J. Phytol. Res. **15** (2) : 201-208, 2002

PHYTODIVERSITY IN RELATION TO ECOVARIABILITY OF TWO WETLANDS OF JAUNPUR (U.P.)

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The fluctuations in temperature, shallowness and turbidity favours the luxuriant growth of periphytic life. The lower temperature, shallowness and transparency encourage the growth of green algae in peripheral regions. High temperature, deepness and transparency promotes the abundance of cyanophycean and diatoms.The comparative study of ecovariability (physico-chemical properties) of two wetlands lucidates the basic understanding of variations in phytodiversity. Present work is aimed to correlate the variation in morphometry with the alteration in allochthonous, physico-chemical edaptic and biological properties (ecovariability) of the two wetlands. The Kunwarpur wetland (Site I) with greater peripheral shallow area is supporting 36 sps. dominated by *Scripus* and *Vallisneria* in peripheral region (lesser biodiversity). The Gujar wetland (Site II) with the deep water and lesser shallwo peripheral area is supporting the growth of 66 species dominated by *Typha, Eichhornia* and *Nelumbo* (greater biodiversity). The chlorophycean phytoplankton dominated on both the sites but diatoms are exclusively present at site I where site II is dominated by cyanophycean algae only.

Keywords : Alkalinity; Ecophases; Ecovariability; Macrophytes; Phytodiversity; Phytoplanktons; Transparency; Turbidity.

Introduction

The wetlands are the shallow ecotones occupy the marginal part of aquatic systems[1]. About 37% natural lake and tal areas are commonly occupied by shallow peripheral zones which support the growth of phytoplankton and emergent vegetation. The depth of water is at its maximum upto 0.30 m. having muddy soil supported rooted plants with principal photosynthetic surface projecting above surface of water. The aquatic plants including macrophytes and phytoplankton photosynthesize and provide food and oxygen to other aquate organisms in wetland systems. The alteration in species composition and abundance of phytoplankton and biotype may be due to any fluctuations in the prevailing interacting environmental complexes with both space and time.

Hejny and Husak[2] have described the actual environmental conditions as 4 reconized ecophases that determine the basic niches for specific macrophytic growth. These are the hydrophase, littoral, limosal and Terrestrial.

The hydrophase includes the floating, submerged or emergent macrophytic forms. Colonising areas having more than one meter water depth. The littoral phase resembles the shallow water areas associated with different aquatic plants. Whereas limosal ecophases denotes the association of amphibious plants with muddy or water saturated soils.

The macrophytic vegetation of aquatic habitat is quite rich in species and covered area grouped into four specific communities viz. free floating, bottom rooted floating, submerged and emergent, with distinct assemblages of macrophytes. The physico-chemical properties of mud and water medium, bring the modification in the qualitative characters of organism. The phytodiversity supported by mineral nutrient based on the sediments of bottom much including the minerals and decomposed organic matter.

The intensity of light temperature and turbidity (i.e. reverse of transparency) constitute the physical characters while the pH, CO_2, DO, N.P.K., Ca, Mg, and Na contents in water contribute to the chemical characteristics which may play effective role in determining the phytodiversity. The edaphic factors also affect density and abundance of algal flora.

These may directly or indirectly influence drastically the biota of the wet environment. The conversion from unavailable to availabe form of an element (i.e. nutrient can improve the water quality even if there is no net nutrient retention by a storage compartment. For example organic nitrogen (NH_4^+ and NO_3^- forms) can deteriorate water quality by promoting algal blooms but other forms of nitrogen cannot be taken up by algae. Therefore the conversion of dissolved inorganic nitrogen to organic forms can imporve the water quality without any change in total nitrogen concentration.

Critical to efficiency of the internal recycling is the complying or compiling between detached algal photosynthesize and bacterial metabolism.

