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Algae of Betana pond and its relationship with water paramers

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Abstract

Algal flora of Betana wetland, their monthly variation, and their relationship with water parameters have been studied. Floating, epiphytic and benthic algae were collected monthly for up to seven months. Out of the total genera (61) observed, only 32 algae were identified up to the species level. The largest class was Bacillariophyceae with 32% algal genera. Similarly, maximum number of genera (93.44%) were found as epiphytic form. *Cymbella* was the dominant genus whereas *Synedra*, *Cocconeis*, *Gomphonema*, *Pinnularia*, *Spirogyra*, *Oscillatoria*, *Cosmarium* and *Navicula* were common genera in the pond. The largest number of genera (68.85%) were found in June and July. The average water temperature of the pond was maximum (32.66°C) in July and minimum (24.25°C) in December and average DO was maximum (8.52 mg/l) in August and minimum (7.2 mg/l) in June. The average pH of water ranges from 7.29 to 7.74. DO and the total number of genera were found to be significantly correlated and the value of correlation coefficient (r) was negative. Water temperature and total number of genera were found to be correlated. Similarly, the pH of watter and number of epiphytic genera were also found to be significantly correlated.

Keywords: Bluegreen algae, correlation, chlorophyceae, diatoms.

Introduction

Algae are photosynthetic organisms that commonly grow in water, but they occur in all sorts of moist habitats, ranging from marine and freshwater to desert sands and from hot boiling springs to snow and ice. They vary in size from small, single-celled forms to complex multicellular forms, such as the giant kelps of the eastern Pacific that grow more than 60 meters in length and form dense marine forests. The largest and most complex marine forms are called seaweeds. The plant body is not differentiated into true roots, stems and leaf or leaf-like organs. Their sex organs are unicellular or multicellular, all the cells are fertile. The zygote formed after fertilization doesn't develop into a multi-cellular embryo. Algae are commonly known as 'pond scums', water 'mosses' or 'sea weeds' and the study of algae is called either Phycology or Algology.

Algae are important as primary producers of organic matter at the base of the food chain accounting for more than half the total primary production in water bodies. Algae are extremely important ecologically and phylogenetically. They stand at the lowest rung of the ladder in the evolution of life and have enormous economic importance.

The major contribution to the algae of Nepal was made by Hirano (1955, 1963, 1969, 1984), Watanabe (1971, 1982, 1995), Joshi (1977, 1979), Shrestha and Manandhar (1983), Watanabe and Komarek (1988, 1989), Komarek and Watanabe (1990, 1998), Jüttner *et al.*

(1996, 2003, 2010), Takeuchi *et al*. (1998, 2001, 2009), Jha and Kargupta (2001, 2006), and Simkhada and Jüttner (2006). Prasad (2011) has also published a modern checklist of algae of Nepal. Recently published literature revealed that the total cyanobacteria of Nepal are listed as 274 under 61 genera and 12 families (Rai *et al*., 2010). Similarly, 23 algae have been identified from the Betana wetland including 6 diatoms new to the country (Rai, 2011). Shrestha *et al*. (2012) have studied the algal flora of Itahari and its adjoining area.

Materials and Methods

Study area

Betana pond is situated at latitude 26º39' N and longitude 87º25' E, and an average altitude of 115 m msl in Belbari Village Development Committee (VDC), Morang District, east Nepal (Fig. 1). It covers about 5.5 ha area in the fringe of the Char-Koshe-Jhaadi of eastern Nepal. It is a natural freshwater ox-bow pond fed by direct atmospheric precipitation and water stored by the forest vegetation surrounding the pond. The evaporation of pond water is reduced considerably due to the native vegetation surrounding it. The depth of the pond is up to 1.5 m in the dry season and 2.5 m in the monsoon. The water is drained out continuously through an outlet from the southern side of the pond.

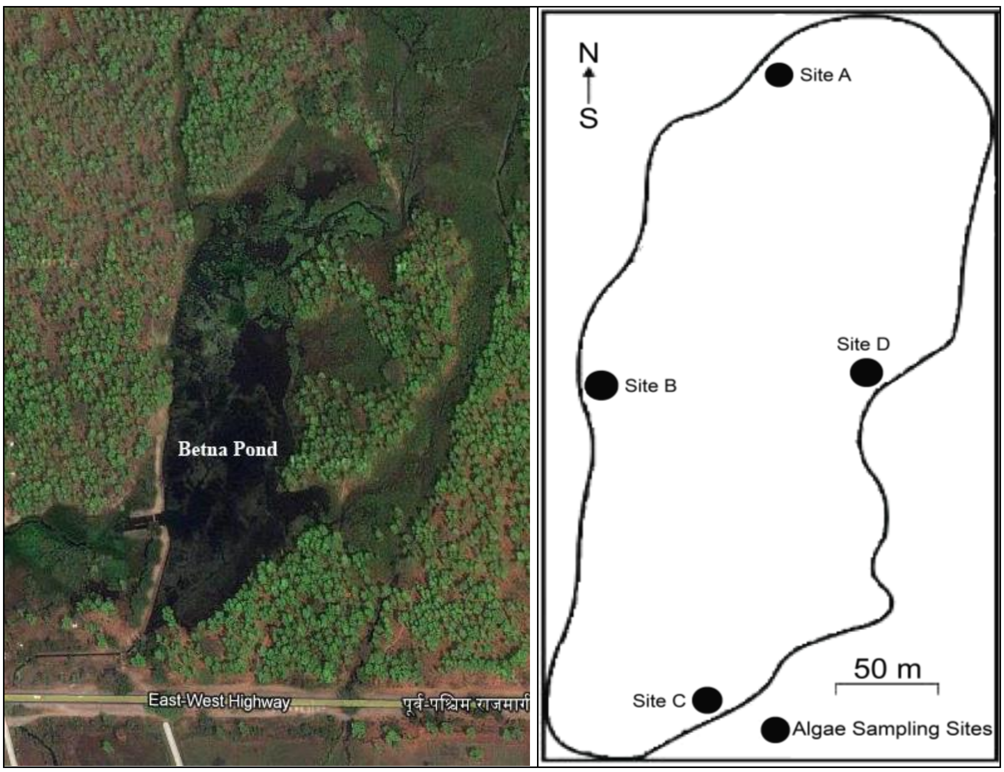

Figure 1. Betana pond showing sampling sites (A, B, C, D).

