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Phytoplankton diversity and its relation with physico-chemical parameters in the river Jaldhaka, West Bengal, India

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Abstract

Jaldhaka is a torrential and glacier feed river. A total 25 genera of phytoplankton belonged to 5 groups were reported during the survey period. Phytoplankton density and diversity indices were maximum in winter months and minimum in monsoon months. Water temperature and other physico-chemical parameters indicates good quality of water. Phytoplankton density and diversity indices positively correlated with dissolved water, total alkalinity, total hardness and chloride but inversely correlated with water temperature and free carbon dioxide.

Keywords: Jaldhaka, phytoplankton, density, diversity, physico-chemical

1. Introduction

River jaldhaka is a transboundary river of Bhutan, India and Bangladesh and its total length is 192 kilometer. This river is originated from the Kupup or Bitang Lake in Sikkim. Fresh water habitats are the most vulnerable habitat and deteriorated by anthropogenic activities. Water pollution, pesticides runoff from agricultural field and municipal discharge deteriorated the river water quality. Phytoplanktons are used as good bio indicator for assessing the quality of water (Palmer, 1963 and Rawson, D.S. 1956, Tiwari and Chauhan, 2006; Hoch *et al.*, 2008) ^[11, 14, 19, 5]. Phytoplanktons are the primary producers of aquatic ecosystem and control the productivity of an aquatic ecosystem (Debi *et al.*, 2013). Fluctuations of phytoplankton populations are influenced by many physico-chemical and biological environmental factors of water body. Aim of the study is to evaluate the Phytoplankton diversity and its correlation with physicochemical parameters in the river Jaldhaka. Few works had been done previously on plankton diversity in North Bengal.

2. Materials and Methods

Water samples were collected at monthly interval between 6 to 9 am. Twenty five liter of water filtered (plankton net, mesh size- 60 micron) and preserved in 1% Lugol's iodine solution (Trivedy and Goel, 1986) ^[20]. Then Phytoplanktons were identified in laboratory up to the species level by - Turner (1982) ^[21]; Anand (1998); Presscot (1962); Turner (1982) ^[21] and APHA (2005). Density of phytoplanktons were calculated with the help of Lacky drop method (Laky, 1938). Biodiversity indices like Shannon's diversity index (Shannon, 1949) ^[15], and Margalef's species richness index (Margalef, 1968) ^[9] were calculated by PAST 3 software. Physico-chemical parameters of water such as - water temperature, pH, TDS, conductivity, dissolved oxygen, free carbon dioxide, total alkalinity and total hardness were analysed by standard method (APHA, 2005).

Duration of study

Duration of study was two years, from March 2014 to February 2016.

Study site

Study was carried out in two sites of the river. Site 1 at Betgara (latitude-26^o34'41.0''N and longitude- 88^o55'49.4''E) and site 2 at Mathabhanga (latitude-26^o19'27.8''N and longitude-89^o14'17.6''E).

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Table 1: Phytoplankton diversity in the river Jaldhaka from March 2014 to February 2016.

S. No.	Class	Genera	2014-2015		2015-2016	
			Site-3	Site-4	Site-3	Site-4
1.	Cyanophyceae	<i>Anabaena sp.</i>	+	+	+	+
2.		<i>Nostoc sp.</i>	+	+	+	+
3.		<i>Oscillatoria sp.</i>	+	+	+	+
4.		<i>Spirulina sp.</i>	+	+	+	+
5.		<i>Anacystis sp.</i>	+	+	+	+
6.		<i>Rivularia sp.</i>	+	+	+	+
7.	Chlorophyceae	<i>Chara sp.</i>	+	+	+	+
8.		<i>Clamydomonas sp.</i>	-	+	-	+
9.		<i>Chlorella sp.</i>	+	+	+	+
10.		<i>Closterium sp.</i>	+	+	+	+
11.		<i>Oedogonium sp.</i>	+	+	+	+
12.		<i>Pediastrum</i>	-	-	-	+
13.		<i>Spirogyra sp.</i>	+	+	+	+
14.		<i>Ulothrix sp.</i>	+	-	+	-
15.		<i>Ulva sp.</i>	-	+	+	+
16.		<i>Coelastrum sp.</i>	-	+	-	-
17.		<i>Cosmarium sp.</i>	+	-	+	-
18.		<i>Volvox sp.</i>	+	+	+	+
19.		<i>Zygonema sp.</i>	+	+	+	+
20.		<i>Netrium sp.</i>	+	-	+	-
21.	Bacillariophyceae	<i>Diatoma sp.</i>	+	+	+	+
22.		<i>Navicula sp.</i>	+	-	+	-
23.		<i>Tabellaria sp.</i>	+	+	+	+
24.		<i>Cymbella sp.</i>	+	+	-	+
25.	Euglenophyceae	<i>Euglena sp.</i>	+	+	+	+
26.	Dinophyceae	<i>Ceratium sp.</i>	+	+	+	+

The range and average value of Phytoplankton density (8 to 40, 19.56), Phytoplankton genera (7 to 20, 24), Shannon-Wiener diversity index (1.88 to 2.85, 2.74) and Margalef's species richness index (2.88 to 5.08, 4.07) were reported during the study period.

Maximum Phytoplankton density and number of genera, Shannon-Wiener diversity index (H') and Margalef's richness index were recorded in January and February and lowest value were found in August-September.

