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Original Research Paper

Physico-Chemical Studies on Water Quality Characteristics of Bahuda Estuary, Bay of Bengal

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ABSTRACT

The study relates to the observation of various physico-chemical characteristics of the Bahuda estuary. The annual variation recorded was for temperature (22.84°C-30.48°C), salinity (14.42 -30.8 ppt), BOD (0.84-2.15 mg/L), DO (4.88-6.99 mg/L), pH (7.48 -8.44), nitrate (1.866-3.991 mg/L), ammonium (1.295-3.816 µg/L), phosphate (0.245-0.773 µg/L) and silicate (20.005-37.180 µg/L). The water temperature and salinity influence the hydro-chemical processes, which control the other parameters like pH, DO, BOD and nutrient levels in estuarine water. Temperature is positively correlated with salinity and negatively correlated with other water quality parameters of the estuarine water. The limits of water quality parameters were very less than the tolerance limits of fish growth. The BOD values in the estuarine water were relatively higher than other similar studies of the coast, which indicate the high productivity of the coastal water.

INTRODUCTION

Estuaries are the integral part of marine ecosystems, which play indispensable role for the biodiversity and also the hydrological processes in the coastal areas. The production of estuaries depends upon the transfer of weathering materials from the land to ocean, which changes the physico-chemical conditions of water. Estuarine circulation indirectly affect the productivity assessment and fishery potential of the region. Therefore, the considerable efforts have been made so far for the assessment of water quality of the Indian estuaries. Many reports are available on the Indian estuaries (Panigrahi & Gouda 1992, Kumeran & Rao 1975, Laxman et al. 1987, Mohapatra et al. 2001), but there are no such reports available on the hydrographical conditions of the Bahuda estuary. The proposed study is aimed on the observation of physicio-chemical characteristics at six locations with 500 meters interval distance along upstream of the estuary during the year 2008-09.

Bahuda estuary (Fig. 1) is situated between latitude 19°3' N-19°10' N and 84°E on the extreme southern part of the Odisha State. It originates from Mahendragiri hills, traverses the distance of 47 km, and opens in Bay of Bengal at Sonepur of Ganjam district (Odisha). The estuary covers an area of 15 km^2 within average depth of 2.6 meter and is connected with Bay of Bengal from the lagoon by a channel of about 3 km. The estuary shows shallowness except in the monsoon flux from land drainage system.

MATERIALS AND METHODS

Surface and bottom water samples were collected from Bahuda estuary at the six selected stations from the mouth to the lagoon situated at 3 km on the upstream of the river. Total number of 144 water samples were collected from surface and bottom by using shallow water sampler every month during the year 2008-09.

Temperature was measured at ± 0.1°C accuracy by precision thermometer. NO_3-N, NH_4-N, PO_4-P and SiO_4-Si were determined by standard photometric methods (Grassoff 1976). The DO was fixed before taking to the laboratory and analysed by the Winkler method. BOD and salinity were estimated by using the standard methods. pH was estimated by using pH meter. Monthly average statistics on water quality parameters, calculated for both surface and bottom water samples during 2008-2009, are given in Table 1.

The interrelationship between hydrographic parameters and their correlation matrix were calculated by using MS Office-97 Excel package, and given in Table 2.

RESULTS AND DISCUSSION

Salinity: The average salinity value ranged from 14.42 to 30.82 ppt, which is due to the extraneous source or river input derived from agricultural paddy fields adjacent to the river. The activities of organisms increase in the lesser salinity water and high temperature causes the consumption of nutrients. Table 1 indicates that there is a negative corre-

