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# PHYSICO-CHEMICAL STATUS OF WATER AT THE VICINITY OF ST. MARTIN'S ISLAND, BAY OF BENGAL, BANGLADESH

**M.Y. Mehedi[a*], S. Islam[b], K. Azam[a] and D. Kamal[a]**

[a] *Fisheries and Marine Resource Technology Discipline, Khulna University, Khulna 9208,Bangladesh*
[b] *Institute of Marine Sciences, University of Chittagong, Chittagong 4331, Bangladesh*

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**Abstract:** Surface water around two stations of the St. Martin's Island stretching 12 km south from southern most part of main land located in Ukhia and Teknaf were collected monthly during low tide and were analyzed for different hydrological parameters. The maximum and minimum values of water temperature, salinity, dissolved oxygen (DO), pH, water transparency, phosphate-phosphorous ($PO_4$-P), nitrate-nitrogen ($NO_3$-N), nitrite-nitrogen ($NO_2$-N), ammonia-nitrogen ($NH_3$-N) were noted as 27.9 and 25.6 °C, 34.93 and 31.40 ppt., 8.71 and 6.35 mg $l^{-1}$, pH 9.39 and 7.2, 74.86 and 52.40 cm, 18.02 and 7.28 mg $l^{-1}$, 3.61 and 0.72 mg $l^{-1}$, 1.88 and 0.07 mg $l^{-1}$, and 1.92 and 0.08 mg $l^{-1}$ respectively. During the period of investigation, the values of DO showed inverse relationship with salinity and water temperature. Nutrient contents in the investigated areas were much higher.

**Key words:** Physico-chemical parameter; Nutrients; St. Martin's Island; Bay of Bengal

## Introduction

Quality of water generally refers to the component of water, which is to be present at optimum level for suitable growth of plants and animals. Various factors like water temperature, turbidity, salinity, and nutrients play a considerable role for the growth of plants and animals in a water body. Each factor has its individual role, which has great significance. Protection of aquatic life is sort by assessment of all available toxicity data from both acute and chronic exposure tests. Values are usually set on the basis of habits of an average member of the most critically exposed group of the population (Hunt *et al*., 1982). GESAMP (1974) took initiatives to find out criteria related to water pollution control for protection of marine living resources and human health. IMCO (1973) considered water quality criteria in preparation for the International Convention for the prevention of pollution from ships.

St. Martin's Island, though a small area, present a variety of physiographic feature *viz.*

* Corresponding author. Present address: Marine Affairs Program, Dalhousie University, Halifax, Nova Scotia, Canada B3H 3J5.
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rocky platform, sandy beach, sand dunes, a lagoon, marshes, a tumble, crenulated shoreline and coral clusters. The rocks of the island are made of argillaceous limestone, calcareous sand stone, fossiliferous conglomerates and coralline limestone. These lie in the form of a thin sheet and also in the shape of big rough boulders (Islam, 1970). Sarker (1992) reported 1500 MT red seaweed biomass available around the St. Martin's Island. There are also rich aquatic fauna inhabiting in water dominating the island. However, scanty information is available on the water quality in this area. The present investigation is undertaken to assess hydrological parameters so as to find out the ecological status of the studied area as well as the contribution of each factor on the growth and distribution of aquatic weeds.

## Materials and Methods

St. Martin's Island is situated in between 92°18″-92°21″ E and 20°34″-20°38″ N and is about 12 km south from southern most part of the mainland. It is stretched North to South. To the East of this island Myanmar boundary line is about 5km away while to the West and South-west it faces the open sea. It is a group of several small and big islets but broadly three or four of this are recognized at high tide. Two stations, namely *Dakshin para* and *Jingira*, were selected around the St. Martin's Island and the stations were treated as station 1 and station 2 respectively. Station 1 is situated at the southern part of the western coast. The shore slope of this station area is gradually slanting. The coast is made up of compactly stacked boulders of different shapes and sizes. Station 2 is situated at the Northern part of the western coast. The shore slope of area is gradually slanting. The coast is composed of large rock boulders.

Water samples were collected from the two stations around the St. Martin's Island during the period of November to April at low tide. The samples were collected in clean plastic buckets of one-liter capacity each for measuring all the physico-chemical parameters except DO and water transparency. For measuring DO, samples were collected in BOD bottles (300 ml) and treated with 2 ml of alkali-iodide azide reagents in the field. The bottles were turned upside down several times to allow thorough mixing. The bottles were closed with stopper in such a way so that no air bubbles were formed.

