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A study on the presence of macrophytes in relation to physicochemical parameters in Diplai Beel water of Kokrajhar District, BTAD, Assam.

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Abstract

Physicochemical properties of water play a major role in determining the occurrence of hydrophytes in a fresh water ecosystem. Presence of minor macrophytes species is investigated in relation to physicochemical parameters of Diplai Beel water such as temperature, pH, dissolved oxygen (DO), BOD, turbidity, electrical conductivity (EC), total dissolved solid (TDS), odour and colour. The study is carried out during the period of Pre-monsoon (March-May, 2015), Monsoon (June-August, 2015), Post-monsoon (September-November, 2015) and Winter (December-February, 2016) in 2015-16. The periodic changes of the physicochemical parameters in the studied water show vital role in the abundance of macrophytes. It is observed that minor species of macrophytes such as *Lemna perpusilla, Lemna minor, Spirodela polyrrhyza, Pistia stratiotes, Azolla pinnata(fern), Salvania natans(fern)* have been influenced more and reflected their variations in presence and number in different study periods of the year. The studied water parameters have great influence in water qualities. Lastly reasons of variation and stress are discussed.

Keywords: Diplai Beel, physicochemical parameters, macrophyte variation, reasons.

1. Introduction

Wetlands are well known for high diversity in class, composition and four broad categories such as physical/hydrological, chemical and socioeconomic (Williams, 1990). Wetlands support plants species and act as intermediate between true aquatic and terrestrial habitats (Benarjee and Venu, 1994). Nutrient concentration data are intrinsically linked to primary productivity and determine the spatial and temporal distribution of biological communities, particularly phytoplankton. Biological monitoring is essential to describe the community constituents and assess variability in seasonal patterns, trophic relationships and potential environmental stresses. Phytoplanktons are useful biological indicators, which are commonly used in water quality monitoring. Variability in phytoplankton community composition, biomass and physiology can reflect environmental changes related to seasonality, acute perturbations or long term environmental change. The quality of water can be estimated by examining its physical and chemical characteristics as well as by plankton growth in it. The influence of limnological parameters as one of the functional environmental factors for species occurrence has received great attention (Moyle 1945, Hutchinson 1975, Catling *et al*.1986). Temperature, turbidity, dissolved oxygen (DO), BOD, biogenic salts, chiefly nitrates, phosphates; pH, electrical conductivity, phosphorous, nitrogen etc play a vital role in water. Several limnological parameters were found to be responsible for the distribution pattern of hydrophytes such as pH (Palmer *et al* 1992), alkalinity (Vestergaard *et al*. 2000), conductivity (Mäkel *et al*. 2004) and nutrients (Heegard *et al*. 2001). Some basic water quality parameters are considered basing on widely used in current fresh water monitoring system. The water parameters chosen here are the fundamental components needed for aquatic plants and animals in a fresh water body.

Bhuyan (1970) studied the physicochemical

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qualities of water of some ancient tanks in Sibsagar district of Assam. Yadava (1987) studied the limnology and productivity on an ox-bow lake in Dhubri district of Assam. Lal and Bhattacharya (1989) reported a short term study on the pollution status of the Bharalu River. Baruah *et al*. (1997) investigated the study on the water quality of Elenga beel at Jagiroad in central Assam. Kar and Barbhyan (2000) studied on macrophytes diversity in certain wetlands of Barak Valley region in Assam. Dewan and Saikia (2004) studied Kapla wetland complex in West Assam. Dutta (2005) presented ecological status of wetlands of Rudrasagar area in Sivasagar district of Assam. Kalita *et al.* (2006) studied physicochemical quality of Beel water of Marigaon district of Assam. Dutta *et. al.* (2010) studied a statistical overview of certain physic-chemical parameters. Sarma (2012) carried out the phytosociological investigation vis a vis human impact on two wetlands of Sonitpur district of Assam.

