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Phytoplankton diversity at Sen Pokhar of Nonihat, Dumka District, Jharkhand

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ABSTRACT

The present study on Sen Pokhar of Nonihat, located at a distance of 26 km from Dumka city of Jharkhand, was undertaken from April, 2010 to March, 2011 to study various physico-chemical parameters including plankton. In Sen Pokhar the largest class was Chlorophyceae, having largest number of genera. It had twelve genera and eighteen species. It was followed by Cyanophyceae with seven genera and eighteen species, Bacillariophyceae with six genera and nine species. Euglenieae with two genera and five species and Xanthophyceae formed the least represented group of phytoplankton.It had lowest one genus and one species.

Kewords: Phytoplankton, physico-chemical, planet, plankton, diversity.

INTRODUCTION

Water is the most common liquid on our planet, vital to all life forms. It is a universal solvent. No other liquid is comparable with water in this respect. It is the dispersion medium for all biochemical reactions of the living process and takes part in many of these reactions. In spite of the chemical simplicity of the water molecule, its physical properties are quite remarkable -- one might say weird! Because of its solvent property, water contains several minerals salts and gases. Water is the only appropriate solvent for solutes required by the living beings. Water is used in varied way by man like cooking, drinking, bathing, disposal of sewage, irrigation and generation of electricity, cooling and manufacturing different products and for the disposal of industrial waste. During all these processes the undesirable substances are added to the water sources to such an extent that 70% streams and ponds in India contain polluted water.

Physico-Chemical analysis shows the changes in different parameters and their influence on biological qualities of the aquatic system at different levels. The development and functioning of freshwater ecosystem is largely regulated by the physico-chemical factors of water, some important contributions on physico-chemical properties of India are made by Bharti and Krishnamurthy (1990), Ghosh (1991), Munshi and Munshi (1995), Sahu *et al.,* (1995), Kumar (1996), Chandra etal (1996), Kumar and Siddiqui (1997), Chakraborty (1998), Kumar and Bohra (2000), Devi and Sharma (2002), Panigrahi etal (2003), Patralekh (2004), Sinha(2007) and Kumar(2008).

Aquatic ecosystem especially, fresh water lentic ecosystems are very rich in aquatic flora and fauna. They contain a variety of micro and macro organisms. Among them plankton are most important. Victor Henson (1887) for the first time used the term plankton for the heterogeneous assemblage of suspended microscopic materials, minute organisms and detritus of water, which wonder on the mercy of air current and tides. Later Welch (1953) suggested the use of this term only for the microscopic free floating organisms. These organisms are further divided into phytoplankton and zooplankton.

Phytoplankton are autotrophic organisms mainly consisting of plants, whereas, zooplankton are heterotrophic animals.

Phytoplankton are the microscopic plants whose movement depend upon the movement of water and wind current. Phytoplankton are the main micro producers, having photosynthetic pigment chlorophyll. They are unique in preparing organic matter by utilizing inorganic compounds (CO_2 and H_2O) with the help of solar energy. They are the main biotic component of an aquatic ecosystem, which not only participate in energy flow but also, provide the basic food to fishes and other aquatic organisms. The phytoplanktonic analysis of Sen Pokhar of Nonihat, Dumka during the one year of investigation showed that, there were altogether five classes of algae. These algae are main constituents of biological parameter of this pond and also are main producers of this pond. These are responsible for algal bloom. It was found that the number and type of species varied from month to month and season to season. In Sen Pokhar phytoplankton were represented by five classes – Cyanophyceae, Chlorophyceae, Xanthophyceae, Euglenieae and Bacillariophyceae. In Sen Pokhar the largest class was Chlorophyceae, having largest number of genera. It had twelve genera and eighteen species. It was followed by Cyanophyceae with seven genera and eighteen species, Bacillariophyceae with six genera and nine species. Euglenieae with two genera and five species and Xanthophyceae had lowest one genus and one species. The objective of the present work is to study variousphysico-chemical characteristics in relation to phytoplanktondiversity which would help in assessing the trophicstatus of this pond. The data obtained would also help inantipollution conservation or conservation strategies inaddition to formulating the diversity of the lake.

METHODOLOGY:

Phytoplankton samples were collected at regular monthly intervals by filtering 85 liters of water with plankton net of bottling silk having 75 meshes per linear centimeter. Samples were preserved in 4% formalin for laboratory analysis. Micro transect method of Lackey (1938), modified by Edmondson (1974) was followed for the counting of numbers of phytoplankton. Following formula was used in its calculation. Subsequently the individual per liter of water were calculated by the formula of Welch (1948) as-

$$\text{No of phytoplankton} = \frac{\text{Area of cover glass x Individual count record per transect}}{\text{Area of transect}}$$

For counting individuals per liter of water method, described by Welch (1948) was followed -

$$N = \frac{(a - 1000) \times C}{L}$$

Where,

N = number of phytoplankton per liter.

a = average no. of phytoplankton in all counts in one cubic millimeter.

C = volume of original concentrate in milliliter.

L = volume of original water filtered expressed in liter.

