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ECOLOGICAL CONDITIONS OF A TEMPORARY WETLAND IN BANGLADESH

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ABSTRACT

Investigation has been done to gain evidence on certain chemical properties of water and vegetation in area representative of the various wetland habitats which go under water during rainy season. The measurements were done with edaphic condition, water chemistry, and floristic composition. Water was neutral to alkaline and pH varied from 6.97 to 7.20 and conductivity was in the range of 97.5 μ mhos to 240 μ mhos. Seasonal variation of chloride content was observed throughout the year and the highest chloride (104.96 mg/l) was in the month of October. Dissolved oxygen concentration was very low (2.99 mg/l) in the month of October. With the decrease of water, the value of alkalinity became double (76.0 mg/). No distinct variation in the content of hardness was observed in the three different locations. Temporary hardness varied from 0.1 0 to 0.56 mg/l. High value of total solids in the month of July (70 mg/l) indicated that high amount of sediment are coming with the flow of water from upstream. Total suspended solids were higher than dissolved solids. Exchangeable cations were low in the beginning and an increasing tendency of Na and Ca was observed in the later stages of marsh formation.

Key words: Wetland, vegetation, chemical properties, Bangladesh.

INTRODUCTION

In the previous works environmental conditions particularly water and soil chemical features of temporary marshes were reported (Nazrul-Islam 1991, 1993, Nazrul-Islam and Kadir 1988 and Abdulla *et al.* 2003) in and around Dhaka. While the hydrosere has long been an object of interest to scientists of natural history (King 1985) relatively little information is available concerning the chemical changes involved in the soil environment and also about the vegetation of wetland and semi-aquatic habitats. Freshwater wetlands are found in many kinds of physical regimes and include such diverse ecosystems as the extensive raised and blanket bogs in many parts of the world particularly in Europe, USA and Canada (Gosselink and Turner 1978). Gorham (1956 a, b) analyzed the aquatic environments of some natural waters in the Moor House Nature Reserve including floristic composition. Ecological significance of some ionic interrelations was examined by Gorham (1956a).

Ecological studies of the vegetation, water and soil of some temporary marshes near Dhaka were studied by Nazrul-Islam and Kadir (1988), vegetation and biomass production in wetland ecosystem and ecological characteristics of fresh water wetlands were described by Nazrul-Islam (1993). According to Akonda (1989) seasonally flooded temporary marshes cover 5,770,000 ha. Ecology and species composition of a temporary marshes were also studied by Abdullah *et al.* (2003). They have shown seasonal fluctuation of water quality particularly DO and conductivity.

The present work is an attempt to investigate certain chemical properties of water and vegetation in area representative of various wetland habitats which go under water during rainy season in Bangladesh (June to November). However, all wetlands have at least one thing in common. They are flooded frequently or once in a year (i.e., temporary) so that roots of the vegetation exist in an anaerobic condition. With the aim of obtaining information for wetlands in Bangladesh water samples were collected from a temporary wetland near Ashulia beside Dhaka-Tangail Highway. The objectives of this study were to account water chemistry and species composition.

MATERIALS AND METHODS

The study area is located in latitude 23º 54' to 23º 53' N and longitude 90 27 to 90 28 E. The Turag river, a tributary of the Bangshi river passes through the study area. During the rainy season, the river could not hold huge amount of flood water for its shallow nature and consequently submerge the surrounding lands and form temporary marsh that remains up to October and November. The average depth of water is 6 to 14 feet. From November the area starts to dry up and boro rice cultivation is done. Total area of this wetland is approximately 16 sq km. Water samples were collected from three locations to observe whether there is any variation in water chemistry. Locations 1, II and III are 100; 500 and 1000 m away from the Highway. The sampling period ranges from July 2007 to October 2007. Total of four visits were done and water samples were collected (four replicates from each location). Dissolved oxygen was determined in the field (APHA 1977). The remaining measurements were carried out in the laboratory. Conductivity was measured by Conductance Bridge. Ca and Mg were determined by atomic absorption spectrophotometer; Na and K were determined by Flame photometer