The rapid recycling of nutrients and gases within the periphyton complex is facilitated by the proximate juxtaposition of cells. Keeping in view the present study has been undertaken to lucidate the impact of alternations in physico-chemical properties of wetlands on the occurrence, density and abundance of phytoplankton in two different wetlands of Jaunpur district (U.P.).

The study area selected for the ecological study are two unmanaged (neglected) wetlands. These are Kunwarpur tal (Site I) and Gujar tal (Site II). The wetland area ranges between 24^0 6' -25^0 5' N and 80-82^0 E longitudes in tropical semi-arid regions of Jaunpur (Fig. 1).

Morphometry and Water Regime Pattern :

SITE I : It is nearly roundish, situated in Kunwarpur village at 35 km south west from Jaunpur city on both the sides of Jaunpur Allahabad metallic road (N.H. 6). It extends from 3 km Khakhopur to its South Moraun-Chittaun village covering an area of about 40 ha. The vegetation is occupied by marginal emergent periphyton submerged and free floating species. The depth rages from 0.3-2 m in December 2001-02. Its catchment area spread about over 2.5 km and it reaches about their maximum in rainy season and reduced to minimum in dry (summer) season. Soil type is clayey with enough minerals and less organic matter. The sampling was done at monthly intervals from July 2001-02 at different sampling stations.

(1) Moraun-chittaun (ii) Khakhopur (iii) Roadsides.

Site II : Approximately it is triangular in shape (Fig. 3) spread over an area about 100 ha[3]. The marginal emergent wet area occupying 30 ha[4] with spacing peripheral area. The wetland lies near Nauli village on the way (the road links Khetasarai to Khutahan) of Jaunpur district. The lake is in rural setup and surrounded by agrofields and located 27 km North from Jaunpur city and 2 km West from Khetasarai is about 30 km. The clayey soil with rich organic matter is responsible for its greater fertility than site I. The depth rages between 1-3.75 m^3.

The Climatic Conditions

The Jaunpur is situated in tropical semi-arid regions of India. The temperature ranges from 8.5°C-45.4°C to 9.3°C-48.5°C during July 2001 to June 2002. The average annual rainfall occurs 1240-1270 mm likewise humidity ranges from 66-93.78% in Ist and 6.94% in last annual session of the study.

Material and Methods

The Samples of water, phytoplanktons and macrophytes were periodically collected monthwise in triplicate from both the wethlands during July 2001 to June 2002 by distructive sampling method. The algae was identified upto the species level[5,6].

For the quantification of phytoplantkton and cell counts one litre water samples were fixed in the Lugol's iodine solution followed by 3% buffered formaldehyde and allowed sedimentation for 3 days. The plankton settled at the bottom was counted in Sedwick cell counter. About 1000 litre of water samples were filtered through a plankton net made up of bolting silk cloth No. 25. All the chemical analysis were done by adapting the methods given by Strickland and Persons[7]. The light penetration was measured by Secchi disc and the temperature was recorded by using a mercury celcius thermometer and DO, CO_2, pH salinity turbidity and nutrients. Na, K and Ca, N and P analysis were done in laboratory with suitable processes suggested by winklers iodometric method[8].

The pH was measured especially with Elico-digital pH meter, turbidity by Nephelometric turbidity unit (NTU) Systronics-make) conductivity (i.e. E.C:electrical conductivity).

Results and Discussion

The peak phytoplanktonic growth was attained during the post monsoonic subseason in periphytonic zone. The decline in algal population during the summer season reflected due to the high temperature and reduced water level in both the wetlands. The abundance of dominant species and increased pressure causes the decrease in phytoplanktonic growth. The enhancement in periphytic population may be attributed to the shade and increased turbidity and lesser light penetration of water.