Belbari area experiences three different seasons in a year: monsoon (Mid-June to October), winter (November to February) and summer (March to early June). Average rainfall is 1225, 5 and 188 mm; average minimum temperature is 25, 10.4 and 19.6ºC; average maximum temperature is 32.3, 25 and 33.6ºC; relative humidity at 8.45 morning is 84.2, 89 and 71.2% and at 5.45 evening 60, 71 and 61.5%; and wind velocity is 6.0, 3.8 and 7.3 Km/hr for monsoon, winter and summer seasons, respectively (Jha *et al*., 2005). The soil of the forest around the Betana pond is alluvial soil.

Sample collection

A total of 84 algal samples were collected from four different sites (3 samples from each site) of Betana pond, monthly from June to December 2009. Site A was located at the north, site B at the west, site C at the south, and site D at the eastern edges of the pond (Fig. 1). Floating, epiphytic and benthic forms of algae were collected separately. Planktonic microalgae were collected by using a plankton net (mesh size 0.5 mm), epiphytic macrophytes were collected by squeezing the submerged roots and leaves of *Eichhornia, Pistia, Hydrilla,* etc., and benthic forms were collected by scrubbing the substratum like stone, pebbles, etc lies at the bottom of the pond. The collection was made between 8 am to 12 am a day. Algal samples were then preserved with 4% formaldehyde solution in polythene bottles. Tagging and labeling were done appropriately. Collection number, date, locality, and methods of collection were labeled. Photographs of sampling sites were taken with the help of a Nikon Digital Camera Coolpix S220.

Air and surface water temperatures were measured with the help of an alcohol thermometer and the pH of water was noted with the help of a portable Hanna pH meter. Water samples were also taken in air-tight, black-coated dark bottles. In the lab, the dissolved oxygen (DO) of four different water samples was determined by the Winklers method.

Algal samples were studied under a light microscope at different magnifications. Diatom frustules were cleaned using nitric acid method. Microphotographs were taken with the help of a Nikon Digital Camera Coolpix S220. Ocular and stage micrometers were used to measure the dimension of algae. Algae were identified following Prescott (1951), Desikachary (1959), Philipose (1967), Prescott, Krammer and Lange-Bertalot (1985, 1986, 1988), Croasdale and Flint (1986), Wojtal (2009). All the collected materials and slides have been deposited in the Phycology Research Lab, Department of Botany, P.G. Campus, Biratnagar.

Data analysis

For the statistical work, the prepared slide and the temporary slide of each sample were examined separately under the compound microscope at different magnifications. All the genera recorded from all habitats of four sites in every month were listed in a table. Dominant, common, occasional and rare genera were also tabulated. The total number of genera collected from all sites throughout the study period was counted. The distribution and dominancy of each genus were calculated. The relationship of algal genera with water parameters like dissolved oxygen, water temperature, and pH was also determined. Finally, data analysis was done with the help of the Microsoft Excel program.

Results and Discussion

Algal flora

A total of 61 genera of algae belonging to 38 families and 8 classes were reported from four sites of Betana pond during June to December 2009 (Table 1).

Table 1. Total genera, families and classes of algae reported from Betana pond.

Genera	Family	Class
1. *Eudorina*	Volvocaceae	Chlorophyceae
2. *Hydrodictyon*	Hydrodictyaceae	
3. *Sorastrum*		
4. *Pediastrum*		
5. *Sphaerocystis*	Sphaerocystidaceae	
6. *Scenedesmus*	Scenedesmaceae	
7. *Coelastrum*		
8. *Ankistrodesmus*	Selenastraceae	
9. *Chaetophora*	Chaetophoraceae	
10. *Stigeoclonium*		
11. *Botryococcus*	Botryococcaceae	Trebouxiophyceae
12. *Oocystis*	Oocystaceae	
13. *Gloeotaenium*		
14. *Ulothrix*	Ulotrichaceae	Ulvophyceae
15. *Cladophora*	Cladophoraceae	Siphonocladophyceae
16. *Penium*	Peniaceae	Zygnematophyceae
17. *Closterium*	Closteriaceae	
18. *Pleurotaenium*	Desmidiaceae	
19. *Cosmarium*		
20. *Arthrodesmus*		
21. *Euastrum*		
22. *Micrasterias*		
23. *Hyalotheca*		
24. *Desmidium*		
25. *Onychonema*		
26. *Spondylosium*		
27. *Mougeotia*	Zygnemataceae	
28. *Zygnema*		
29. *Spirogyra*		
30. *Microchaete*	Microchaetaceae	Cyanophyceae
31. *Aphanotheca*	Cyanobacteriaceae	
32. *Chroococcus*	Chroococcaceae	
33. *Merismopedia*	Merismopediaceae	
34. *Aphanocapsa*		
35. *Coelosphaerium*		
36. *Anabaena*	Nostocaceae	
37. *Microcystis*	Microcystaceae	
38. *Lyngbya*	Oscillatoriaceae	
39. *Oscillatoria*		
40. *Phormidium*	Phormidiaceae	
41. *Melosira*	Melosiraceae	Bacillariophyceae
42. *Diatoma*	Fragilariaceae	
43. *Fragilaria*		
44. *Ulnaria*		
45. *Eunotia*	Eunotiaceae	

46. *Achnanthes*	Achnanthaceae	
47. *Caloneis*	Naviculaceae	
48. *Navicula*		
49. *Cocconeis*	Cocconeidaceae	
50. *Cymbella*	Cymbellaceae	
51. *Epithemia*	Rhopalodiaceae	
52. *Rhopalodia*		
53. *Gomphonema*	Gomphonemataceae	
54. *Gyrosigma*	Pleurosigmataceae	
55. *Hantzschia*	Bacillariaceae	
56. *Nitzschia*		
57. *Neidium*	Neidiaceae	
58. *Pinularia*	Pinnulariaceae	
59. *Stauroneis*	Stauroneidaceae	
60. *Surirella*	Surirellaceae	
61. *Phacus*	Phacaceae	Euglenophyceae

Out of 61 genera, only 32 algae belonging to 20 families and 5 classes were identified completely (Table 2).