RESULTS AND DISCUSSION

Water of the marsh was neutral to alkaline and pH ranged from 6.97 (July) to 7.20 (October 2007). pH values did not show any significant variation ($p = 0.05$). The results therefore indicated that temporary marsh is calcicolous and will support the growth of calcium loving plants. Slight variation in pH was possibly due to heavy rain which rapidly washed away to the neighbouring areas. Such variations of pH were also reported by Gorham (1956a,b) in some waters of Moor House Nature Reserve. Study of the other marshes near Dhaka also showed very similar values (Nazrul Islam and Kadir 1988, Abdullah *et al.* 2003). Conductivity varies from 97.5 to 240 μ mhos/cm. and the highest value was recorded in the month of November when the marsh was drying and this is possible when water is concentrated. Chloride content varied from 61.23 (September) to 104.96 mg/l (October). Seasonal variation of chloride values were observed throughout the year (Table 1). These values suggest that the marsh was oligohaline in nature (Walter 1968).

Dissolved oxygen was measured at 10 to 11 AM and the value varied from 2.99 to 7.23 mg/l. Oxygen depletion often results during the time of high community respiration, particularly very low value was obtained in the morning since no photosynthesis occurred at night. In addition, many physical and chemical reactions in water may

affect the content of dissolved oxygen. The diurnal amplitude of DO in aquatic system is, in fact, mainly due to biotic functions (Wong *et al.* 1979). The high DO value in September was possibly due to photosynthesis by the luxurious growth of plants. In addition, movement of boats for fishing was very high which also increased the value of DO. Low value in October may be due to decrease of water depth and high turbidity which occurred due to lack of flow of water from upstream. Alkalinity values became double in October than that of July. The value of total hardness was highest in September (1.02 mg/l) and did not show seasonal variation (Table 2). Fractions of solids are given in Table 3. The range of total solids (TS) varied from 40 to 70 mg/l and the lowest value (40 mg/l was in the month of September and October when the flow of water was very low and the highest value (70 mg/l) was obtained in July when the flow of water was very high. This is possibly due to high turbidity which occurred as a result of water flow of the river. Total dissolved solids varied from 10 to 30 mg/l and the maximum value of total suspended solids was 35 mg/l in July. These results may be supported by the concept of Payne (1986). During the dry season, the amount of suspended material was lowest possibly owing to the lack of material being washed in, but also due to the increased possibility of sedimentation caused by the flow and lack of turbulence.

Results of water analysis showed that concentrations of Na, K, Ca and Mg were low in the beginning of formation of marsh and after two months, i.e. in October the values of all these elements showed an increasing tendency when the water depth was decreased (Table 4). In addition, some aquatic species have decomposed which perhaps increased the concentration of exchangeable elements. Remarkable change was noted for calcium (7.0 to 8.1 ppm) and sodium (7.0 to 8.2 ppm). The values of exchangeable cation indicated that the marsh water was suitable for the growth of aquatic plants (Davis and Cornwell 1998).

Table 1. Physico- chemical properties of water in a temporary wetland. (Location 1, II and III are ≈100, land ≈500 and 1000 m, respectively away from Dhaka-Tangail Highway) .

Parameters	Locations	Date of Collections				Mean with 95% confidence limits
		13.07.07	12.08.07	16.09.07	06.10.07	
pH	I	7.12	7.05	7.16	7.05	7.09±0.05
	II	7.02	6.99	7.09	7.06	7.04±0.05
	III	6.97	7.13	7.12	7.20	7.10±0.14
Conductivity	I	123.50	107.00	110.00	240.00	145.12±101.27
(μ m hos/cm^2)	II	97.50	105.00	112.00	229.00	135.87±99.22
	III	104.00	102.00	110.00	220.00	134.0±91.37
Chloride (mg/l)	I	87.47	89.97	61.23	112.46	87.78±33.35
	II	84.97	92.47	63.73	104.96	86.53±27.51
	III	84.97	92.47	62.48	104.96	86.2±28.44
DO (mg/l)	I	6.05	6.19	7.12	2.98	5.58±2.86
	II	6.11	5.57	7.23	3.71	5.65±1.71
	III	6.12	5.78	7.12	4.23	5.81±1.90
Alkalinity (mg/l)	I	33.60	36.00	40.00	76.00	46.4±31.67
	II	40.00	41.00	43.00	72.00	49.0±24.47
	III	32.80	37.00	41.00	68.00	44.7±25.28

Table 2. Fractions of hardness in water of the temporary wetland.