In free floating *Azolla* and *Lemna* dominated in patches at site-I and *Eicchornia, Azolla and Salvinia* dominated in segments at site-II. Like this, in bottom rooted floating plants *Ipomea* and *Nymphaea* at site-I and *Nelumbo* and *Euryale* at site-II. Among submerged sps. *Aponogeton, Sangittaria* and *Vallisneria* are at site-I and *Hydrilla, Typha* and *Potamogeton* at site-II. Among emergent species *Scirpus, Marsilea* and *Cyperus* are at site-I while *Oryza, Phragmites* and *Saccharum* are at site II (Table 2).

It was observed that at site I temperature ranges between 19-32°C and 18-33°C, shows a seasonal cycle (Table 1).

Table 1. Ecovariability of water in two wetlands (Average of 3 Samples).

S.N.	Parameters	Annual Range	
		Site-I	**Site-II**
1.	pH – Water	5.26 to 6.59	7.18 to 7.75
	pH – Mud	6.0 to 7.16	7.32 to 7.69
2.	Temperature	19.32°C to 18-33°C	15-33°C to 13-30°C
3.	Light Penetration (cms)	41-60	35-54
4.	Total D.O.	1.3-13.4 mgl^{-1}	1.92-16.3 mgl^{-1}
5.	C.O.D.	15-85	20-95
6.	Total alkalinity Summer	27-189 ppm	29-178 ppm
7.	Winter	27-46 ppm	29-57 ppm
8.	Ammonia	0.28 - 1.06 mgl^{-1}	0.28 - 1.60 mgl^{-1}
9.	NO_3	0.78 - 2.96 mgl^{-1}	0.91 - 3.76 mgl^{-1}
10.	NO_2	0.00 - 0.08 mgl^{-1}	0.00 - 0.11 mgl^{-1}
11.	Inorganic-P	0.10 - 0.39 mgl^{-1}	0.12 - 0.48 mgl^{-1}
12.	H_2S	0.4 - 2.2 mgl^{-1}	1.1 - 4.0 mgl^{-1}
13.	Sulphate	13.6 - 31.3 mgl^{-1}	12.8 - 33.7 mgl^{-1}
14.	Calcium	1.4 - 9.2 mgl^{-1}	12.8 - 33.7 mgl^{-1}
15.	Cl	13.6 - 31.3 mgl^{-1}	11.0 - 22.0 mgl^{-1}
16.	Na	3.0 - 68.0 mgl^{-1}	2.5 - 57.8 mgl^{-1}
17.	K	1.0 - 8.0	1.0 - 7.0 mgl^{-1}

Table 2. Macrophytic composition of the two wetlands of Jaunpur.

S.N.	ZONATION IN WETLANDS	Site-I	Site-II
1.	Free-floating	*Azolla pinnata, Lemmna minor, L. perpusila, Spirodela polyrhiza, Salvinia*	*A. pinnata, Eichhornia Crassipes, L. minor, L. perpusila, Ottelia alismoides, Pistia stratiotes, Salvinia sps, S.polyrhiza. Trapa bispinosa. T. natans, Wolffia.*
2.	Bottom rooted-floating	*Ipomea aquatica, Nelumbo nucifera, Nymphaea nouchali*	*Euryale ferox, I. aquatica, Nelumbo nucifera, N. nouchali, Nymphoides hydrophila, Sesbania sesban*
3.	Submerged	*Aponogeton natans, Potamogeton crisspus, P. nodosuss, Sagittaria guayanesis, Vallisneria spiralis*	*A. natans, Ceratophyllum limmerssum. Hydrilla verticillata, Najas graminea, P. crisspus. P. nodossuss, S. guayanesis. Typha elephantica, Vallisneria spirallis*
4.	Emergent	*Scirpus lacustris, Oryza rufipogan Cyperus rotundus, C.iria, C.difformis, Ipomea aquatica, Scirpus articulatus, S. littoralis, S. lacustris and S.grossuss, T.latifolia*	*Typha angustata, C. rotundus C.iria, C difformis, Echinochloea colonum, E. crusgalli, Hygroryza aristata, Melochia corchorifolia, O. satiava, Paspalidium germinatum, Paspalum scorbiculatum, Phragmites karka, Sachharum spontaneum, Scripus grossus, Vetiveria zizaniodes*
5.	Littoral	*Marsilea minuta, Eleocharis dulcis, Ipomoea reptans, I.cornea, Limnophilla indica and Rumex dentatus.*	*Chenopodium ambroides, Colocasia esculanta, Eclipta prostrata, E. dulcis, Fimbristylis sps. I. reptans, I.cornea, Jussiaea reptans, Lindica, Marsilea minuta, Rumex, Rumex dentatus, Dicanthium annulatum*
6.	Shore Flora	*Anagallis arvensis, Commenlina benghalensis, Croton bomplandianum, Cyprus sps, Cyprus pangorei, Euphorbia sps. Mentha sps, Setaria vericillata*	*Achyranthes aspera, Amaranthus sps, Anagalis arvensis, Barringtonia acutangula, Commelina benghalensis, C. bomplandianum, Cyprus sps., Euphorbia sps., Mentha viridis, Ranunculus sps., Scleranthus sacchrum, Spontaneum sps., Scripus maritimus, Setaria glauca, S.intermedia, S. verticillata, Sporobolus diander*