Table 2. Completely identified algae from Betana pond during the study period.

Algal	**Family**	**Class**
1. *Gloeotaenium loitlesbergereanum* Hansg.	Oocystaceae	Chlorophyceae
2. *Pediastrum integrum* Näg. [*Pseudopediastrum integrum* (Näg.) Jena et Bock]	Hydrodictyaceae	
3. *Pediastrum tetras* var. *tetraodon* (Corda) Hansg. [*Stauridium tetras* var. *tetraodon* (Corda) Hall et Karol]		
4. *Ankistrodesmus falcatus* (Corda) Ralfs	Selenastraceae	
5. *Scenedesmus perforatus* Lemm. [*Desmodesmus perforatus* (Lemm.) Hege.]	Scenedesmaceae	
6. *Penium minutum* (Ralfs) Cleve [*Haplotaenium minutum* (Ralfs) Bando]	Peniaceae	Zygnematophyceae
7. *Spirogyra columbiana* Czurda	Zygnemataceae	
8. *Closterium incurvum* Bréb.	Closteriaceae	
9. *Cosmarium lundellii* var. *ellipticum* West et West	Desmidiaceae	
10. *Cosmarium maculatiforme* Schm.		
11. *Cosmarium speciosum* Lund.		
12. *Cosmarium subprotumidum* var. *gregorii* (Roy et Biss.) West et West		
13. *Spondylosium nitens* (Wall.) Lund. [*Sphaerozosma nitens* (Wall.) Toni]		
14. *Coelosphaerium dubium* Grun.	Merismopediaceae	Cyano phyceae
15. *Oscillatoria princeps* Vauch. et Gom.	Oscillatoriaceae	
16. *Anabaena orientalis* Dixit	Nostocaceae	
17. *Fragilaria crotonensis* var. *prolongata* Grun. [*F. prolongata* (Grun.) Vijver et al.]	Fragilariaceae	Bacillario phyceae
18. *Ulnaria ulna* (Nitz.) Compère		

19.	*Caloneis silicula* (Ehr.) Cl.	Naviculaceae	
20.	*Pinnularia acrosphaeria* f. *undulata* (Cl.) Hust.	Pinnulariaceae	
21.	*Pinnularia braunii* var. *amphicephala* (Mayer) Hust. [*P. mayeri* Kram.]		
22.	*Pinnularia microstauron* (Ehr.) Cl.		
23.	*Pinnularia viridis* (Nitz.) Ehr.		
24.	*Cymbella affinis* Kütz.	Cymbellaceae	
25.	*Cymbella tumida* (Bréb.) Van Heurck.		
26.	*Gomphonema constrictum* Ehr.	Gomphonema-taceae	
27.	*Gomphonema lanceolatum* f. *turris* (Ehr.) Hust.		
28.	*Cocconeis placentula* var. *euglypta* (Ehr.) Cl.	Cocconeidaceae	
29.	*Stauroneis anceps* var. *hyalina* Perag. et Brun [*S. neohyalina* Lange-Bert. et Kram.]	Stauroneidaceae	
30.	*Stauroneis phoenicenteron* f. *gracilis* (Ehr.) Hust.		
31.	*Surirella fonticola* Hust. [*Iconella fonticola* (Hust.) Kap. et Kulikov.]	Surirellaceae	
32.	*Phacus curvicauda* Svirenko	Phacaceae	Eugleno phyceae

Only three algae *viz*., *Oscillatoria princeps*, *Pinnularia braunii* var. *amphicephala*, and *Cocconeis placentula* var. *euglypta* reported in the present study have been reported previously (Rai, 2011). The largest class of algae was Bacillariophyceae with 32% genera and Euglenophyceae, Ulvophyceae and Siphonocladophyceae had the least number of genera (2% each) (Fig. 2).

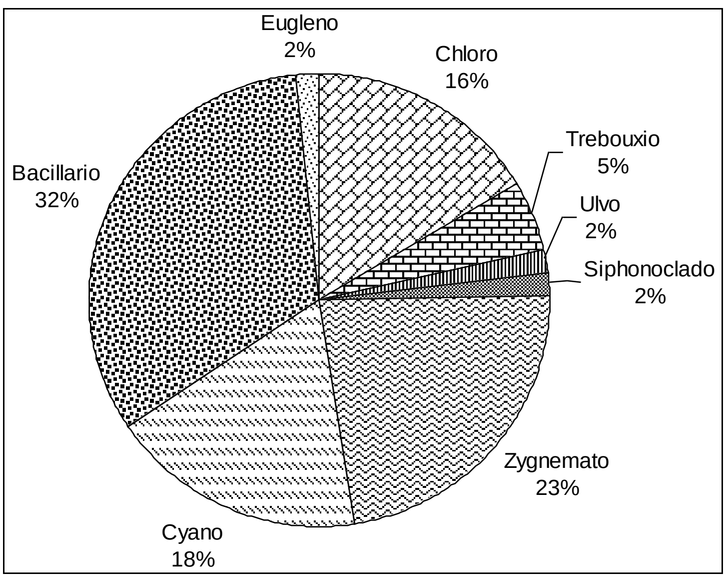

Figure 2. Class-wise representation of total algal genera of Betana pond.

Monthly study showed that maximum algal genera (68.85%) were found in rainy and hot months (i.e., June, July) and then their number decreases continuously with decrease in temperature and reached up to 32.78% in December (Fig. 3).

