Proc. Symp. Mar. Chem. in the Arab Region, Suez, April, 1991 : 81 - 88

Water Characteristics of Dongonab Bay, Sudanese Red Sea

By

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Abstract

Surface water temperture, pH, dissolved oxgen, nutrients and light penetration at Dongonab village site were measured from September 1974 to August 1975 . The surface water temperature ranged between 20 °C and 32-5 °C during January and July respectively. The water temperature followed seasonality with no sudden rise or fall. The surface water was supersaturated with dissolved oxygen through out the year excluding oxygen depletion oyster mortality cause. The pH was almost constant throughout the year at 8.62 ± 0.05. Nutrients were found in high concentrations. Water was highly turbid during mortality season (March-May) suggesting a correlation between oyster mortality and suspended matter concentration.

Introduction

Dongonab Bay lies 176 km north of Portsudan extending in a NNW- SSE direction between Lat. 20° 56 N and 21° 13 N and Long 37° 05°E and 37° 15'E, Fig.(1). The area of the bay is about 305 km^2. The bay is relatively shallow with an average depth of about 16m. It is separated form the Red Sea by a sill 3m deep at its southern end, Fig. (2).

The climate is hot (air temp. reaches 45 °C in summer) and with an average annual precipitation of about 5mm (Morcos 1970). Salinity ranges between 40% at its northern end (Farah, 1982). During winter wind blows mainly form N-NE attaining maximum strength (50-80 km/h) in January & February. During Summer, the wind direction varies but is mainly from NW & SSE. The only freswater sources to the bay are the seasonal streams that drain into its western side.

The bay has been found to be a natured ground for the oyster **Pinctada margaritifera** (Crossland, 1957; Reed, 1962). Form 1915 to 1969 the bay had been utilized for the culivation of the above mentioned oyster on commerical basis. Natives and their families used to run oyster farms near Dongonab village and sell their yield to the Sudanese government which, exports it.

Unfortunately, in March 1969 a Sudden mass mortality occured and all the culivated oysters were killed. Consequently, commercial cultivation stopped and Sudanese scientists were called to investigate the cause (s) of that mortality. Among the suggested mortality causes were (1) overcrowdness, (2) oxygen depletion, (3) plankton bloom (4) siltation (5) pathogenic infection and (6) sudden rise or fall in temperature.

