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Seasonal Diversity and Habitat characteristics of Algae of Wetlands in the West Garo Hill, Meghalaya, India

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Abstract

Seasonal diversity and habitat characteristics of algae of wetlands in West Garo Hill were investigated in three seasons in the year 2013. The wetlands were found to be highly fluctuates with season. The water showed slightly alkalinity. DO was found normal as prescribed by WHO. COD and TSS were found beyond the permissible limit. The BOD was slightly higher than permissible limit. About 36 algal species belonging to Chlorophyceae, Cyanophyceae, Bacillariophyceae, Desmidiaceae, Euglenophyceae, species have been identified. Chlorophyceae and bacilariophyceae were found maximum number than other class of algae. The species of spirogyra was most frequent among Chlorophyceae. The Bacillariophyceae members were dominated by Pinnularia and Navicula. Among Cyanophyceae, Nostoc, Anabaena and Oscillatoria were abundant. Large number of species of cyanophyceae was observed in summer season. Desmids were represented by a large number of Cosmarium and Closterium. There was a seasonal variation of algal types, count and that mostly depending on pH value, clearity of water, and amount of nutrients of water.

Keywords: west Garo hill, seasonal diversity, algae, water quality.

Introduction

Water is the home of almost all form of algae. It provides not only shelter to the aquatic life but also provides oxygen, food, nutrient and all other necessary requirements for the growth of aquatic community. The quality of water arises from physical, chemical and biological interactions. Its quality is changed with seasonal variation due to variation of temperature, amount of rainfall, transformation and accumulation of matter of living things, agricultural residues into the water body.

The quality of water body has direct influence on the type and distribution of algal community. Excessive changes of water quality may be threat to algal life by changing the community structure as well as losing biodiversity. To conserve the algal community in addition to maintaining water quality properly, the study of algal community is essential. Goswami proposed that the conservation of an aquatic system should be on the identification and assessment of biodiversity composition[1].

In Indian sub continent, substantial studies have been made on the algal assemblages in relation to environmental factors by many algologists, although most of the studies were concentrated to phytoplanktons of lakes, pond and large rivers. Meghalaya, which occupied almost a virgin ground have very little information on algae. Only Syiem *et. al.*[7],Goswami *et. al.*[8] and Siangbood *et. al.*[9] have worked on algae available in Meghalaya till now. The present investigation is the collection of data for the analysis of water quality and the occurrence and diversity of algae of the wetlands.

Materials and methods

Study area: West Garo Hill occupies most of the wetlands is located at the western part of Meghalaya. The boundary of the district is on the east side East Garo Hills, on south- east side South Garo Hill, on north side Goalpara District, Assam and on south side the international boarder Bangladesh. The Tura range, Arbella range and Ranggira range are the three important ranges present in this district. The district is situated between 25°10' and 25°35'N latitudes and 90°15 and 91°-0' E longitude. The climate of the district is controlled by seasonal winds and South-West monsoon.

Collection of sample: Ten sampling waterlogged (Water present both in wet and dry season) sites were chosen at approximately equal distance from each other. Water and algal Samples from these sites were collected in three seasons viz. summer (March-Jun), monsoon (July—Sept) and winter (Oct—Feb) in the year 2013. Before collection of data the water temperature, pH and dissolved oxygen (DO) were determined immediately in the field. For analysis of other physico – chemical parameters i.e. Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Total hardness, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), nitrate (NO_3) and phosphate (PO_4), water sample were bring to laboratory for analysis following standard methods (Trivedi & Goel[10], APHA[11]). Data were analyzed using SPSS 16. Algal sample collected from these sites was preserved in 4.5 % formalin for further observation. Algal identification was carried out with the help of relevant taxonomic literature of Desikacharty[12], Smith[13] and Prescott[14].

