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Physico-chemical Characteristics of the Water of Manakudy Estuary in Kanyakumari District—Tamil Nadu (India)

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Physico-chemical characteristics of Manakudy estuary and their seasonal pattern and periodicities were studied from November 1993 to April 1994. The parameters studied were pH, temperature, bicarbonate and carbonate alkalinity, nitrate-nitrogen, nitrite-nitrogen, phosphate and total phosphorus.

INTRODUCTION

Pazhayar, one of the main river systems in Kanyakumari district of Tamil Nadu, India takes its origin at Surlacode, 14 km from Nagercoil, the district headquarters and traverses 23.1 km before it enters the Arabian Sea through Manakudy estuary. It is polluted by the effluents from the retting fields which are at the banks of the estuary. To study the physico-chemical status of the polluted water three stations were selected in the Manakudy estuary. Station I is located before the retting fields. Station II, is150 metres away from Station I and is located at the middle of the retting fields. Station III is located between the retting fields and the sea and is 150 metres away from Station II.

EXPERIMENTAL

Water samples from surface and bottom layers were taken with the help of Meyer's water sampler in the early morning between 6.30 and 7.30 a.m. The temperature was noted using a 110°C bulb thermometer immediately after the collection of water samples. pH of the water was determined by pH meter of Systronics make. Carbonate and bicarbonate were estimated by standared titration methods. Nitrite-nitrogen, nitrate-nitrogen phosphate and total phosphorus were also determined by standard methods.[1]

RESULTS AND DISCUSSION

The study conducted for six months (Nov. 1993 to April 1994) revealed that the physico-chemical parameters were affected by seasonal variations and retting fields. Kanyakumari district gets rainfall both in South-West (June to September) and North-East (October to January) monsoon seasons. During November to January the district gets maximum rainfall.

Temperature

The temperature of the surface layer was found to be higher than the bottom layer. This is due to solar heating. These results are in agreement with earlier workers.[2,3]

pH

The pH of the surface water ranged from 7.9 to 8.3 and bottom water ranged from 7 to 8.3.

The variation in pH was due to the heavy inflow of rain water into the estuary and the release of ret liquor from the retting fields which is acidic.[4,5] The high value of pH was recorded when the ret liquor did not mix with the estuary and at the same time lime shell dredging took place. The significant role of the latter in enhancing the pH value was already recorded by earlier workers.[6]

Bicarbonate and carbonate alkalinity

The carbonate alkalinity varied from 0 to 14 mg/L in Station I, 0 to 16 mg/L in Station II and 4 to 16 mg/L in Station III. At Station III the carbonate alkalinity was higher than the other two stations only during monsoon. This may be due to tidal influence. The presence of considerable amount of carbonate alkalinity in Stations I and II may be due to dredging of lime shell.

The bicarbonate alkalinity varied from 64 to132 mg/L at Station I, 66 to 134 mg/L at Station II and 76 to 139 mg/L at Station III.

The bicarbonate alkalinity was higher at station II than the other two stations and very high during March and April. During rainy season bicarbonate value was comparatively low (64 mg/L) because in rainy season the river flows into the sea, and the sea water in turn enters into the river. During this period lime shell dredging was also not taking place. During non-rainy season bicarbonate values were comparatively high because the estuary was sand locked and the rain water could not flow into the sea and the sea water could not enter into the river. Because of lime shell dredging the stagnant water contained high value of bicarbonate. The high value of bicarbonate in Station III may be due to tidal influence.