Closely related to the site II as 15-33°C and 13-30°C, which is affected by enrichment of nutrient through rainy water and agricultural runoff wind force in land water flow, influx of the in shore water and atmosphere lake in western sector at site I is quite turbid in the summer due to strong westernly wind causing mixing of sediments from shallow bottom and during the monsoon due to inflow of silt laden rain water wind mixing probably rises in planktonic populations due to its greater turbidity than site II. The reason is that it is situated at a very busy Allahabad road, which adds particulate matter and traffic dust into it. Whereas site II is deeper and bigger in size situated in rural setup away from the road.

A relatively low transparency is obtained in the the months of October-November is attributed to the phytoplanktonic growth[9].

Table 3. Phytoplanktonic composition of two wetlands (average of 3 samples).

S.N.	CLASSES	SITE-I	SITE-II
1.	Cyanophyceae	*Anabaena, Aphanocapsa, Aphanothece, Cylindrospermum, Chroococus, Gloeocapsa, Nostoc, Nodularia, Oscillatoria, Phormidium, Rivularia sps.*	*Oscillatoria, Scytonema, Anabaena, Nostoc, Rivularia, Gloeocapsa, Gloeotrichia, etc.*
2.	Chlorophyceae	*Ulothrix, Spriogyra, Pithophora, Stigeoclonium, Cladophora, Stigonema, Fristcheilla, Tolypothrix, Microchaete, Lyngbya, Trentepohlia, Spirulina, Tetraspora, Hormidium, Chilorococcus, Volvox and Ankistodesmus*	*Pithophora, Coleochaete, Cladophora, Chlorococcum, Clostridium, Ulothrix and Spirogyra*
3.	Xanthophyceae	*Vaucheria*	*Vaucheria etc.*
4.	Bascillariophyta (Diatoms)	*Navicula, Frustulina and Asterionella*	*Pillularia, Navicula etc.*

The early part of monsoon due to higher water temperature and salinity caused by decomposition of organic detrites during that period[10].

This influxes of primary nutrient materials depend on inflow of allochthonous materials containing N,P and various salts, oxygen concentration and seasonal cycle of circulation and stagnation. These depends upon the depth turbidity, temperature, light penetration and size of the wetland.

The *Volvox, Pandorina* and diatoms may form the water blooms in patches for the short duration. The increased level of calcium, magnesium, sodium carbonate and bicarbonate contents of water also acts as growth enhancing factors thus fluctuation in biotic composition is deserved due to seasonal and spacial variation in hydrological nutrient composition of the wetlands.

N and P contents are rich in cyanophycean dominated wetlands and water is alkaline with pH 7.2 to 9.5 at temperature 25 to 30^{0}C.