Results and Discussion

The results of physico- chemical parameters of water with different season are presented in table-I. Water temperature directly related with the growth and distribution of aquatic community. It determines the status of oxygen in water body. The water temperature recorded maximum in the summer season followed by monsoon and minimum in winter season (figure-1). The water temperature is directly related with atmospheric temperature. PH is a indicator of water pollution. It is related with the presence of CO_2, H_2Co_3 and Hco_3 water body. PH values showed that water is neutral to alkaline ranging from 6.7 to 9.2. The maximum value of pH was observed during summer and minimum in winter season. During summer water temperature raise and photosynthetic activity increases in aquatic community. This results in increasing the demand of CO_2 and raises the level of PH value. Electrical conductivity (EC) determines the amount of ionic matter in water body. It was maximum during monsoon followed by summer and minimum during winter (figure-1). High conductivity in monsoon was due to the run way of domestic product from households and fertilizer, crop residues from agricultural land to the wetlands. The mean value was below the permissible limit as prescribed by WHO[15]. DO determine the level of water pollution. The DO was higher (10.44 mg/l) in winter season and comparatively lower (8.38 mg/ml) during monsoon and lowest (6.57 mg/l) in the summer (table-1). The maximum DO in winter may be due to low atmospheric temperature at relatively higher solubility of oxygen and minimum DO in summer may be due to high metabolic rate of organisms (Hazelwood and Parker[16]). BOD indicates the organic load of a water body. The significant difference between BOD and COD were not observed in the summer and monsoon season and their values were higher than winter season (Table-1). Monsoon season showed the maximum value of TSS, TDS, and total hardness followed by summer and minimum in the winter season (Fig-1). According to Verma *et al*. high value showed during the monsoon season may be due to the addition of domestic as well as agricultural product to the water body[17]. Their mean values were higher than permissible limit as prescribed by WHO. Nitrate (NO_3) and Phosphate (PO_4) are the eutrophication causing nutrient leading to extensive algal growth. Summer season showed high amount of nitrate and phosphate followed by monsoon and winter season (figure-1). Increase in nutrients during summer is related with the decrease the water level effecting concentration and the release of nutrient during decomposition, which in turn increased with rise the temperature (Chaurasia and Adoni[18]). However the seasonal mean of both the parameters were below the permissible limit.

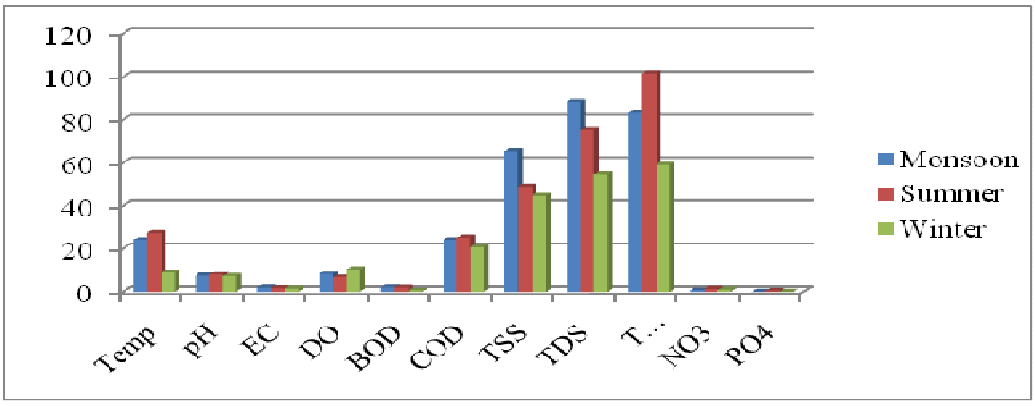

Figure-1
Variation of physic-chemical parameters of water with different seasons

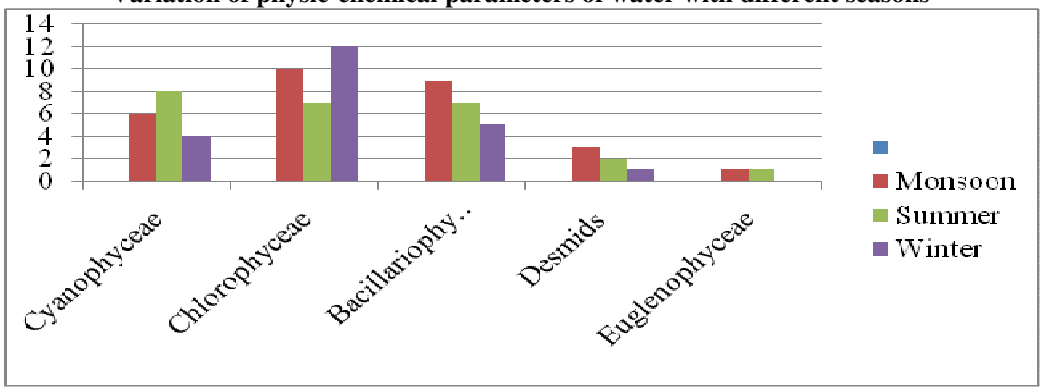

Figure-2
Variation of different class of algae with different seasons

Table-1
Seasonal variation of physico- chemical characters of wetlands in the west Garo Hill, Meghalaya (2013)