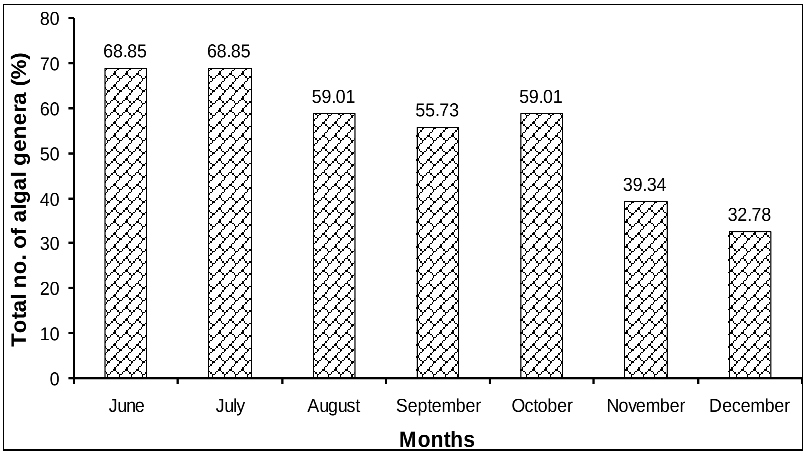

Figure 3. Occurrence of algal genera in different months in Betana pond.

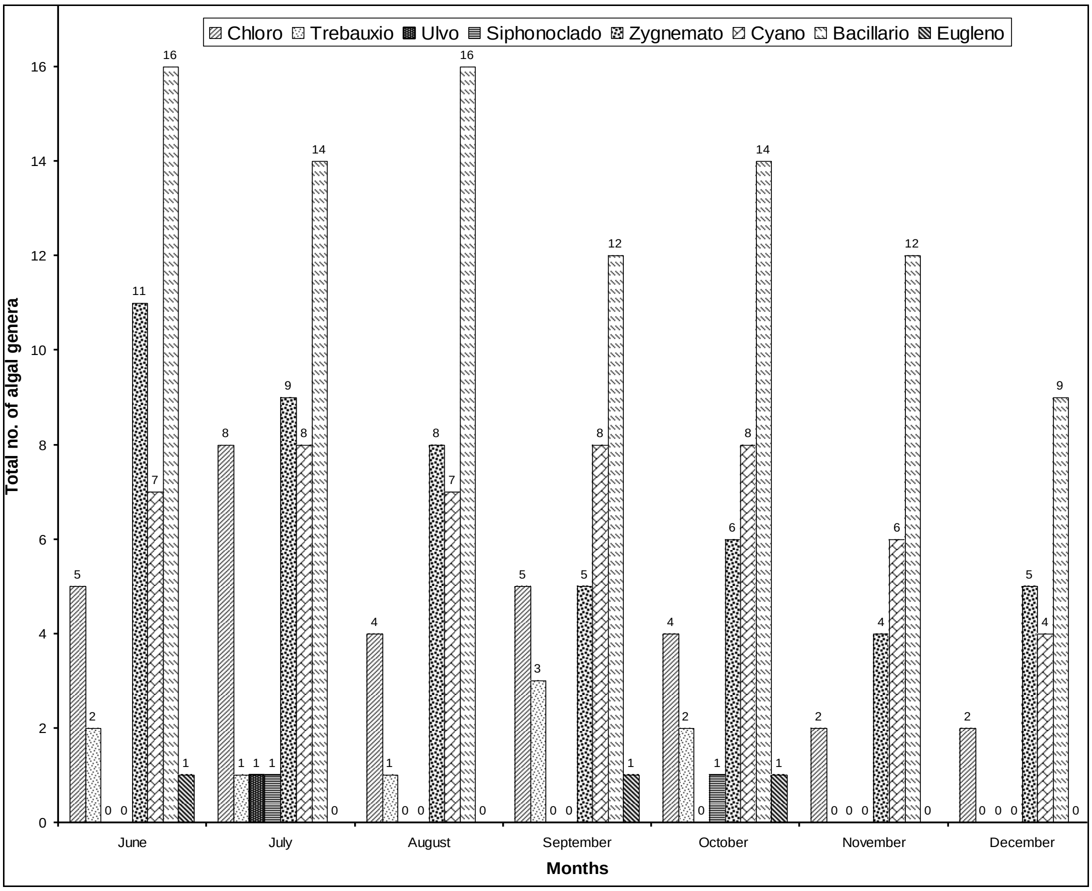

Figure 4. Class-wise comparision of algal genera at different months in Betana pond.

Chlorophyceae, Zygnematophyceae, Cyanophyceae and Bacillariophyceae genera were found in all the seven months in Betana pond. Class Trebauxiophyceae was absent in November and December. Similarly, Ulvophyceae was found only in July;

Siphonocladophyceae was found only in July and October; and Euglenophyceae was found only in June, September and October. Among the classes, Bacillariophycean genera was always maximum in number comparative to other classes (Fig. 4) followed by Zygnematophyceae, Cyanophyceae and Chlorophyceae. There is a trend of decreasing of number of genera in all classes from hot June to cool December.

Number of algal genera collected by squeezing the epiphytic plants was maximum in all months except December. In June, planktonic genera were minimum than the other two while in December, both planktonic and benthic were equal (Fig. 5).

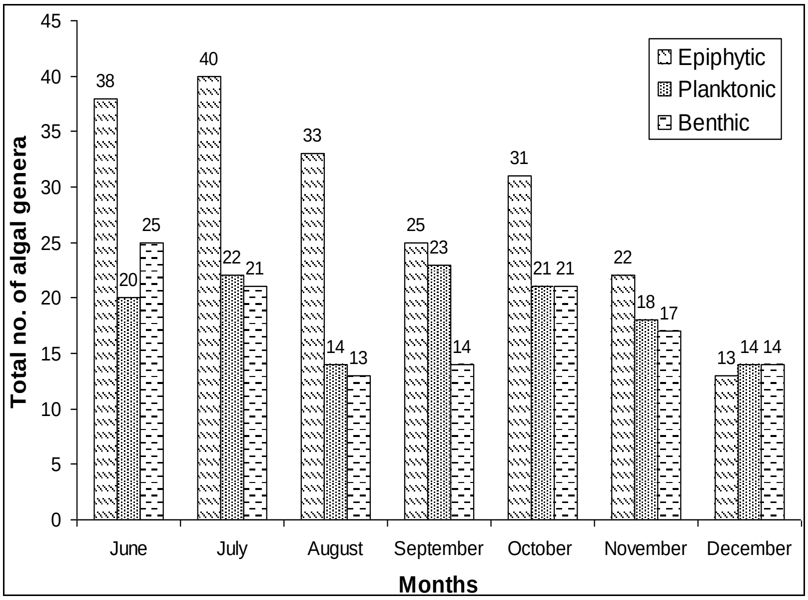

Figure 5. Comparison of algal genera of different habitats occurred in different months.