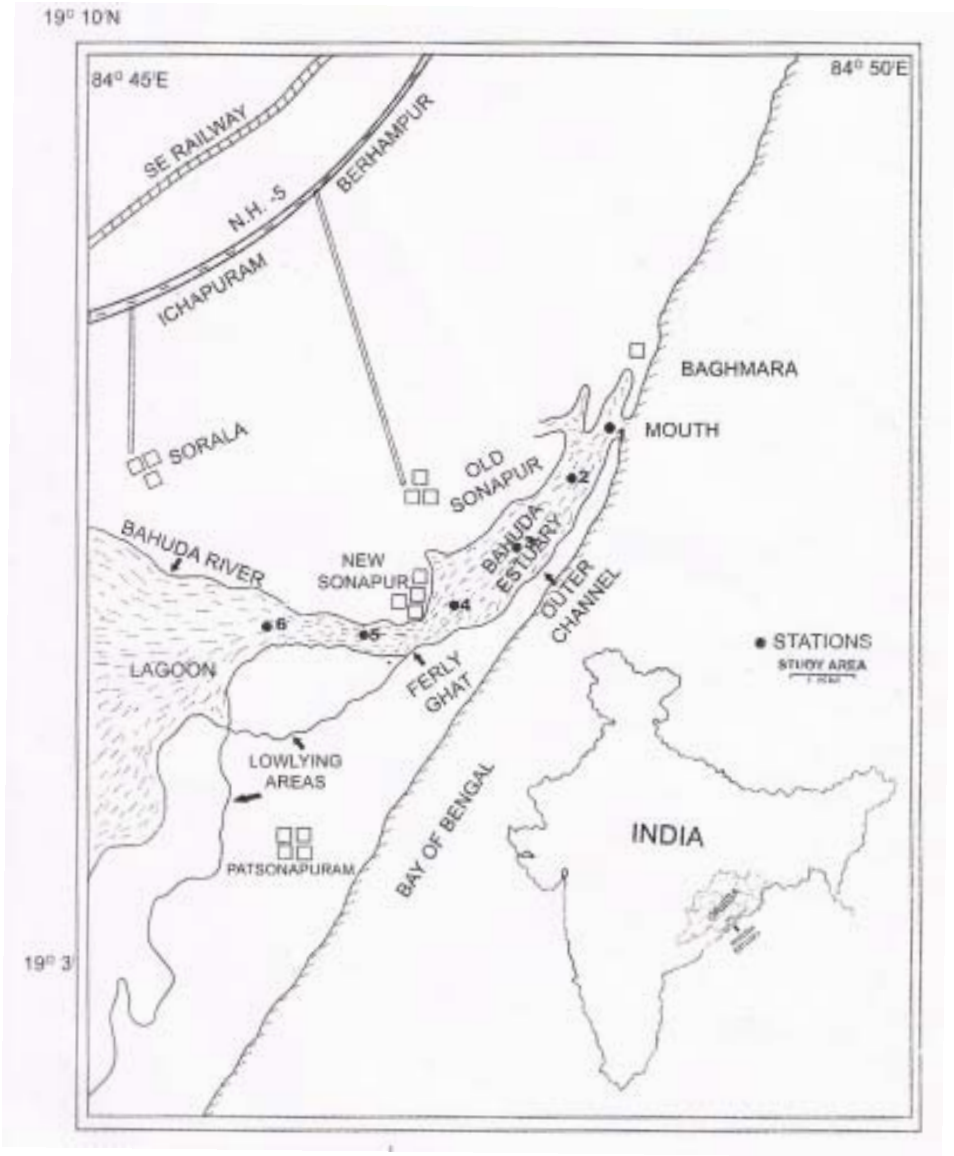

Fig. 1: Map of Bahuda estuary.

lation of salinity with nutrients. Dissolved oxygen and biochemical oxygen demand insignificantly relate with pH of water.

Biochemical Oxygen Demand: The average BOD of the water ranged from 0.84 mg/L to 2.15 mg/L. The BOD is due to the inputs of organic matter from the river run off to the estuary along with the increase of nutrients in the water resulting in a positive correlation with PO_4-P, SiO_4-Si, NO_3-N and NH_4-N of the estuarine water. It is negatively correlated with the salinity and temperature.

pH: The pH value of the estuary ranges from 7.48 (August) to 8.44 (October), which is positively correlates with salinity and may due to the alkalinity and photosynthetic activities. Similar observations were made by Valdies & Real (1998) in Bermunda beach. pH value is positively related to the temperature (Harvey 1960, Riley & Chester 1971).

Dissolved oxygen: The average DO value ranged from 4.88 mg/L to 6.99 mg/L in the estuary during the period of study. It is negatively correlated with temperature, salinity and pH, and positively correlated with the nutrients (PO_4-P, SiO_4-Si, NO_3-N, NH_4-N). The higher oxygen content in water demands more growth of phytoplankton. Further, dissolved oxygen has negative correlation with salinity and the nutrients resulted from abundance of phytoplankton in the estuary. Similar results were also reported by Bandopadhya & Datta (1980), Gouda & Panigrahy (1995) and Das et al.

Table 1:Average monthly variation of physico-chemical characteristics of Bahuda estusry (2008-2009).

