contents of sea water along with primary productivity values (Krishnamurthy, 1966) at CIRUS Jetty are shown in Fig. 2. Inorganic phosphate content values vary between 0.6 µg. at P-Po_4/L and 12.5 µg at P-Po_4/L. Low values of inorganic phosphate content are observed during monsoon (June to September). Then the values start rising, reaching maximum in winter (December). An increasing trend in primary productivity values is noted after the phosphate values have reached high enough. A maximum value (665 mg C/m^3/hr) for primary productivity is reported in the month of February. Phosphate is an essential nutrient for the growth of phytoplankton and it is expected that phosphate content of sea water is more when phytoplankton production is less, but thereafter as the productivity increases, phosphate being utilised by the phytoplankton, it decreases (Sverdrup *et al* 1942). Such an inverse relationship between the phosphate and phytoplankton content of the water is generally found in temperate and polar waters (Subrahmanyan, 1959). But an overall inverse relationship is not observed here.

A definite relationship between dissolved oxygen and inorganic phosphate values is not noted for the region. A minimum value of 3 ml/L dissolved oxygen is obtained in monsoon and a maximum value of 8 ml/L is noted in the month of March. In general, high values of dissolved oxygen are associated with high values of primary productivity (Krishnamurthy and Vishwanathan, 1968). It is assumed

that high concentration of oxygen is met with before and after the outburst of phytoplankton (Subramanyan, 1959). But many factors are responsible for the variation in contents of dissolved oxygen and therefore seasonal fluctuation of the oxygen content on the coast is influenced by meteorological, chemical and physical factors.

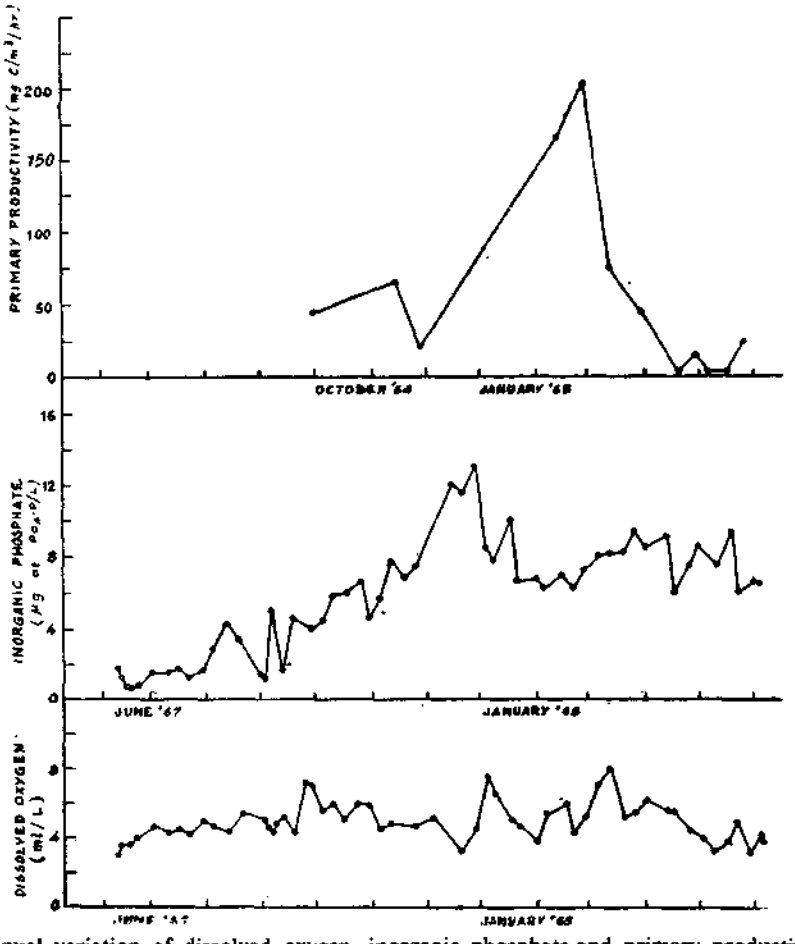

Fig. 2. Annual variation of dissolved oxygen, inorganic phosphate and primary productivity at CIRUS Jetty (Primary productivity values taken from M. Sc. Thesis of T. M. Krishnamurthy, 1966).

Table 1 gives monthly average values of inorganic phosphate content at CIRUS Jetty, Light house and Light ship. It is seen from Fig. 1 that CIRUS Jetty and Light house are near the coastline while Light ship is away from the coast nearer to ten fathom line. Table 1 indicates that inorganic phosphate content is highest at CIRUS Jetty and lowest at Light ship. Light house values are greater than Light ship values by a factor of two but are lesser by a factor of six to nine than CIRUS Jetty values. This suggests that higher amount of phosphate can be expected in coastal waters.