Nitrite-nitrogn

Nitrite-nitrogen values varied from 9.3 to 36.4 μg/L in surface water and 13.9 to 55.1 μg/L in bottom water at Station I, from 21.9 to 37.5 μg/L in surface water and 17.3 to 40.8 μg/L in bottom water at Station II and from 14.6 to 72.2 μg/L in surface water and 24.8 to 66.4 μg/L in bottom water at Station III. In the monsoon period sharp increase in the concentration of nitrite-nitrogen was evident at all stations presumably due to heavy rainfall and river discharge.[7,8]

When the annual average of nitrite-nitrogen was computed it was seen that the concentration of nitrite increases slowly from Station I to III. The nitrite concentration in the bottom was slightly higher than in the surface and the differences were remarkable at all stations in the back water. The depletion of nitrite in the surface noticed during the present investigation could be attributed to its oxidation to nitrate.[9]

From February to April the nitrite-nitrogen value increased because of the presence of large number of migratory birds. These migratory birds are coming here for feeding and breeding. So they remain for some time in the small island like patches. The river bed is the important feeding ground for the birds. This place is about two kilometres away from the mouth of the sea. The excreta of the migratory birds contribute a large amount of nitrite and nitrate.

Nitrate-nitrogen

Nitrate-nitrogen values varied from 21.3 to 214.5 µg/L in surface water and 22.5 to 303.2 µg/L in bottom water at Station I, from 12.1 to 359.9 µg/L in surface water and 59.3 to 227.4 µg/L in bottom water at Station II and from 8.4 to 413.3 µg/L in surface water and 29.4 to 236.3 µg/L in bottom water at Station III.

The high nitrate-nitrogen concentration during the monsoon period was possibly due to heavy rainfall and land drainage since river pazhayar crosses through thousands and thousands acres of paddy fields. Such high concentrations of nitrate associated with monsoon rain have been reported by Sreedharan *et al.*[8] and Thresiamma *et al.*[10].

Low nitrate concentration was observed at all stations in February and March probably due to its utilisation by biological activity.[11]

Due to flood, a relatively higher bottom value was found in April when phytoplankton bloom was concentrated in the surface water.[12]

Phosphate

Phosphate concentration values varied from 42.3 to 229.4 µg/L in surface water and 46.5 to 549.9 µg/L in bottom water at Station I, from 69.6 to 244.0 µg/L in surface water and 114.7 to 523.6 µg/L in bottom water at Station II and from 88 to 298 µg/L in surface water and 137.7 to 341.2 µg/L in bottom water at Station III.

The concentration of phosphate was low during the months of November, January to February. In December, March and April the concentration of phosphate was found to be higher. This may be due to heavy rain. The low values recorded during January to March may be due to the diminished river discharge. Utilisation of biological productivity also have caused low phosphate levels.

At Station I phosphate was maximum during April (549.9 µg/L) due to the untimely rain which led to transportation of sediments and minimum (42.3 µg/L) during November.

The seasonal variation have been found to be remarkable. It can be stated that the impact of rainfall and river discharge is indeed significant.

Release of nutrients during the retting of coconut husks may also have enhanced the concentration. It is well known that the nutrient concentration of the bottom water was very much dependent on the regenerative capacity of the bottom sediments.[13] The high concentration of phosphate observed in the bottom water was probably due to the liberation of this nutrient from the bottom sediments.[11]

Total phosphorus

Total phosphorus concentration values varied from 20.4 to 99 µg/L in surface water and 33.8 to 174 µg/L in bottom water at Station I, from 31.2 to 114 µg/L