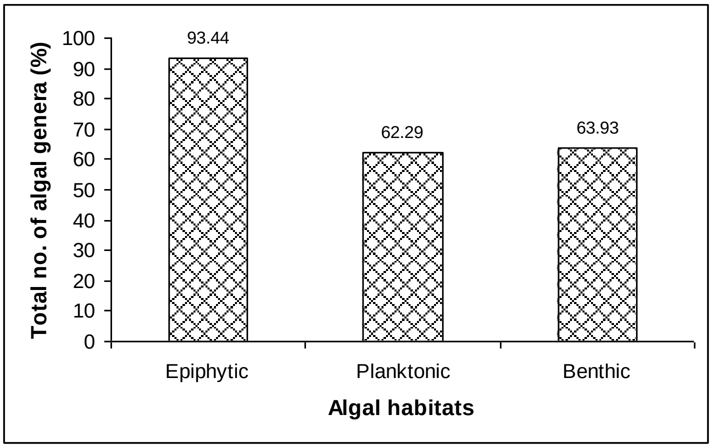

Figure 6. Algal genera occured in different habitats in Betana pond.

Maximum numbers of algal genera (93.44%) were found as epiphytic whereas planktonic forms were least (62.29%) even less than the benthic ones (Fig. 6). Except four genera *viz*., *Nitzschia*, *Chaetophora*, *Stigeoclonium* and *Microchaete*, rest 58 genera were present in epiphytic condition which were collected by squeezing roots and leaves of macrophyte plants like *Eichornia*, *Pistia*, *Potamogenton*, *Hydrilla* etc.

Algae of class euglenophyceae was absent in epiphytic form, class Trebouxiophyceae was absent in plonktonic form and class Siphonocladophyceae was absent in benthic form (Fig. 7). In all three algal habitats, class bacillariophyceae was maximum. It was distinctly high number in epiphytic and benthic habitats.

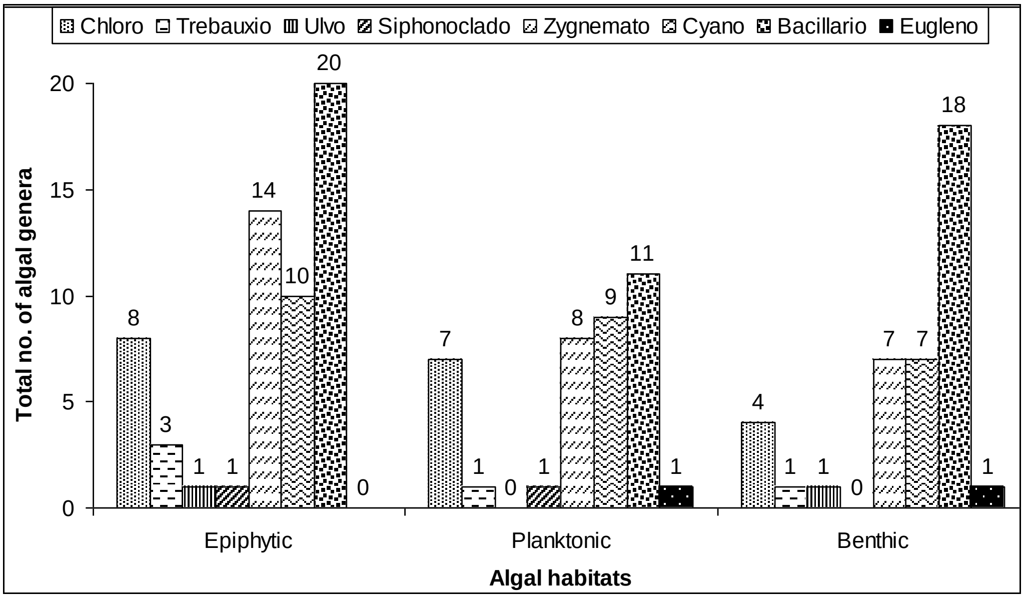

Figure 7. Class-wise comparision of total algal genera collected from different habitats.

Total 28 genera *viz*., *Cosmarium, Closterium, Mougeotia, Scenedesmus, Surirella, Cymbella, Synedra, Cocconeis, Navicula, Gomphonema, Pinularia, Diatoma, Merismopedia, Chroococcus, Phacus, Spirogyra, Fragilaria, Oscillatoria, Stauroneis, Rhopalodia, Onychonema, Coelastrum, Micrasterias, Oocystis, Lyngbya, Phormidium, Chaetophora* and *Anabaena* were common to all three habitats. All together 13 genera *viz*., *Botryococcus, Zygnema, Caloneis, Hyalotheca, Pleurotaenum, Aphanotheca, Penium, Gyrosigma, Spondylosium, Sorastrum, Coelosphaerium, Epithemia* and *Gloeotaenium* were found only as epiptytic forms. Genera *Nitzschia* and *Stigeoclonium* were found only as benthic and planktonic forms, respectively. Among the studied genera, four were not found in epiphytic habitats were *Nitzschia*, *Chaetophora*, *Stigeoclonium*, and *Microchaete*. A total 22 genera *viz*., *Neidium*, *Botryococus*, *Zygnema*, *Eunotia*, *Arthrodesmus*, *Achnanthes*, *Caloneis*, *Hyalotheca*, *Pleurotaenium*, *Hantzschia*, *Nitzschia*, *Ulothrix*, *Penium*, *Gyrosigma*, *Eudorina*, *Sorastrum*, *Coelosphaerium*, *Aphanocapsa*, *Epithemia*, *Melosira*, *Stigeoclonium*, and *Gloeotaenium* were absent in planktonic habitat. Similarly, 21 genera *viz*., *Botryococus*, *Zygnema*, *Ankistrodesmus*, *Pediastrum*, *Hydrodictyon*, *Hyalotheca*, *Pleurotaenium*, *Aphanotheca*, *Euastrum*, *Penium*, *Gyrosigma*, *Cladophora*, *Desmidium*, *Spondylosium*, *Sorastrum*, *Sphaerocystis*, *Coelosphaerium*, *Aphanocapsa*, *Epithemia*, *Stigeoclonium*, and *Gloeotaenium* were not found in benthic habitat.