All the bottles with samples were placed in wooden boxes to avoid direct sunlight. Samples were then transferred to the laboratory and preserved at 4°C before analysis (WHO, 1982). Water temperature was measured by thermometer (centigrade) by dipping in the water for three minutes. The value of pH was determined with the help of digital pH meter (Model PW 9409 Philips). Salinity was determined by following Mohr's titration method (Strickland and Parson, 1965). DO, Phosphate-phosphorous, Nitrate-nitrogen, Nitrite-nitrogen, Ammonia-nitrogen were measured according to the procedure of APHA (1976). To obtain transparency, a secchi disc was lowered in to the water, in the shade until it disappeared and a depth measurement at this point was taken. Then the disc was raised until it reappeared and another depth measurement was taken. This process was repeated three times and the over all average was considered as the proper secehi disc reading or value of water transparency.

## Results and Discussion

Different water temperature ranges were observed in two stations during the period of investigation. Between the two stations, the highest water temperature was recorded as 27.9°C in station 2 and the lowest was recorded as 25.6°C in station 1. Interpretation (Table 1 and 2)) reveals that water temperatures were higher in November, February and March than those of December and January. Such higher values of water temperature in those months occurred probably due to the air temperature of the surrounding influence air. Similar inferences were observed by Quasim and Gopinathan (1969) in Cochin back water and Dehadri (1970) in Mormugua Bay. In the present study, the water temperature suddenly dropped from a peak high (March) to a peak low (April). It might be attributed to heavy rainfall. In the present study, the range of water temperature was within the limit stated by Luning (1990).

Table 1. Hydrological parameters of station 1 in different months (1994-1995).

| Parameter | Nov. 1994 | Dec. 1994 | Jan. 1995 | Feb. 1995 | Mar. 1995 | Apr. 1995 | Mean |
|---|---|---|---|---|---|---|---|
| Water temp. (°C) | 27 | 25.8 | 25.7 | 26.4 | 27.82 | 25.8 | 26.39 |
| Salinity (ppt.) | 33.82 | 32.7 | 32.25 | 33.71 | 34.7 | 31.8 | 33.11 |
| DO ($mgl\text{-}1^{-1}$) | 7.93 | 8.12 | 8.71 | 7.51 | 6.82 | 8.21 | 7.88 |
| pH | 7.2 | 7.35 | 8.11 | 9.13 | 8.2 | 7.41 | 7.9 |
| Water transparency (cm) | 52.4 | 55.9 | 67.18 | 73.42 | 67.98 | 55.83 | 62.12 |
| $PO_4$-P ($mg\ l^{-1}$) | 9.13 | 18.02 | 16.25 | 10.52 | 9.02 | 8.56 | 11.92 |
| $NO_3$-N ($mg\ l^{-1}$) | 2.78 | 2.43 | 1.82 | 1.0 | 0.95 | 0.91 | 1.65 |
| $NO_2$-N ($mg\ l^{-1}$) | 1.82 | 1.8 | 1.32 | 0.6 | 0.07 | 0.46 | 1.01 |
| $NH_3$-N ($mg\ l^{-1}$) | 1.55 | 1.5 | 1.32 | 1.02 | 0.08 | 0.45 | 0.99 |

Table 2. Hydrological parameters of station 2 in different months (1994-1995).

| Parameter | Nov. 1994 | Dec. 1994 | Jan. 1995 | Feb. 1995 | Mar. 1995 | Apr. 1995 | Mean |
|---|---|---|---|---|---|---|---|
| Water temp. (°C) | 27.1 | 26.21 | 25.88 | 27.5 | 27.9 | 25.9 | 26.75 |
| Salinity (ppt.) | 34.35 | 32.74 | 32.55 | 33.61 | 34.93 | 31.4 | 33.26 |
| DO ($mgl\text{-}1^{-1}$) | 7.91 | 8.28 | 8.45 | 7.6 | 6.35 | 7.02 | 7.59 |
| pH | 7.6 | 7.92 | 8.65 | 9.39 | 8.82 | 7.91 | 8.38 |
| Water transparency (cm) | 54.12 | 60.7 | 71.33 | 74.86 | 69.86 | 59.24 | 65.01 |
| $PO_4$-P ($mg\ l^{-1}$) | 9.05 | 17.54 | 16.92 | 9.95 | 8.63 | 7.28 | 11.56 |
| $NO_3$-N ($mg\ l^{-1}$) | 3.61 | 3.38 | 2.62 | 1.01 | 0.81 | 0.72 | 2.03 |
| $NO_2$-N ($mg\ l^{-1}$) | 1.88 | 1.8 | 1.2 | 0.53 | 0.09 | 0.55 | 1.01 |
| $NH_3$-N ($mg\ l^{-1}$) | 1.92 | 1.7 | 1.6 | 1.02 | 0.1 | 0.75 | 1.18 |