2. Material and methods

Diplai Beel is eutrophic in nature. It is 15 km away from Kokrajhar town towards South direction and can be reached by *Silgara-Kokrajhar* Road. Diplai Beel is surrounded by hills and hillocks and covered by deciduous forests. Chakraborty, A.K. (2016) describes about the history of Diplai Beel in his article 'Diplai Bilar Eti Thulmul Bibaran'. Formerly it was under Koch King of "Bijini State" then it goes to undivided Goalpara district and then comes under Dhubri district. Now it is placed in Kokrajhar district by Govt. of Assam and administered by Forest and Fishery Departments of Bodoland Autonomous Council. It is the second largest fresh water body in Kokrajhar district covering an area of about 4.5 sq km. Its length and breadth are 3.30 km, North to South and 1.20 km East to West respectively. It has a shoreline length of 9.21 km in winter. The geographical coordinates of Diplai Beel are 26° 16' 55" N and 90°21' 10"E. Its elevation is 37.8 m. The annual rainfall of this region is maximum 303 cm. and minimum 177 cm. Annual temperature in summer is maximum 33minimum 17 but in winter temperature becomes maximum. 28minimum 15 The average humidity falls under 83.00. It is a site of rich aquatic biodiversity, a place of eco-tourism and limnological research. The aquatic biodiversity of Diplai Beel is being threatened by anthropogenic activities in recent times.

Surface water samples are collected monthly in1L PVC bottles in between 9 A.M. to 11 A.M. at a depth of 5 cm from four selected sites of Diplai Beel during the study period of 2015-16. The period is divided into four seasons such as Pre-Monsoon (March-May, 2015), Monsoon (June-August, 2015), Post-Monsoon (September-November, 2015) and Winter (December-February, 2015-16) of the year 2015-16. Physicochemical parameters are analyzed following the standard methods of APHA, 1989. The average of five samples for each parameter studied is considered as one reading. The odour, colour, water Temperature, pH, DO, BOD, Electrical Conductivity (EC),Turbidity, Total Dissolved Solids (TDS).The odour, water Temperature, pH, Electrical Conductivity (EC), Turbidity are determined in the field and the others were analyzed in the laboratory within 48 hours. Water temperature is measured using Mercury Thermometer and pH by a digital pH Meter. Turbidity is measured using Secchi disc in the field. DO is determined in laboratory by Winker's method using preservative in the field. Electrical Conductivity (EC) and TDS are measured by digital EC meter, HM digital, (model COM-100). BOD**5** and colour analysis is done in laboratory.

Minor floating macrophytes are collected from selected sites of North, South, East and West and recorded monthly during the study periods in 2015-16. A quadrat of 1sq.m size is made by PVC pipes with PVC angle joints. Every month 10 quadrates readings are recorded from an area of 20 sq.m in selected collection sites of Diplai Beel. Plants are collected by free hand and sometimes by hooks or by nets of different sized mesh from over a boat. Date, spot name, name of collector and time of collection are recorded in log book. Macrophytes thus collected are placed in herbarium sheets by following the standard methods of Jain and Rao (1977).The plant specimens are identified based on books of Hooker 1872-1897; Cook 1996.

3. Result and discussion

The results of the study are reflected in the tables 1,2,3,4 and 5. Free floating macrophytes *Lemna perpusilla, Lemna minor, Spirodela polyrrhyza, Pistia stratiotes, Azolla pinnata(fern), Salvania natans(fern)* are very small aquatic plants and shown their abundance of distribution in comparison to other macrophytes growing in Diplai Beel are very less.. These plants are very much sensitive to the vital components of water characters as shown in Table no.5. The ratio of distribution of these plants in relation to the area covered by Diplai Beel is very negligible. The availability of the species *Pistia stratiotes* and *Spirodela polyrrhyza* is less in table no.1 than the

other 4. Variation of species distribution in different sites of Diplai Beel is observable. This variation of existence of the plants is discussed by analyzing the water parameters studied in Table no. 5.