The common genera of the pond were *Synedra*, *Cocconeis*, *Gomphonema*, *Pinnularia*, *Spirogyra*, *Oscillatoria*, *Cosmarium* and *Navicula* since they were present in more than 50% of the sample collected and was found in all sites and habitats. *Cymbella* was found to be dominant one i.e., present in 73/84 samples and was maximum in number at each focus during microscopic examination throughout the 7 months' collection period.

The genera that occurred throught the study period in Betana pond were *Cosmarium, Closterium, Senedesmus, Cymbella, Synedra, Cocconeis, Naviculla, Gomphonema, Pinnularia, Chroococcus, Spirogyra, Oscillatoria* and *Phormidium.* There were 42 genera that occurred during hot and rainy season (June and July) were *Cosmarium*, *Closterium, Mougeotia, Scenedesmu, Surirella, Cymbella, Synedra, Cocconeis, Navicula, Gomphonema, Pinularia, Diatoma, Merismopedia, Chroococcus, Spirogyra, Fragilaria, Oscillatoria, Stauroneis, Botryococcus, Ankistrodesmus, Rhopalodia, Eunotia, Achnanthes, Caloneis, Micrasterias, Pediastrum, Hydrodictyon, Hyalotheca, Pleurotaenium, Ulothrix, Lyngbya, Phormidium, Chetophora, Cladophora, Anabaena, Eudorina, Desmidium, Spondylosium, Sorastrum, Sphaerocystis, Coelosphaerium* and *Aphanocapsa.* Similarly, 20 genera occurred during winter season (December) were *Cosmarium, Closterium, Mougeotia, Scenedesmus, Cymbella, Synedra, Cocconeis, Navicula, Gomphonema, Pinularia, Chroococcus, Spirogyra, Oscillatoria, Stauroneis, Achnanthes, Micrasterias, Phormidium, Anabaena, Eudorina* and *Melosira*.

The abundant genera in the month of June were *Surirella*, *Cymbella*, *Synedra* and *Fragilaria*; in July were *Mougeotia*, *Cymbella*, *Synedra* and *Spirogyra*; in August were *Cymbella* and *Gomphonema*; in September were *Cosmarium*, *Cymbella*, *Synedra*, *Spirogyra* and *Oscillatoria*; and in October was only *Cymbella*. No one genus was dominant in November and December. Genus *Cymbella* was found to be dominant throughout the months of June to October. Similarly, the scarce algal genera of the pond throughout the study period were *Nitzchia, Penium, Gyrosigma, Spondylosium, Sorastrum, Coelospaerium, Epithemia, Stigeoclonium, Gloeotaenium, Euastrum, Ulotherix, Hantzschia, Hyalotheca, Arthrodesmus, Rhopalodia, Fragilaria, Neidium, Hydrodictyon, Pediastrum, Microchaete, Desmidium, Cladophora, Sphaerocystis, Eudorina, Microcystis, Oocystis, Eunotia, Phacus, Cladophora, Aphanotheca, Pleurotaenium, Caloneis, Botryococcus, Ankistrodesmus, Anabaena* and *Phormidium*.

Water parameters

The average water temperature of Betana pond was recorded maximum to 32.66°C in july which was then decreased continuously in the following months and reached minimum to 24.25°C in December (Table 3, Fig. 8). Similarly, average pH of water was ranged from 7.29 to 7.74 throughout the study period. Average dissolve oxygen (DO) of water was recorded maximum of 8.52 mg/l in August and minimum of 7.2 mg/l in June.

Table 3. Physico-chemical characteristics of water of Betana pond in June-December, 2009.

Parameters		June	July	August	Sept.	October	Nov.	Dec.
Air temp. (°C)	Mean ±SD	33.16 ±1.4492	31.33 ±0.8348	32.62 ±1.4162	32.5 ±1.3142	26.04 ±1.2515	25.91 ±0.9962	24.91 ±1.0836
	Range	32-37	30-33.5	31-35	31-35	24-28	24-27	23-26
Water	Mean	31.4	32.66	30.83	30.33	27.08	25.41	24.25

temp. (°C)	±SD	±1.3080	±0.8348	±1.3540	±0.8876	±1.2401	±1.3789	±0.7537
	Range	30-33.5	31.5-34	29-33	29-32	25-29	23-28	23-25
pH of water	Mean ±SD	7.72 ±0.2780	7.65 ±0.2746	7.6 ±0.3015	7.74 ±0.2065	7.53 ±0.4417	7.49 ±0.4166	7.29 ±0.2574
	Range	7.2-8	7-8	7-8	7.5-8	7-8	7-8	7-7.5
DO (mg/l)	Mean ±SD	7.2 ±0.3559	6.72 ±0.8995	8.52 ±0.4787	8.12 ±0.4349	8 ±0.3741	8.2 ±0.4320	8.42 ±0.4856
	Range	6.7-7.5	5.9-7.6	8.1-9.2	7.5-8.5	7.5-8.4	7.6-8.6	7.8-8.9