VARIATION OF PHYSICO-CHEMICAL PARAMETERS

Physico-Chemical Pharameteers		Station I						Station II						Station III					
		Nov	Dec	Jan	Feb	Mar	Apr	Nov	Dec	Jan	Feb	Mar	April	Nov	Dec	Jan	Feb	Mar	April
Temperature	S	24.5	24.5	25.2	27.3	28.8	29.0	24.3	24.2	24.7	26.5	28.6	29.6	25.0	25.0	24.8	27.8	28.9	30.2
	B	24.0	24.3	24.8	26.8	28.3	29.5	24.1	23.8	24.6	25.8	28.8	30.0	24.5	24.6	24.2	27.3	28.3	30.5
pH	S	7.9	8.3	7.9	7.8	8.0	8.1	8.0	8.3	7.9	7.9	8.0	8.0	8.0	8.2	8.2	8.0	8.2	7.9
	B	8..0	8.2	7.8	7.8	8.3	7.9	8.0	8.1	8.0	7.7	8.2	7.9	8.0	8.3	8.2	8.7	8.2	7.0
Carbonate	S	8.0	0.0	6.0	14.0	4.0	12.0	12.0	0.0	12.0	4.0	4.0	0.0	12.0	16.0	4.0	6.0	4.0	8.0
	B	12.0	0.0	8.0	10.0	4.0	8.0	16.0	8.0	4.0	4.0	10.0	8.0	16.0	14.0	6.0	10.0	4.0	8.0
Bicarbonate	S	64.0	85.0	115.0	112.0	130.0	120.0	66.0	87.0	117.0	112.0	132.0	134.0	98.0	76.0	128.0	117.0	139.0	126.0
	B	64.0	89.0	116.0	112.0	132.0	128.0	66.0	82.0	128.0	127.0	123.0	124.0	100.0	86.0	128.0	116.0	131.0	124.0
Nitrite-nitrogen	S	36.4	34.1	15.9	9.3	12.7	36.0	37.5	32.5	23.6	21.9	26.7	36.4	72.2	40.6	21.1	25.3	16.6	61.9
	B	48.7	39.2	21.9	16.1	13.9	55.1	30.5	39.3	26.6	31.4	17.3	40.8	66.4	47.1	24.8	27.4	25.0	43.9
Nitrate-nitrogen	S	67.5	209.3	65.4	30.6	21.3	214.5	159.9	359.4	77.8	40.3	12.1	186.7	17.1	304.1	63.5	17.0	8.4	413.3
	B	61.0	265.7	46.6	22.5	25.5	303.2	117.7	229.0	59.3	66.1	100.4	227.4	52.4	231.7	98.7	32.3	29.4	236.3
Phosphate	S	42.3	150.4	67.7	48.1	131.9	229.4	69.6	189.0	156.6	80.4	169.1	244.0	298.0	157.5	116.1	88.0	151.8	248.0
	B	157.9	127.4	68.7	46.5	172.5	549.9	114.7	167.4	142.9	144.5	241.3	523.6	401.0	341.2	140.8	137.7	210.2	305.5
Total phosphorus	S	20.4	54.0	37.8	30.3	92.0	99.0	31.2	63.2	71.4	52.4	108.9	114.0	108.9	67.2	55.7	46.8	100.7	120.0
	B	65.4	54.4	54.9	33.8	85.8	174.0	54.9	62.0	75.3	72.2	167.0	270.0	145.2	141.8	100.2	63.5	76.2	124.0

S—Surface B—Bottom

in surface water and 54.9 to 270 µg/L in bottom water at Station II and from 46.8 to 120 µg/L in surface water and 63.5 to 145.2 µg/L in bottom water at Station III.

In all the three stations of Manakudy estuary the phosphorus content declined on the approach of summer. These findings were in accordance with earlier findings carried out by Saha,[14] Zutshi and Khan.[15]

Station II showed the maximum phosphorous content *i.e.* 270 µg/L during April. This station was very close to the retting pits. Release of nutrients during the retting of coconut husks would have enhanced the concentration. It is well known that the nutrient concentration of the bottom water very much depends on the regenerative capacity of the bottom sediments[13] and there is a regular exchange of phosphorus between the mud and overlapping water.[16]

On either side of the river Pazhayar paddy fields are situated. From the paddy fields excess of irrigated water mixed into the river. There is every possibility that the run-off water might have been carrying these nutrients.

Conclusion

1. Nitrate-nitrogen seems to be occurring more in Station I and II when compared with Station III. The major source for the nitrate-nitrogen is purely from the run off water from the adjoining paddy fields.

2. Likewise, the total phosphorus content occurring in abundance, particularly, in Station II, is also an important feature. These two important plant nutrients should have been contributed to the abundance of the phytoplankton. But such situation never occurred as far as the estuary is concerned. This is due to the presence of hydrogen sulphide in the estuary water.[5]

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