Fractions (mg/l)	Locations	Date of Collections 13.07.07	12.08.07	16.09.07	06.10.07	Mean with 95% confidence limits
Total hardness	I	0.82	0.70	1.02	0.70	0.81±0.23
	II	0.72	0.80	0.95	0.60	0.76±0.23
	III	0.70	0.90	1.02	0.50	0.70±0.47
Permanent hardness	I	0.36	0.60	0.80	0.50	0.54±0.35
	II	0.40	0.70	0.85	0.45	0.61±0.55
	III	0.40	0.60	0.70	0.30	0.47±0.32
Temporary hardness	I	0.46	0.10	0.22	0.20	0.27±0.31
	II	0.32	0.10	0.10	0.15	0.15±0.17
	III	0.30	0.30	0.32	0.20	0.23±0.15

Table 3. Fractions of solids in water of the temporary wetland.

Fractions (mg/l)	Locations	Date of Collections 13.07.07	12.08.07	16.09.07	06.10.07	Mean with 95% confidence limits
Total Solids (TS)	I	70	60	40	50	55.00 ± 20.53
	II	70	65	50	40	56.25 ± 21.90
	III	60	60	50	40	52.50 ± 15.23
Total Dissolved Solids (TDS)	I	30	25	10	20	21.25 ± 13.58
	II	25	20	20	15	20.00 ± 6.49
	III	25	20	10	15	17.50 ± 10.26
Total Suspended Solids (TSS)	I	35	30	20	25	27.50 ± 10.26
	II	35	25	20	20	25.00 ± 11.25
	III	30	25	30	20	26.25 ± 7.61

Table 4. Seasonal variation of water chemistry of the temporary wetland.

Cations (ppm)	Locations	Date of Collections 13.07.07	12.08.07	16.09.07	06.10.07	Mean with 95% confidence limits
Na	I	4.6	3.5	3.0	7.7	4.70±3.35
	II	4.3	3.3	3.2	8.2	4.75±3.74
	III	3.7	3.3	3.5	7.0	4.37±2.79
K	I	3.1	3.2	2.9	4.2	3.35±0.92
	II	3.0	3.2	3.1	4.3	3.40±0.96
	III	2.8	3.3	3.0	3.7	3.20±0.48
Ca	I	4.5	3.4	3.0	7.6	4.62±3.31
	II	4.2	3.2	3.1	8.1	4.65±3.74
	III	3.6	3.2	3.4	7.0	4.30±2.87
Mg	I	3.0	3.1	2.8	4.1	3.25±0.92
	II	3.0	3.1	3.0	4.2	3.32±0.93
	III	2.7	3.2	3.0	3.6	3.12±0.60

Phytoplankton and Angiosperm flora

Works on phytoplankton density on the wetland were done by Islam and Haroon (1975) and Islam *et al.* (1974). In the present investigation different genera of dominant phytoplankton were *Melosira, Trachelomonas, Euglena, Gomphonema, Stigeoclonium* and *Pithophora*.

The plant communities along wetland are dynamic and species rich (Nilson 1992) and have high values for both productivity (Peterjohn and Correll 1984) and biomass (Gregory *et al.* 1991). The plant communities noted from this marsh were *Eichhornia crassipes*, *Hygrorrhiza aristata*, *Potamogeton crispus*, *Ipomoea* sp. and *Ottelia alismoides*. Cultivation of *Trapa* sp. by the local poor people for their livelihood is very common. When the land was drying in the month of December, *Polygonum* sp. *Euphorbia hirta*, *Enhydra fluctuans* were invading the area and from the month of January, rice cultivation begin hence the successive stages of plant growth did not occur.

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