Season / Parameter	Monsoon		Summer		Winter		Average seasonal mean	WHO
	Range	mean±SD	Range	mean±SD	Range	mean±SD		
Temp(°C)	20.05-26.40	24.13±4.66	26.4-28.4	27.33±2.65	7.91-12.26	9.40±2.1	20.28	
pH	7.0-7.6	7.40±1.7	7.6-9.2	8.70±2.36	6.7-7.3	7.10±1.31	7.73	5-5.9
EC(mmohs/cm)	1.33-2.65	1.98±0.21	1.55-1.81	1.67±0.21	1.02-1.52	1.39±0.3	1.68	0-1000
DO (mg/l)	7.43-9.21	8.33±1.66	5.65-7.94	6.57±2.22	9.05-11.42	10.44±2.8	8.44	6.2-7
BOD (mg/l)	1.62-2.80	2.09±0.03	1.56-2.00	1.93±0.3	0.21-0.62	0.51±0.06	1.31	01-2
COD (mg/l))	21.17-28.55	24.05±3.55	20.44-28.70	25.22±4.66	18.90-21.46	20.56±2.7	23.27	10
TSS (mg/l)	59.66-70.94	65.35±24.7	46.69-51.21	48.96±20.7	43.67-45.83	44.54±5.6	53.28	50
TDS (mg/l)	893.10-1034.66	988.54±243.8	668.03-854.69	775.21±222.5	687.24-791.99	754.33±178.9	839.36	1000
T. Hardness (mg/l)	172.51-208.00	183.06±78.00	172.66-237.33	206.88±98.7	146.71-174.06	158.75±65.7	182.89	200-600
NO_3 (mg/l)	0.35-0.76	0.65±0.11	1.11-1.47	1.32±0.22	0.69-1.02	0.87±0.10	0.94	45
PO_4 (mg/l)	0.005-0.02	0.022±0.003	0.032-0.52	0.043±0.005	0.011-0.024	0.013±0.006	0.025	0.1

SD- Standard deviation, WHO- World Health Organization

The seasonal variation changes the physico- chemical parameters of water which in turn change the occurrence and diversity of algal species. Table-2 showed the diversity of algal species with different season. From the table-2 and figure-2, it was observed that Maximum algal species diversity occur in monsoon season and minimum in winter season. This may be due to the maximum deposition and suitable temperature occurring during monsoon season (table-1) which favour for algal growth. Altogether 36 algal species belonging to *Chlorophyceae, Cyanophyceae, Bacillariophyceae, Desmidiaceae, Euglenophyceae,* species had been identified. Chlorophyceae showed the maximum number of occurrence of species followed by bacilariophyceae and minimum by other class of algae (table-2). The group Euglenophyceae was present very less number in all season. Seasonal diversity showed that Diatoms and desmids favour monsoon season by occuring maximum number of species diversity (figure-2). The occurrence of high number of species of Desmids and Diatoms are characteristics of low nutrient of the water body. Kadiri, Nwankwo established the fact that desmids are characteristics of fresh water environment with poor ionic composition[19]. On the contrary, Cyanophyceae showed maximum species diversity in summer season (figure-2). Summer season favours the growth of microorganism. Microorganisms decompose the organic matter and release large amount of inorganic compounds and nutrients to the water body. In addition to this water showed high alkalinity during summer season which favour cyanophycean algal growth. table-1 and figure-1 showed the presence of high amount of TSS, TDS, and total hardness and PH during summer season which is suitable for the growth of Cyanophycean algae. Though winter season is not suitable for algal growth, chlorophyceae prefer this season for their growth and reproduction. In winter season microorganisms are metabolically less active, less organic decomposition and as a result less pollution of the water body which is probably the suitable habitat for chlorophycean algae. Descy also found a positive correlation between chlorophycean diversity and purity of water body[20]. The species spirogyra of Chlorophyceae*; Pinnularia* and *navicula of Bacillariophyceae; Nostoc, anabaena* and *Oscillatoria of Cyanophyceae* and *cosmarium* and *closterium* of *Desmids* were found more frequent in this observation. Algal bloom had not been observed in any of the season. This may be due to minimum deposition of NO_3 and PO_4 as observed from the Table-1. Blomqvist *et al*[21], Anderson *et al*[22], Zimba [et al][23] said that maximum deposition of NO_3 and PO_4 along with other nutrient occur in water body support algal bloom. This indicates the clearity of water body of the wetlands.