Table-1 : Period wise Number of Free Floating Macrophytes in Diplai Beel sites N,S,E,W

Sampling Site – N (North)														
Plant species	PreMonsoon (March, April & May,2015)			Monsoon (June, July & August, 2015)			Post-Monsoon (September, October & Nov, 2015)			Winter (December, Jan & February, 2015-2016)			Total species	Abundance
Free Floating	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**		
Pistia stratiotes	0	0	5	12	15	17	10	9	3	2	0	0	73	**6.08**
Lemna perpusilla	0	2	7	23	20	27	10	9	7	0	0	0	105	**8.75**
Lemna minor	1	3	2	18	19	21	5	7	3	0	0	2	81	**6.75**
Azolla pinnata	5	6	10	18	24	30	17	12	15	6	2	0	145	**12.08**
Salvinia natans	7	5	16	20	27	34	19	13	20	14	2	0	177	**14.75**
Spirodela polyrrhiza	2	4	8	9	8	11	9	7	0	0	0	0	58	**4.83**

Table-2 : Sampling Site – S (South)

Plant species	Pre-Monsoon (March, April & May,2015)			Monsoon (June, July & August, 2015)			Post-Monsoon (September, October & Nov, 2015)			Winter (December, Jan&February, 2015-2016)			Total species	Abundance
Free Floating	**Mar**	**Apr**	**May**	**Ju**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**		
Pistia stratiotes	0	0	4	5	10	13	10	0	0	0	0	1	43	**3.58**
Lemna perpusilla	0	0	6	15	13	14	8	5	4	0	2	0	67	**5.58**
Lemna minor	0	0	2	10	12	14	2	3	4	1	0	0	48	**4.00**
Azolla pinnata	3	7	4	2	4	10	5	9	0	0	3	0	47	**3.91**
Salvinia natans	0	4	9	17	16	21	19	16	9	9	0	2	122	**10.16**
Spirodela polyrrhiza	0	0	2	7	8	10	6	8	0	1	1	0	43	**3.58**

Table-3 : Sampling Site – E (East)

Plant species	Pre-Monsoon (March, April & May,2015)			Monsoon (June, July & August, 2015)			Post-Monsoon (September, October & Nov, 2015)			Winter (December, Jan & February, 2015-2016)			Total species	Abundance
Free Floating	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**		
Pistia stratiotes	0	0	3	6	5	8	5	3	0	0	0	0	30	**2.50**
Lemna perpusilla	0	1	4	5	7	9	4	3	3	0	0	1	37	**3.08**
Lemna minor	0	2	3	7	5	5	6	1	1	0	0	0	29	**2.41**
Azolla pinnata	0	0	8	10	20	12	10	7	2	0	0	0	69	**5.75**
Salvinia natans	0	0	2	12	12	14	5	4	3	0	0	1	53	**4.41**
Spirodela polyrrhiza	0	0	0	0	3	5	7	2	0	0	0	0	17	**1.41**

Table-4 : Sampling Site –W (West)

Plant species	Pre-Monsoon (March, April & May,2015)			Monsoon (June, July & August, 2015)			Post-Monsoon (September, October & Nov, 2015)			Winter (December, Jan & February, 2015-2016)			Total Species	Abundance
Free Floating	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb		
Pistia stratiotes	0	0	3	9	10	13	6	2	0	0	0	0	43	**3.58**
Lemna perpusilla	0	0	3	12	15	12	3	2	0	0	0	0	47	**3.91**
Lemna minor	0	0	0	14	16	10	4	4	1	0	0	0	49	**4.08**
Azolla pinnata	0	3	0	12	23	9	7	6	i	0	0	0	52	**4.33**
Salvinia natans	0	0	5	10	20	12	14	7	2	0	0	0	70	**5.83**
Spirodela polyrrhiza	0	0	0	5	9	2	5	1	0	0	0	0	22	**1.83**

Table-5 : Water parameters data in different periods (months) of the year, 2015-16