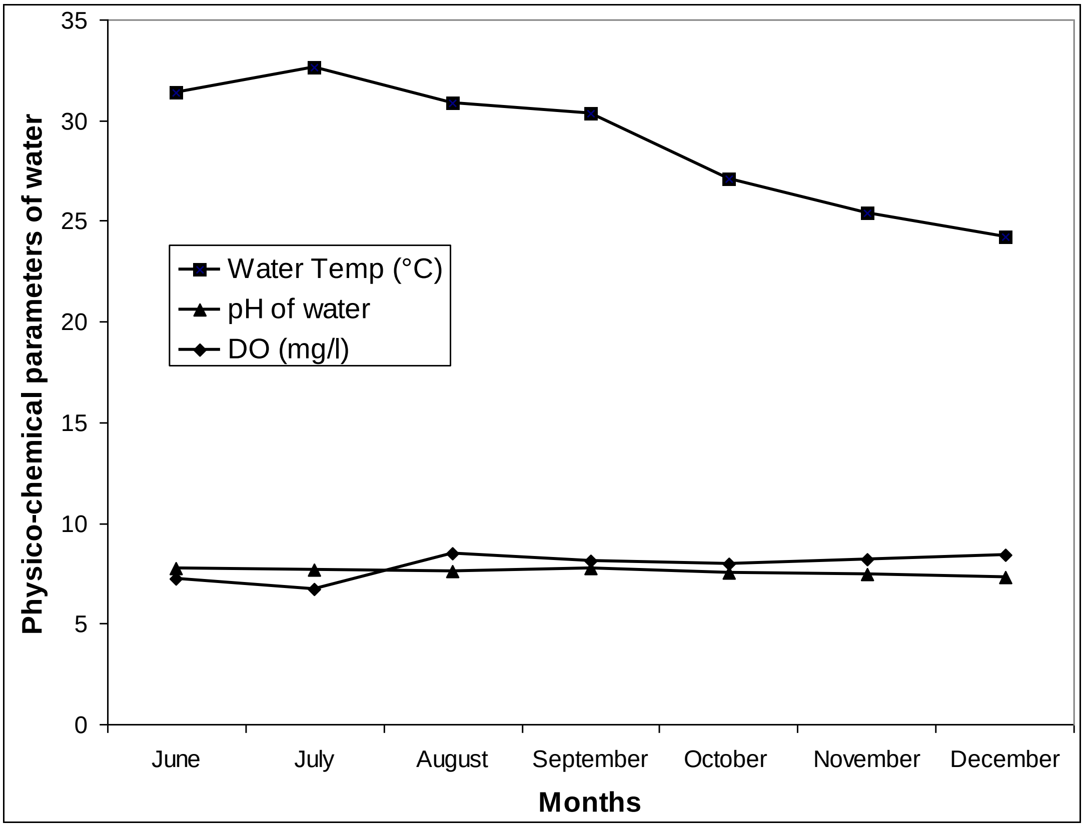

Figure 8. Variation in water temp., pH, and DO of Betana pond from June to December, 2009.

Relashionship of algal genera with water parameters

Correlations: Correlations of total number of algal genera, total number of epiphytic genera (found on root), total number of planktonic genera, and total number of benthic genera with air temperature, water temperature, pH of water and dissolve oxygen of water of Betana pond were as follows (Table 4).

Dissolve oxygen and total number of genera were found to be significantly correlated ($P<0.01$). The value of correlation coefficient (r) was negative. Water temperature and total number of genera were found to be correlated ($P<0.05$). Number of epiphytic genera and pH of water were found to be significantly correlated ($P<0.05$).

Table 4. Correlations between total number of algal genera, epiphytic genera, planktonic genera and benthic genera with air/water temperature, pH and DO of water of Betana pond.

		Total no of genera	A	B	C	Air T. (°C)	Water T. (°C)	pH of water	DO mg/l
Total no of genera	PC	1	0.972(**)	0.770(*)	0.712	0.632	0.854(*)	0.742	-0.883(**)
	S		0.000	0.043	0.073	0.127	0.014	0.056	0.008
A	PC	0.972(**)	1	0.765(*)	0.683	0.703	0.873(*)	0.828(*)	-0.806(*)
	S	0.000		0.045	0.090	0.078	0.010	0.021	0.029
B	PC	0.770(*)	0.765(*)	1	0.907(**)	0.191	0.394	0.469	-0.808(*)
	S	0.043	0.045		0.005	0.681	0.382	0.288	0.028
C	PC	0.712	0.683	0.907(**)	1	0.173	0.369	0.551	-0.693
	S	0.073	0.090	0.005		0.711	0.415	0.199	0.084
Air T. (°C)	PC	0.632	0.703	0.191	0.173	1	0.916(**)	0.862(*)	-0.425
	S	0.127	0.078	0.681	0.711		0.004	0.013	0.341
Wat. T. (°C)	PC	0.854(*)	0.873(*)	0.394	0.369	0.916(**)	1	0.864(*)	-0.663
	S	0.014	0.010	0.382	0.415	0.004		0.012	0.105
pH of water	PC	0.742	0.828(*)	0.469	0.551	0.862(*)	0.864(*)	1	-0.471
	S	0.056	0.021	0.288	0.199	0.013	0.012		0.287
DO mg/l	PC	-0.883(**)	-0.806(*)	-0.808(*)	-0.693	-0.425	-0.663	-0.471	1
	S	0.008	0.029	0.028	0.084	0.341	0.105	0.287	

A = Number of epiphytic genera, B = No of planktonic genera, C = No of benthic genera, PC = Pearson Correlation, S = Significance (2-tailed), ** Correlation is significant at 0.01 level, * Correlation is significant at 0.05 level.

Regression**:** Dissolve oxygen was found to be decreased when the number of genera was increased. It was most probably due to the consumption of oxygen by high density of algal genera and may be due to increased in termprature at that time. Thus, there was significant relationship between total number of genera and dissolve oxygen (Fig. 9).