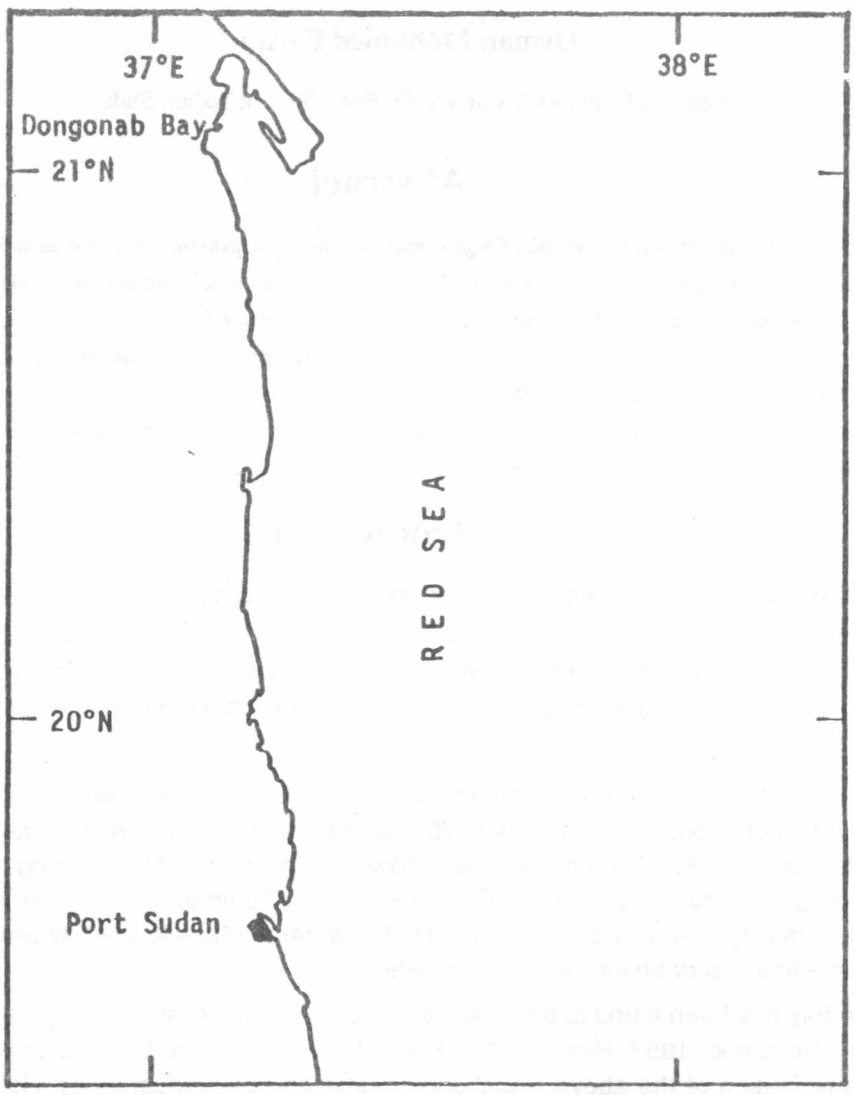

Fig. (1)
Location of Dongonab Bay.

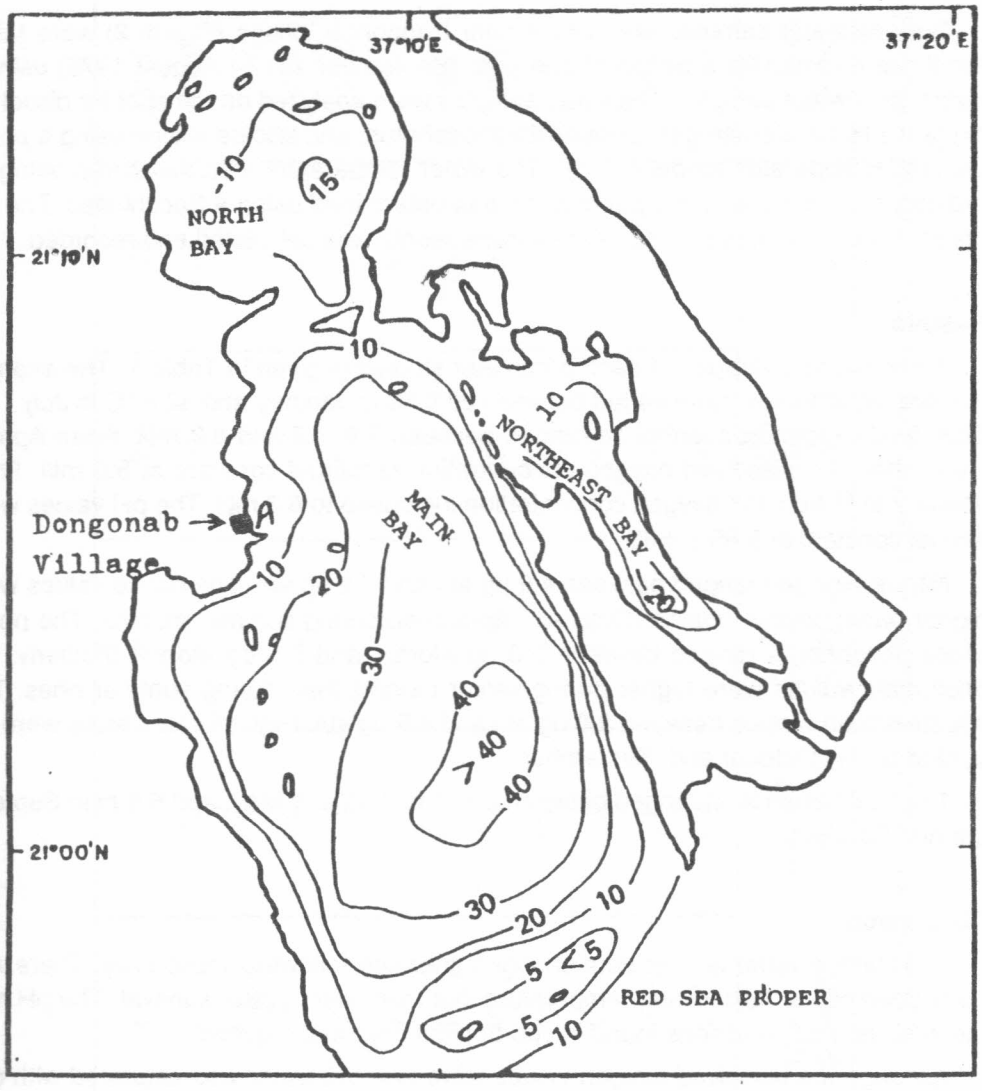

Fig. (2)

Fig. 2 - Bathymetry (m) of Dongonab Bay.

The objective of this study was to measure some physico-chemical characteristics of Dongonab Bay water (water temperature, dissolved oxygen, pH, nutrients and water transparency) to find out if they could have possibly contributed to the oyster mortality.