Table 2: Percent composition of Phytoplankton in two sampling sites of the river Jaldhaka during the two year of study period (March 2014- February 2016).

Phytoplankton group	No.	%
Chlorophyceae	14	53.85
Cyanophyceae	6	23.08
Bacillariophyceae	4	15.38
Euglenophyceae	1	3.85
Dinophyceae	1	3.85

Table 3: Range and average (S.D) values of the density and diversity indices of the Phytoplankton in the river Jaldhaka during the two year of study period (March 2014- February 2016).

Study period	Mach 2014 –February 2016		
	Range	Average	S.D
Diversity Indices			
Density (org./L)	8-40	19.56	6.44
Number of Genera (S)	7-20	24	1.29
Species Diversity Index(H')	1.88-2.85	2.74	0.246
Margalef's Species Richness Index (R)	2.88 -5.08	4.07	0.80

The range and average value of Water temperature (⁰ C), Depth of water (m), P^H, Total dissolved solid (mg/L), Conductivity (µmhos), Dissolved Oxygen (mg/L), Free Carbon dioxide (mg/L), Total alkalinity (mg/L), Total hardness (mg/L) and Chloride content (mg/L) are represented in the table.

Table 4: The range and average (S.D) values of water temperature and physicochemical parameters of the river Jaldhaka.

Study period	March 2014 – Feb. 2016		
Parameters	Range	±S.D	Average
Water Temperature (⁰ C)	6.13-30.66	23.60	25.39
Depth of water (m)	1.1-4.86	0.35	2.00
P ^H	6.06-7.86	0.35	7.20
Total dissolved solid (mg/L)	36-127	19.49	66.37
Conductivity (µmhos)	51.93-84.23	6.97	73.21
Dissolved Oxygen (mg/L)	6.33-8.93	0.60	7.34
Free Carbon dioxide (mg/L)	2-4.56	0.73	3.09
Total alkalinity (mg/L)	14.5-40.86	7.14	47.26
Total hardness (mg/L)	6.93-28.2	6.12	17.26
Chloride content (mg/L)	3.2-5.43	0.70	4.23

P^H, Total dissolved solid, dissolved Oxygen and free Carbon dioxide are within the permissible range for aquatic organism. The average total alkalinity (47.26 mg/L) indicates good productive water body.

Density and number of phytoplankton genera, Species diversity index (H') and Margalef's species richness index (R) showed positive and significant correlation with pH, total dissolved solid, conductivity, dissolved Oxygen, Total alkalinity, total hardness and Chloride but inversely correlated with water temperature, water depth and free Carbon dioxide (tab.-5)

Table 5: Pearson's correlation coefficient matrix for Phytoplankton and water temperature and physico-Chemical parameters of the river Jaldhaka (n=24, d.f. 46).

	WT	DW	pH	TDS	COND	DO	FC	TA	TH	CL
Density (org./L)	-.839**	-.505**	.377**	.650**	.700**	.696**	-.490**	.837**	.811**	-.095
Number of Genera (S)	-.783**	-.564**	.420**	.606**	.727**	.648**	-.561**	.832**	.835**	-.035
Species Diversity Index(H')	-.743**	-.623**	.497**	.583**	.736**	.641**	-.543**	.817**	.843**	-.067
Margalef's Species Richness Index (R)	-.698**	-.545**	.410**	.525**	.693**	.569**	-.576**	.766**	.786**	.001

WT= Water temperature; DW=Water depth; TDS= Total dissolved solid, pH= Power of hydrogen ion concentration; COND= conductivity; DO= Dissolved oxygen; FC= Free carbon dioxide, TA= Total alkalinity; TH= Total hardness and CL= Chloride.

** Correlation is significant at the 0.01 level (2-tailed);

* Correlation is significant at the 0.05 level (2-tailed)

4. Discussion

A total of 26 genera of Phytoplankton belonged to five groups were recorded during the study period from the river Jaldhaka. Acherjee and Barat (2013) [11] reported 47 and 34 genera of phytoplankton from the river Teesta and Relli respectively. A total of 28 genera of phytoplankton from the Pagladia river, Assam was reported by Das and Dutta (2011). Chlorophyceae constituted the most abundant group with 13 genera (54%), followed by Cyanophyceae with 6 genera (23%), Bacillariophyceae with 4 genera (15%), Euglenophyceae and Dinophyceae with 1 genera each (4%) (Tab.-2 and Fig.-1). The average value of Phytoplankton genera, Shannon-Wiener diversity index and Margalef's species richness index were 24, 274 and 4.07 respectively. Sharma (2015) found Margalef richness index and Shannon diversity index ranged between 0.5459 to 0.2951 and 1.092 to 0.37 in the river Narmada. Density and diversity of the phytoplankton was high in winter seasons due to low volume of water and high nutrients content. Maximum phytoplankton density was recorded in winter season and minimum value in monsoon season in the river Beehar, Rewa (Patel, 2014) [12]. Density and diversity of the phytoplankton showed significant positive correlation with dissolved Oxygen, total alkalinity, total hardness and chloride. Similar findings was suggested by Senapati *et al.* 2011, Ghosh 2012 and Patel (2014) [12].

5. Conclusion

Moderate number of phytoplankton species was recorded in this river during the study period. Presence of *Oscillatoria*, *Euglena*, *Chlamydomonas* and *Navicula* indicates organically polluted waters.

6. References

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