As the level of nitrates and phosophates are low the phytoplanktonic population is high due to the nutrients being consumed and stored in organisms but the phytoplanktonic population declines through an accelerated death rates when the disintegration occures the elements released and their percentage chemical activity enhanced in the wetlands.

Nitrogen enters directly into phytoplanktonic cycle. Nitrogen content in turn is dependent upon several physical processes prevailing in and around the water body i.e. water runoff coming from agrofields in catchment areas.

It is obvious that oxygen is one of the primary limiting and determining factors in phytoplankton ecology as for all other forms of life is concerned. Because of their photosynthetic activities in day light or the practical independece of free oxygen in water when CO_2 is present in sufficient quantities and other factors are favourable.

Sarwar and Zutshi[11]. observed that periphytic growth on natural substances was maximum in lake from autumn to early spring and minimum during summer.

Along the different groups the maximum populations of green algae was recorded during winter and minimum during the summer seasons.

Kant and Kachroo[12] have observed the optimal grwoth conditions and better reproduction of green algae during

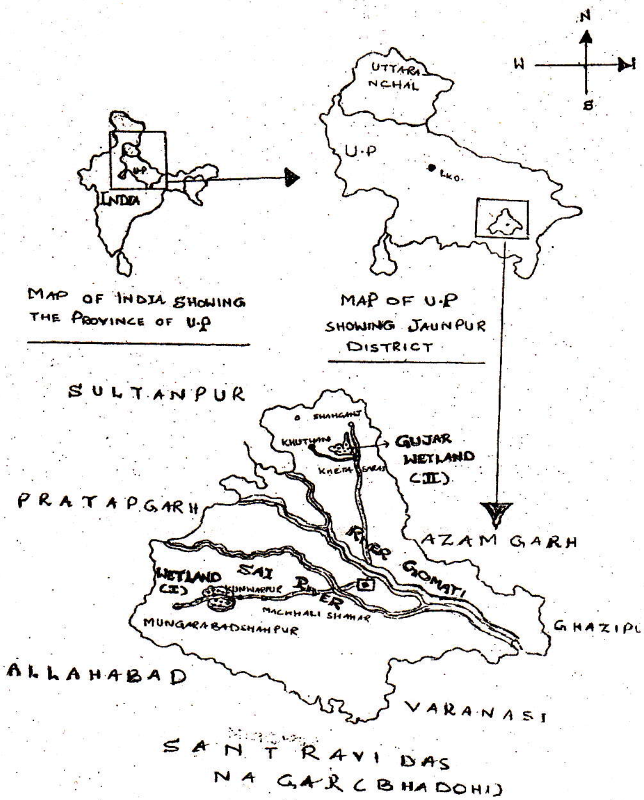

Fig. 1. Location Map of Jaunpur Showing Wetlandsites.

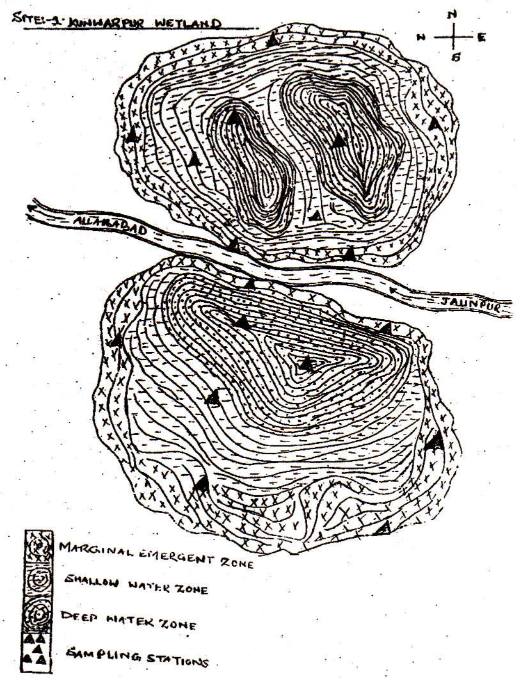

Fig. 2. Location Map of Kunwarpur Wetland (Total area = 40 ha.).