Materials and Methods

Surface water samples from site A near Dongonab Village (Figure 2) were taken ten times a month for a period of one year (September 1974 - August 1975) using a Hydro Bios water sampler. The water samples were analyzed on the spot for dissolved oxygen, pH, nitrate-nitrogen, phosphate-phosphorus, and silicate-silicon using a portable HACH apparatus model DR-SL. The water temperature was measured using an ordinary thermometer. Light penetration was determined using a Secchi disc. The average value of each parameter for the whole month was calculated and recorded.

Results

The monthly averages of each parameter studied is given in Table 1. The average surface water temperature varied between 20.0 °C in January and 32.5 °C in July. The Dissolved oxygen concentration ranged between 5.6 ml/l and 6.3 ml/l. From April to December, the dissolved oxygen concentration remained constant at 5.6 ml/l. From January to March, the oxygen concentration increased to 6.3 ml/l. The pH values were almost constant at 8.65 ± 0.05.

Nitrate-nitrogen ranged between 4.9 ug at/l and 7.2 ug at/l. The nitrate values were higher during winter months (October - April) than during summer months. The phosphate-phosphorus ranged between 0.3 ug atom/1 and 7.5 ug atom/l. Similarly, the phosphate values were higher during winter months than during summer ones. The silicate-silicon ranged between 2.0 ug at/l and 4.5 ug at/l. High silicate values were recorded during October and September.

The light penetration ranged between 3.5 m in April and May, and 6.0 m in September and October.

Discussion

The surface water temperature changed gradually following seasonality. There was no sudden rise or fall in water temperature that may affect oyster survival. The pH represented normal conditions found in sub-tropical bays and lagoons.

Although the dissolved oxygen values were low, the water was saturated with dissolved oxygen. This is mainly because the oxygen saturation value decreases with increasing salinity and temperature. According to Fox (1907) calculations, the surface water at Dongonab Village site was supersaturated with dissolved oxygen throughout the year. The slight increase in dissolved oxygen content during winter was due to the increase of oxygen solubility with decreasing temperatures (Ross, 1977). Therefore, dissolved oxygen is not expected to have contributed to the oyster mortality.

Table (1): Monthly averages Values of Various Oceanographic Parameters at Dongonab Village Site

Parameter / Month	Water temp. C	PH	Dissolved Oxygen (ml/L)	Nitrate-N ug. atom/L	Phosphate-P ug. atom/L	Silicate-S ug. atom/L	Light penetration (m)
Sep.	28.5	8.7	5.6	4.9	0.3	2.0	5.0
Oct.	28.6	8.7	5.6	5.7	1.1	4.0	6.0
Nov.	28.5	8.7	5.6	6.1	1.1	4.5	6.0
Dec.	25.0	8.7	6.3	5.6	1.3	2.6	5.5
Jan.	20.0	8.6	6.3	6.1	1.1	2.6	5.0
Feb.	23.0	8.6	6.3	7.2	1.5	2.4	5.0
Mar.	25.2	8.6	6.3	5.7	1.3	2.4	4.5
Apr.	27.1	8.6	5.6	5.7	1.3	2.4	3.5
May	30.0	8.7	5.6	5.2	0.6	2.0	3.5
June	30.0	8.7	5.6	5.2	0.5	2.0	5.0
July	32.5	8.7	5.6	5.2	0.5	2.0	5.5
Aug.	31.0	8.7	5.6	5.4	0.5	2.4	5.0

Nutrients at Dongonab Village site were present in relatively large amounts. The slight increase during winter months was due to resuspention from relatively nutrient-rich bottoms by waves and currents generated by the strong wind blowing during winter months. The high values of nutrients are due to the freshwater inputs which is associated with nutrient-rich soil material and also due to the presence of many coral reefs at the site. The presence of the sill at the southern end of the bay reduces water exchange between Dongonab Bay and the Red Sea which is in itself poor in nutrients (Grasshoffs, 1969; Mohamed Salih, 1987) and as a result, the nutrients are retained inside the bay. The nutrient values obtained in this study are higher than those obtained by Nasr et al., (1976) and El-Amin (1988) near Portsudan.

Minimum light penetration coincided with the mortality season (March - May). Low light penetration is an indication of turbid water. High turbidity could result from resuspention of mud size particles (< 0.0625 mm) from the muddy bottom at Dongonab Village site (Nasr, 1975; Farah, 1982). The high turbidity observed during the mortality season gives an impression that there is a sort of correlation between high turbidity and oyster mortality. Nasr (1975) stated that **Pinctada margaritifera** can feed in turbid water but to a lesser extent than in clear water. In a laboratory experiment, the author and others observed that oysters close their valves and cease feeding in turbid water. If high turbidity remains for a long time, oysters will become weak and susceptible to death.

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