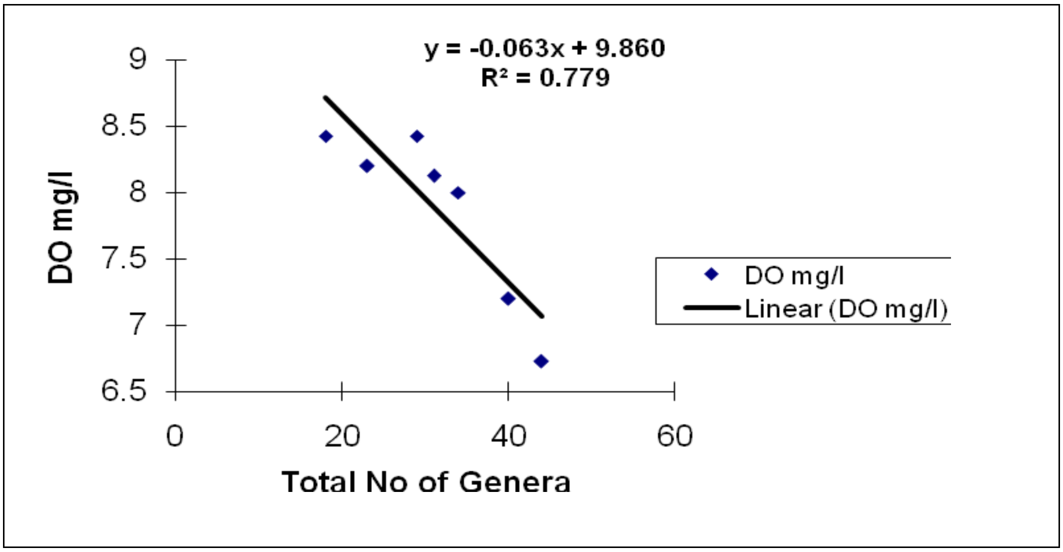

Figure 9. Regression between total number of algal genera and DO of water.

High temperature of water was found to be favourable for the growth and increase in number of different genera. Thus, there was significant relationship between total number of genera and water temperature (Fig. 10).

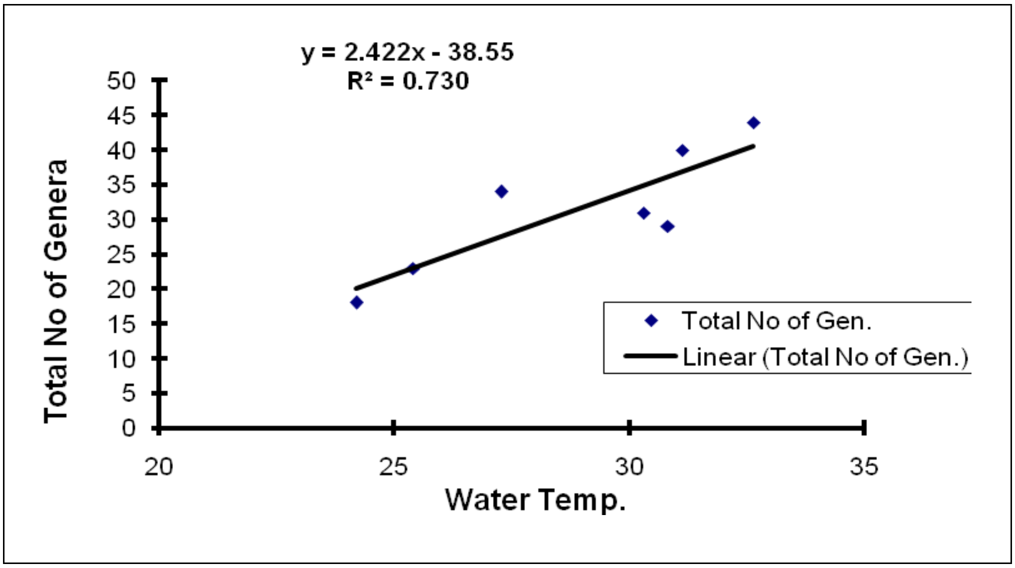

Figure 10. Regression between total number of algal genera and water temperature.

The number of epiphytic genera attached on the root was found to be increased when the pH value of water was increased. The relation may not be the direct. There may be the third factor that affected the number of genera. There was significant relationship between number of epiphytic genera (found on root) and pH of water (Fig. 11).

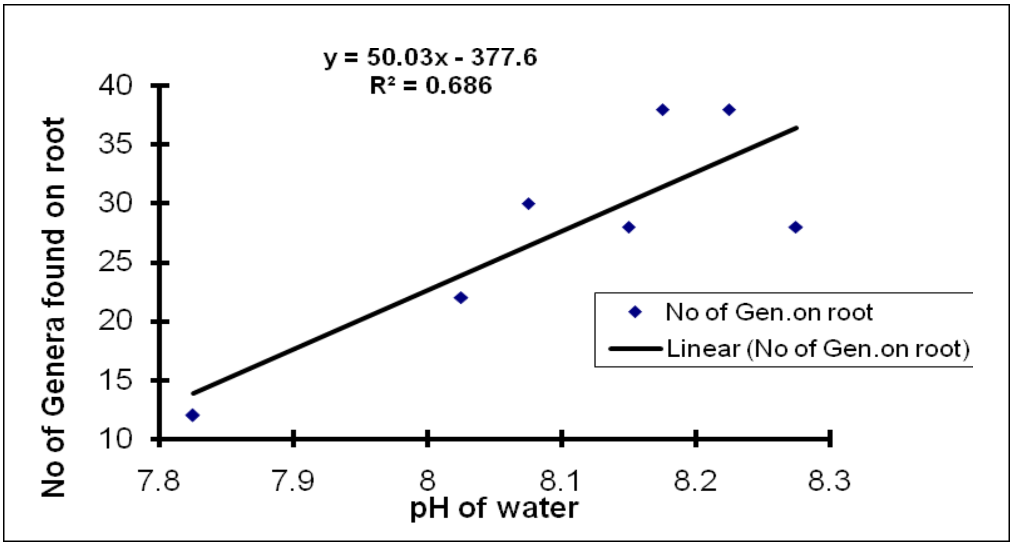

Figure 11. Regression between number of algal genera epiphytic on root and pH of water.

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