The maximum (34.93 ppt.) and the minimum (31.40 ppt.) values of salinity were recorded in station 2 between the two stations (Table 2). The maximum salinity was observed in March, 1995 and the minimum salinity was observed in April, 1995. Variations in salinity during the present investigation were related to seasons with an exception in April, 1995. Similar seasonal variations were observed by Hossain (1980). In April, 1995, salinity suddenly dropped from the maximum value to the minimum value probably due to heavy rainfall and discharge of terrestrial and river runoff. Similar fluctuations were also reported Rao and Sastry (1980). Zafar (1992) observed that the

values of salinity were proportional to the values of water temperature in coastal waters of Bangladesh.

Mean values of water temperature and salinity in station 1 were comparatively lower than that of station 2 (Tables 1 and 2). These lower values of water temperature and salinity at station 1 occurred probably due to higher wave action at station 1 compared to station 2. The highest values of dissolved oxygen (8.81 mg $l^{-1}$ was observed at station 1 in January, 1995 and lowest (6.35 mg $l^{-1}$) was observed in station 2 in March, 1995. The mean values of DO at station 1 and 2 were 7.88 and 7.59 mg $l^{1}$ respectively (Tables l and 2). The standard value of DO for the coastal water of Bangladesh is 6.0 mg $l^{1}$ (EQS, 1991). However, the values of DO in the present investigation were higher than the EQS value. This was probably due to heavy wave action and high algal production. An inverse relationship of DO with salinity and temperature was observed during the present study. Similar relationship was also made by Benakappa *et al*. (1980) from the fishing ground of Mukka-kaup. As suggested by Redfield (1948), this was perhaps due to the greater solubility of oxygen in water at lower temperature and lower salinity.

The maximum (9.39) and the minimum (7.20) pH were recorded in station 2 and station 1 respectively (Tables 2 and 1). The mean values of pH at station 1 and station 2 were 7.90 and 8.38 whereas the standard value of pH of the coastal water of Bangladesh is pH 6 to 9 (EQS, 1991). The values of pH of the present investigation were found higher during, January-March, 1995, when the algal vegetation was maximum and lower in November, 1992 and April, 1993. There higher values of pH might be due to utilization of carbon-di-oxide by primary producers (e.g. seaweed) in their photosynthetic activities. Similar higher values of pH were reported by Benckappa *et al*. (1980). The lower values of pH might be attributed to the dilution of waters by river runoff.

Different values of water transparency were observed in two stations during the period of investigation. In the present study, the maximum (74.86 cm) and the minimum (52.40 cm) values of water transparency were recorded in station 2 and l, respectively (Tables 2 and 1). The values of water transparency were found higher during, January, February, and March, 1995. It could be due to low wave action and absence of rainfall. Comparatively lower values of water transparency were found in November, 1994. The low values of water transparency occurred due to rainfall.

The maximum (18.02 mg $l^{1}$) and the minimum (7.28 mg $l^{1}$) $PO_4$-P contents were recorded in station 1 and station 2 respectively during the period of investigation (Tables 1 and 2). The higher $PO_4$-P contents were observed during December 1994, January and February, 1995. While the lower $PO_4$-P contents were observed during November, 1994, March and April, 1995. This variation in $PO_4$-P content might be due to utilization of $PO_4$-P by seaweeds, and absorption and desorption of $PO_4$-P by phytoplankton. Besides, buffering action of sediment under varying environmental condition may also cause the variation in $PO_4$-P content. Uddin (1993) found the range of $PO_4$-P between 7.3 and 12.2 mg $l^{1}$ in the Karnafully River. Nair *et al*. (1984) reported the concentration of $PO_4$-P between 3.4 µg $l^{-1}$ and 6.02 µg $l^{-1}$ from Ashtamudi estuary. Abidi *et al*. (1983) found the values of $PO_4$-P from 1.1 to 10 µg $l^{-1}$. The range of $PO_4$-P content (7.28-18.02 mg $l^{-1}$) in

the present investigation is nearly similar to the contents (7.30-12.2 mg $l^{1}$) reported by Uddin (1993). However, it does not agreed with the ranges reported by Nair *et al*. (1984) and Abidi *et al*. (1983).