Various suggestions have been put forward as to the source of phosphate in the sea. Hickling (1938) believes that drainage from land contributes to the phosphate content of the sea nearer the coast. High phosphate content has been reported in marine estuaries by MacGinitie (1935) and Howes (1939).

TABLE 1. *Monthly average values of inorganic phosphate* (μg at PO_4-P/L) *in surface waters at CIRUS Jetty, Light house* and Light ship* during a year*

Month/Year	CIRUS Jetty	Month/Year	Light house	Month/Year	Light ship
June 67	1.11	June 58	0.61	June 59	0.81
July	1.56	July	1.16	July	—
August	3.39	August	1.12	August	0.68
September	3.21	September	1.07	September	0.42
October	5.73	October	0.81	October	0.47
November	6.66	November	1.22	November	0.42
December	12.18	December	1.10	December	0.55
January 68	7.16	January 59	1.05	January 59	0.86.
February	6.69	February	0.96	February	0.60
March	8.43	March	1.21	March	0.57
April	7.74	April	0.80	April	0.47
May	7.59	May	0.75	May	0.53

* Values for Light house and Light ship taken from M.Sc. Thesis of S. S. Gogate.

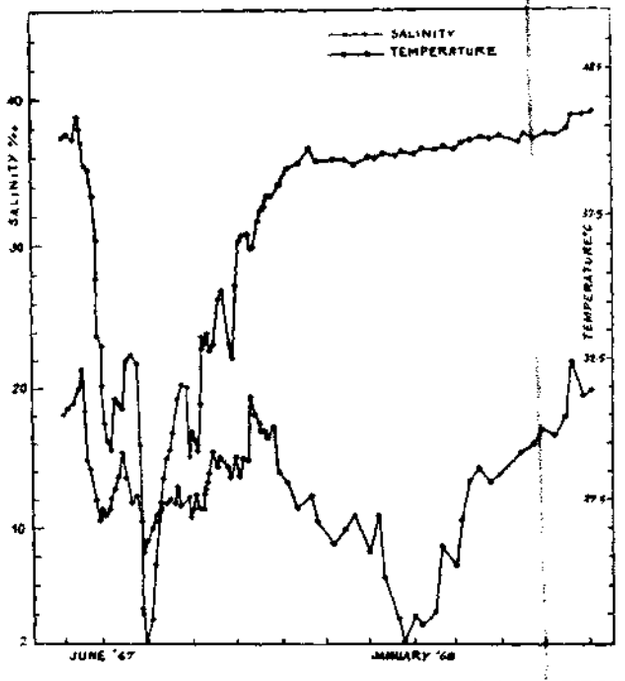

Fig. 3. Annual variation of surface temperature and salinity at CIRUS Jetty.

Table 2 gives monthly average values of dissolved oxygen content at CIRUS Jetty, Light house and Light ship. In general, CIRUS Jetty and Light house values

are high compared to Light ship values. This perhaps may be due to more agitation of water near the coast, which tends to increase the solubility of oxygen (Subrahmanyan, 1959).

TABLE 2. *Monthly average values of dissolved oxygen (ml/L) in surface waters at CIRUS Jetty, Light house* and Light ship* during a year*

Month/year	CIRUS Jetty	Month/year	Light house	Month/year	Light ship
June 67	3.64	June 58	4.5	June 59	—
July	4.49	July	4.4	July	—
August	4.85	August	4.9	August	—
September	5.42	September	4.5	September	4.1
October	5.65	October	3.8	October	4.2
November	4.57	November	5.7	November	3.5
December	4.30	December	4.6	December	3.4
January 68	6.30	January 59	5.2	January 59	4.2
February	4.97	February	4.8	February	4.5
March	6.45	March	4.2	March	4.5
April	5.57	April	3.9	April	4.1
May	3.82	May	4.4	May	3.8

* Values for Light house and Light ship taken from M. Sc. Thesis of S. S. Gogate.

Figure 3 shows annual variation of surface temperature and surface salinity at CIRUS Jetty. Salinity values vary between 2.2‰ and 39‰ low values are obtained in monsoon. A maximum value of 39‰ is noted in the month of June 1968, before monsoon set in. Temperature values vary between 22.6° C and 32.4°C. Fluctuations in temperature as well as salinity are more during monsoon; low temperature and low salinity values are observed in monsoon. Thereafter salinity tends to increase reaching maximum in summer whereas temperature tends to decrease in winter and rises again in summer.

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