Table-2
Seasonal variation of algal diversity of wetlands of West Garo Hill, Meghalaya

Class	Name of algae	Monsoon	Summer	Winter	Total no. of Sp. occur
CYANOPHYCEAE	1. *Microcystis marginata (*Menegh)	+	+	-	8
	2. *Chroococcus turgidus* (Kütz.)	+	+	–	
	3. *Oscillatoria acuminata* Gomont	+	+	–	
	4. *Nostoc punctiforme* (Kütz.)	–	+	+	
	5. *Nostoc commune* Vaucher	+	+	+	
	6. *Anabaena azollae* Strasburger	–	+	+	
	7. *Anabaena oryzae* Fritsch	+	+	+	
	8. *Scytonema hofmanni* Ag ex.	+	+	–	
Cyanophycean diversity		6	8	4	
CHLOROPHYCEAE	9. *Cladophora glomerata* Kuetzing	+	—	+	13
	10. Oedogonium sp.	+	+	+	
	11. *Cosmarium contractum* Kirchner	–	–	+	
	12. Spirogyra micropunctata Transeau	+	+	+	
	13. S. *crassa* Kuetzing	+	–	+	
	14. S. *gratiana* Transeau	+	–	+	
	15. *Volvox sp.*	+	–	+	
	16. *Chlamydomonas globosa*	–	+	–	
	17. *Chara zeylanica*	+	+	+	
	18. *Ulothrix zonata*	+	+	+	
	19. *Zygnema pectinatum*	+	+	+	
	20. Chlorella vulgaris	–	–	+	
	21. *Pediastrum simplex*	+	+	+	
Chlorophycean diversity		10	7	12	
DIATOMS	*22. Diatoma Sp.*	+	+	–	10
	23. Stauroneis sp.	+	+	–	
	24. Fragillaria sp.	+	+	+	
	25. Nitzschia subtilis Gron	+	+	+	
	26. N. densestriata Hustedt	+	–	–	
	28. N. dicephala (Ehr.) W. Smith	+	+	–	
	29. Gomphonema gracile Ehr.	–		–	
	30. Cymbella ventricosa Kuetz	+	+		
	31. Achnanthes microcephala (Kuetz.) G		+	+	
	32. Amphora venata Kuetz	+	—	+	
		+	+	+	
Diatom diversity		9	7	5	

DESMIDS	*33. Cosmarium sp.*	+	+	+	3
	34. Closterium sp.	+	+	_	
	35. Penium sp.	+	_	_	
Desmids		3	2	1	
EUGLENO PHYCEAE	*36. Euglena sp.*	+	+	_	1
Euglena diversity			1	1	0

Conclusions

From present study of seasonal diversity and habitat characteristics of algae the following conclusions may be drawn. i. All type of algae more or less prefer monsoon season as their suitable environment for their growth and reproduction. Alkalinity and temperature present during monsoon season support algal growth. ii. Monsoon season favours the growth of algae belongs to the class Bacillariophyceae and Desmids. This may be due to the maximum deposition of organic matter and prevailing suitable temperature favour for algal growth. iii. Cyanophycean algae prefers summer season for their growth and reproduction. Presence of high amount of TSS, TDS, and total hardness and PH during summer season is suitable for the growth of Cyanophycean algae. iv. Only the algae belongs to the class Chlorophyceae showed the highest species diversity in winter season. Microorganisms are metabolically less active in this season hence less pollution of the water body which is probably the suitable habitat for chlorophycean algae. v. The seasonal variation of algal types, count mostly depends on pH value, clearity of water, and amount of nutrients of water. vi. The current status of wetlands of West Garo Hill lies below the level of pollution hence there is no indication of algal bloom and prevailing suitable environment for growth of all type of algae.

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