Between the two stations, both the maximum (3.61 mg $l^{-1}$) and the minimum (0.72 mg $l^{-1}$) $NO_3$-N contents were recorded in station 2 (Table 2). The $NO_3$-N concentration was high during the months of November and December, 1994 and January, 1995 and low concentration during the months of March and April, 1995. It was also observed that from the highest concentration in November, 1994, $NO_3$-N concentration gradually decreased. This gradual depletion occurred probably due to utilization of $NO_3$-N by seaweeds and phytoplankton. Uddin (1993) found the values of $NO_3$-N ranged from 8.2 mg $l^{1}$ to 11.40 mg $l^{1}$ in the Karnafully River. Abidi *et al*. (1983) found the values of $NO_3$-N ranged between 0.57 µg $l^{1}$ and 7.6 µg $l^{-1}$ in the west coast of India. Whereas in the present investigation the $NO_3$-N content ranged between 0.72 mg $l^{1}$ and 3.6 ng $l^{1}$. The results of the present investigation did not coincide with the results of Uddin (1993) and Abidi *et al*. (1983).

The maximum (l.88 mg $l^{1}$) and the minimum (0.07 mg $l^{1}$) $N0_2$-N concentrations were recorded in station 2 and station 1 respectively during the period of investigation (Tables 2 and 1). The values of $NO_2$-N were found lower than those of $NO_3$-N values. This less values of $NO_2$-N might be caused by the rapid alternation from $NO_2$-N to $NO_3$-N. Uddin (1993) found $NO_2$-N concentrations ranged from 0.70 to 1.52 mg $l^{1}$ in the Karnafully River. Sarma *et al*. (1982) reported maximum concentration (1 mg $l^{-1}$) of $NO_2$-N from the Visakhapatnam harbour. Results of the present investigation coincided with the results of Uddin (1993) and Sarma *et al* (1982) with little differences. In the present investigation the highest $NO_2$-N concentration was found in November, 1994. It gradually decreased in April, 1995 and reached to the lowest value. Higher concentrations occurred during the months of November, December, 1994 and January, 1995, which might be due to the production of extracellular nitrite produced by phytoplankton population as reported by Carlucci *et al*. (1970). Further it was also assumed that excretion by phytoplankton, oxidation of ammonia and reduction of nitrate had contributed higher concentration of nitrite in the studied water bodies. Monthly variations in $NO_2$-N contents were observed during the period of investigation. This was probably due to the predominance of any one of the above processes.

The maximum (1.92 mg $l^{1}$) and the minimum (0.078 mg $l^{1}$) $NH_3$-N contents were recorded at station 2 and station 1 respectively during the period of investigation (Tables 2 and 1). The values of $NH_3$-N were found lower than the values of $NO_3$-N. Uddin (1993) found $NH_3$-N that ranged between 0.25 mg $l^{1}$ and 0.50 mg $l^{1}$ in the Karnafully River. Sarma *et al*. (1982) reported maximum concentration (l2 ng $l^{1}$) in the Visakhapatnam Harbour. Results of the present investigation show similarity with the results of Uddin (1993) but disagree with the results of Sharma *et al*. (1982). Highest values of $NH_3$-N were found in November 1994 and gradually decreased till February 1995. No remarkable fluctuations of $NH_3$-N were observed from November 1994 to February 1995 but it suddenly dropped to the minimum value in March 1995. It happened probably due to the utilization of $NH_3$-N by seaweeds and phytoplankton. In April 1995, the value of

$NH_3$-N increased but did not reach the highest value. The increasing trend of $NH_3$-N probably occurred due to the metabolic activities of plants, animals and bacteria. Severdrup *et al.* (1970) reported that the metabolic activities of the plants, animals and bacteria returned the elements to inorganic forms. The present work is in well agreement with the findings of Severdrup *et al*. (1970).

Generally, nutrients contents remain lower in the open ocean than coastal water or adjacent to the locality. Higher values in the coastal water were usually due to the addition of river run off, terrestrial run off, organic wastes etc. In the present work the concentrations of nutrients were much higher than the normal range. This higher range of nutrients occurred probably due to the addition of river run off, terrestrial run off, organic wastes etc. Moreover, certain bacteria played a vital role for such higher values of nutrients during the present investigation around St. Martin's island by decomposing various organic substances such phytoplankton, seaweeds and other aquatic plants and animals.

## Conclusion

The values of pH during the studied period were within the limit of EQS (6-9) for coastal water that was also responsible for the growth of seaweeds with an exception in February 1995. Nutrients ($PO_4$-P, $NO_3$-N, $NO_2$-N, $NH_3$-N) content around the St. Martin's Island water very high, which were essential for the growth of seaweeds. The findings of the present investigation will add to our understanding about the ecological status of St. Martin's Island.

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