Water Parameters & Unit	Pre-Monsoon (March, April & May,2015)			Monsoon (June, July & August 2015)			Post-Monsoon (September, October & Nov, 2015)			Winter (December, Jan& February (2015-2016)			Mean & ±SD
	Mar	*Apr*	*May*	Jun	Jui	Aug	*Sep*	*Oct*	*Nov*	Dec	Jan	Feb	
Temperature°C	23.4	27.4	31.5	31.9	32.1	29.16	27.43	27.25	23.13	21.71	19.72	20.54	26.27 ±4.27
pH	7.2	7.1	6.9	6.8	6.5	6.8	7.1	6.8	6.4	6.7	5.7	5.8	6.65 ±.45
Dissolved Oxygen(DO) *mg/L*	4.3	5.6	5.9	7.7	7.2	7.2	7.6	5.4	5.1	4.1	4.2	4.1	5.7 ±1.08
Turbidity *NTU*	4.6	4.7	3.1	2.9	2.7	2.5	2.8	2.4	3.1	3.6	3.9	3.8	3.34 ± 0.74
Electrical Conductance (EC) *µS/cm*	31.1	30.2	22.4	2.12	27.1	21.1	29.1	34.3	33.1	33.9	34.5	33.2	29.25 ±0.18
Total Dissolved Solid (TDS) *mg/L*	27.8	28.1	14.1	13.2	14.7	15.5	17.2	19.1	16.2	15.1	16.7	16.2	15.66 ±1.67
Odour	aromatic			No odour				Fishy					
Colour *Hazen*	56	58	40	28	30	24	32	40	56	58	60	67	fare
	Tea colour			Light tea colour				Tea colour					
BOD5 *mg/L*	6.01	7.2	8.1	7.3	7.8	6.9	6.4	6.8	6.2	5.9	5.3	5.8	6.64 ±0.88

Temperature influences metabolic rate and photosynthetic production in aquatic plants. Metabolic activity is directly proportional to temperature increase. Temperature above 35 degree centigrade can begin denature or breakdown enzymes reducing metabolic function. Temperature fluctuation changes behavior of aquatic plants. Here in the observation temperature is moderate during winter period and shows no any adverse effect.

pH of water increases with the increase of temperature. It is a determining factor of ecosystem productivity (Singh, *et al.*2009).The observation of Dipai Beel water shows almost acidic in nature and harmful to small macrophytes. Decrease in pH below 6 may increase the amount of mercury soluble in water. In this stage some sensitive plants will face difficulty to survive.

Dissolved Oxygen (DO) helps to assess the

trophic status and the magnitude of eutrophication in an aquatic system (Edmondson, 1966). The amount of dissolved oxygen often determines the number and types of organisms living in the water body. In this observation winter DO is below the normal level which indicates poor quality of water. Some sensitive plants will face difficulty to survive here.

Turbidity is suspended particles in the water. Algae, suspended sediments, organic particles diffuse sun light and water absorbs heat. Turbidity reduces growth rate of macrophytes due to decrease in light availability for photosynthesis. Turbidity a increases water temperature because suspended particles absorb heat. Higher temperatures can result in lower dissolved oxygen in the water; in this observation water turbidity increases during winter period and thus macrophytes are affected in the beel. It may increase the waterborne disease.

TDS is total dissolved solids. It measures all organic and inorganic substances dissolved liquid.. Total dissolved solids cause toxicity through increase in salinity, changes in the ionic composition of the water and toxicity of individual ions. In Dipli Beel TDS of water is above moderate level and affects the plants.

BOD is the scale of organic pollution. The greater the BOD the more rapidly oxygen is depleted in the water. Sources of BOD include topsoil, leaves and woody debris; animal manure. This means less oxygen is available to higher forms of aquatic life. The consequences of high BOD are the same as those for low dissolved oxygen: aquatic organisms become stressed, suffocate, and die. In our observation values are moderate during winter period.

Odour of Diplai Beel Water is black in colour like that of tea. It hampers light penetration into water and retards the growth and development of plants.

4. Conclusion

From the results it comes to notice that the value of some water parameters are in moderate and some are bellow threaten level for aquatic plants. The aquatic biodiversity and ecosystem of Diplai Beel are being threatened due to unscientific use of this Beel by the surrounding people. Deforestation, agricultural practices in the catchment area by shrinking water area, conversion of fresh water ecosystem into commercial fisheries by authorities, use of pesticides in cultivating lands, collection of water plants for selling in the markets, cleaning of minor hydrophytes by fishing nets etc, are the reasons of ecological imbalance in Diplai Beel. These collective effects have shown varying characters of water qualities of Diplai Beel. If no immediate measures are taken for the ecological safety of Diplai Beel by authorities in recent times, we will be losing varieties of rare aquatic flora and fauna from this fresh natural water body very soon.

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