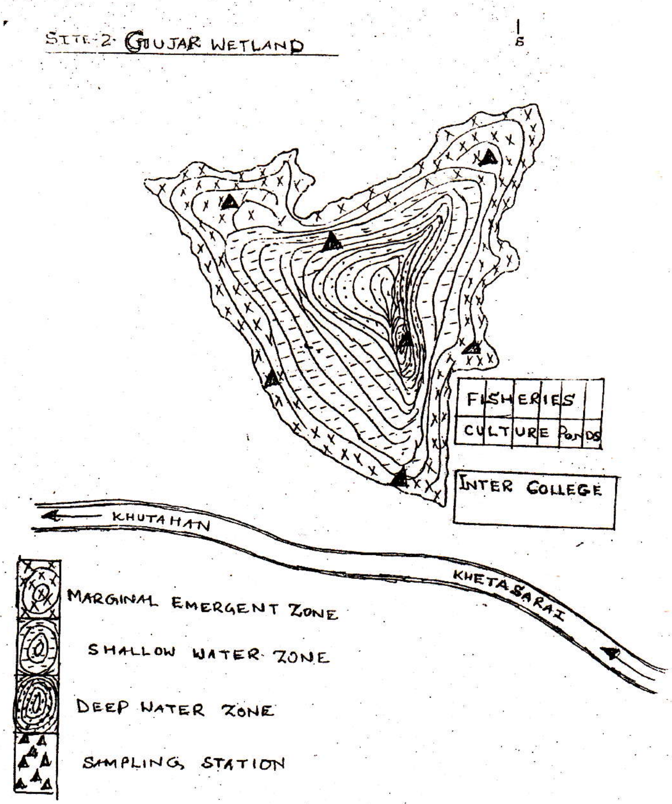

Fig. 3. Location of Gujar Wetland in Map (Total Area = About 100 ha.).

February.

Chlorococales dominated and Desmidiales were poorly represented indicating highly eutrophic conditions of the wetland. Green algae are very sensitive to population[13].

The maximum population of Bascillariophyceae was recorded during post monsoon and winter seasons. Philipose[14] reported diatomous growth peakes in winter and Philipose[14] and Kamat[15] have mentioned that the diatoms are usually abundent in slightly alkaline water.

Cyanophyceae exhibited maximum during the summer and minimum during the winter. Lin[16] has observed that relatively high summer water temperature favours the enhanced grwoth of blue green algae forming blooms resulting in the accumulation of high amount of organic matters.

Microcystis is an indicator of scum forming eutrophicating conditions. *Oscillatoria* and *Anabaena* shows their tolerance to high degree of pollution.

The reports of all above mentioned workers are in support of our findings and concluding remark is that the peak periphytonic growth occurs in the months of September and October and minimum in May and June and favours turbidity and shallwoness of water.

Among the phytoplanktons the chlorophycean populations are maximum in winter but January-February is the very suitable periods for their growth. While Diatoms are abundant in the months of November-December and favour alkaline water.

The maximum cyanophycean growths are met in the months of May-June and minimum in winter (Nov.-Jan.) and their bloom formation is favoured by high termepature and resulted high concentration of organic matter (Table 2 and 3). So, the high akalinity, turbidity, temperature and pH at site I favours the richness in phytoplankton (i.e. diversity) while the abundance of organic matter at site II shows the luxuriant growth of periphytic sps. (Marcophytic species).

Significant variations are marked in phytoplanktonic composition due to variation in locality situations, shape and size of two wetlands. The physico-chemical properties, fluctuations in environmental factors are also varied drastically. The main ecological variations influencing the growth and population of microphytes and periphytons are also marked.

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