Month	Phosphate	silicite	nitrate	temperatute	pH	DO	BOD	Salinity
February	0.333	23.23	2.37	24.73	8.18	6.03	0.89	28.5
March	0.321	23.298	2.261	26.3	7.65	5.96	0.86	29.15
April	0.33	21.7	2.782	29.37	8.08	5.1	0.96	29.66
May	0.245	20.005	1.944	30.48	8.24	4.88	0.84	30.82
June	0.361	28.506	1.866	28.21	8.26	5.92	0.96	30.52
July	0.53	31.677	3.575	27.45	8.15	6.25	1.32	15.18
August	0.596	37.18	3.999	26.31	7.48	6.22	2.15	14.42
September	0.758	34.76	3.394	28.23	8.35	6.07	1.73	17.46
October	0.74	30.206	5.255	27.3	8.44	5.36	1.05	18.26
November	0.773	32.543	4.462	24.41	8.21	6.17	1.31	21.26
December	0.682	29.574	3.879	23.34	7.95	6.99	1.21	22.85
January	0.639	25.728	3.433	22.84	7.75	5.75	1.13	24.18

Note: The values are in mg/L except temperature (°C), salinity (ppt) and pH.

Table 2: Correlations matrix of physico-chemical parameters of Bahuda estuary.

	pH	DO	BOD	Salinity	PO_4	SiO_4	NO_3	NH_4	Temp.
pH	1								
DO	-0.298	1							
BOD	-0.324	0.433	1						
Salinity	0.071	-0.434	-0.810	1					
PO_4	0.104	0.465	0.585	-0.771	1				
SiO_4	-0.062	0.584	0.871	-0.876	0.772	1			
NO_3	0.069	0.272	0.475	-0.783	0.875	0.651	1		
NH_4	-0.021	0.476	0.669	-0.871	0.968	0.798	0.903	1	
Temp.	0.408	-0.666	-0.112	0.199	-0.473	-0.216	-0.375	-0.48	1

(1997), where the dissolved oxygen is taken as index for measuring the water quality parameters (Bijaya Nandan & Abdul Aziz 1990).

Temperature: The average water temperature during the year ranged from 22.84°C (January) to 30.48°C (May). The variation in temperature influences hydrochemical parameters (PO_4-P, NO_3-N, SiO_4-Si, NH_4-N, DO, BOD, pH, salinity) and their correlations are given in Table 1. The temperature has a negative correlation with PO_4-P, NO_3-N, SiO_4-Si, NH_4-N, DO and BOD. The fertileness of the water for the photosynthetic activity is significant at 5%, the only limited to a threshold temperature at a par with the value of pH and salinity of the water.

Nitrate: It ranged from 1.866 mg/L to 5.255 mg/L during the study period. It is positively correlated with phosphate and silicate, and negatively correlated with temperature and salinity. The addition of nitrate to estuarine water is due to river water that carries nitrate from the anthropogenic inputs such as industrial effluents and organic wastes from the catchment area (Das et al. 1977).

Ammonia: The occurrence of ammonia in water resulted from denitrification process of nitrates. The NH_4-N ranged from 1.295 mg/L to 3.816 mg/L. The lower value was observed during premonsoon period and the higher value in monsoon period which may be due to the higher productivity and decomposition and denitrification process during premonsoon and post monsoon period respectively. The ammonia is negatively correlated to temperature and salinity, and positively correlated with nitrate which relates with the primary productivity and decomposition of organic matter by bacteria during monsoon period.

Phosphate: It ranged from 0.245 mg/L to 0.773 mg/L during the period of study. The phosphate is positively correlated with silicate and nitrate. It may be due to addition of phosphate to seawater through the river, which are derived from the agricultural water and land runoff. It is negatively correlated with the temperature and salinity, which may be due to desorption of phosphate in high salinity (Padmavati & Satyanarayana 1999).

Silicate: Its value ranged from 20.00 mg/L to 37.18 mg/L during the study period. It is positively correlated to nitrate and phosphate, which may be due to abundance suspension in wide spectrum of finely divided siliceous material (Gouda & Panigrahy 1992, Mohapatra & Padhy 2001). The silicate is negatively correlated with salinity. The silicious materials are mostly produced by river discharge or action of wind (Relay & Chestor 1971). The dissolved silicon content of coastal waters is generally high due to runoff from land.

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