Since, in the present study the number of individuals was counted in one cubic centimeter (c.c.) the formula is changed to

$$n = \frac{a \times C}{L}$$

IDENTIFICATION OF PHYTOPLANKTON

Phytoplankton were identified with the help of relevant monographs and literature of West and West (1907), Fritsch (1935), Krishnamurthy (1954), Gandhi (1958, 1959 a, 1960, b), Desikachary (1959), Venkataraman (1959), Randhawa (1959), Bharadwaja (1963) etc. phytoplankton were identified upto species level.

RESULTS AND DISCUSSION

Among members of Chlorophyceae the most dominant genus was Ulothrix. It had 222 populations in 2010-11 which was 13.26% of total population of green algae. Spirogyra was followed by Spirogyra. Its total population was 217 which were 12.96% of total opulation of green algae for entire study period. Oedogonium occupied third rank in population among green algae. It had total 194 population which was 11.59% of total green algae. Oedogonium was followed by Scendesmus with 178 population,Volvox with 162 population, Euderina with 161 population, Pediastrum with 146 population, Zygnema with 141 population, Chlorella with 95 population, Microspora with 90 population, Cladophora with 37 population, Cosmarium with 31 population while, most poorly populated genus which was 1.85% of total population of green algae during the period of investigation.

Among member of Cyanophyceae the most dominant genus was Ocillatoria it had 289 populations which was, 26.51% of total population of blue green algae during study period. It was followed by Anabeana with 246 population and 22.57%,Microcystis with 186 population and 17.06%, Nostoc with 178 population and 16.33%, Rivularia83 population and 7.61%, Gleotrichia with 67 population and 6.15%, while lowest population was of Gleocapsa with 41 populations and 3.76% of total population of blue green algae.

Among class Bacillariophyceae the most dominant genus was Navicula. It showed 183 populations which was 32.11% of total population of Diatoms during study period. Navicula was followed by Synedra with a total 175 population which was 30.70%, Cymbella68 population which was 11.93%, Melosira with 65 population which was 11.40%, Pinnularia with 64 population which was 11.32%, while, Cyclotella had lowest 15 population which was 2.63% of total population of Diatoms during the entire period of investigation. Among Euglenieae the most populated genus was Euglena. Its population was 109 during the study period. Phacus was most poorly populated genus. Its population was 82 during the study period.

Xanthophyceae was represented by its one genus Ophiocytium. Its population was 30 during the study period.

Table 1. Phytoplankton diversity

A. CLASS - CYANOPHYCEAE			
No	**GENUS**		**SPECIES**
1	Microcystis	1	*M. robusta*
		2	*M. aeruginosa*
		3	*M. sp.*
2	Gleocapsa	1	*G. compacta*
		2	*G. magma*
3	Oscillatoria	1	*O. princeps*
		2	*O. laete-virens*
		3	*O. rubescens*
		4	*O. sp.*
4	Nostoc	1	*N. linkia*
		2	*N. carneum*
		3	*N. hatei*
5	Anabeana	1	*A. spiroides*
		2	*A. vaginicola*
		3	*A. volzii*
6	Geleotrichia	1	*G.natans*
7	Rivularia	1	*R. aquatica*
		2	*R. gigantea*
B. CLASS - CHLOROPHYCEAE			
1	Euderina	1	*E. sp.*
2	Volvox	1	*V. sp.*
3	Pediastrum	1	*P. duplex*
		2	*P. tetras*
4	Chlorella	1	*C. vulgaris*
5	Actinastrum	1	*A. sp.*
6	Coelastruum	1	*C. microsporium*
7	Scendesmus	1	*S. dimorphus*
		2	*S. quidricauda*

8	Dictyosphaerium	8	*D. pulchellum*
9	Microspora	9	*M. indica*
10	Spirogyra	10	*S. gallica*
			S. sahnii
			S. sp.
11	Mougeotia	11	*M. transeque*
			M. gelatinosa
			M. sp.
12	Cosmarium	12	*C. javanicum*
C. CLASS - XANTHOPHYCEAE			
1	Ophiocytium	1	*capitatum*
D. CLASS - EUGLENIEAE			
1	Ophiocytium	1	*P. mesonpochmann*
		2	*P. anomala*
		3	*P. curvicauda*
2	Euglena	1	*E. oxyuris*
		2	*E. polymorpha*
E. CLASS - BACILLARIOPHYCEAE			
1	Melosira	1	*M. granulata*
2	Cyclotella	1	*C. glomerata*
3	Synedra	1	*S. ulna*
		2	*S. sp.*
4	Navicula	1	*N. laterostrata*
		2	*N. radiosa*
		3	*N. sp.*
5	Pinnularia	1	*P. conica*
6	Cymbella	1	*C. fugarica*

Table 2. Monthly variations in population density (No./ml) of Phytoplankton at Sen Pokhar of Nonihat, Dumka from April 2010 to March 2011.

CYANOPHYCEAE

GENUS	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Microcystis sp.	36	43	18	9	7	5	6	7	9	8	17	21
Gleocapsa sp.	8	10	3	2	0	0	2	1	2	3	4	6
Oscillatoria sp.	45	58	30	11	6	4	8	15	17	25	30	40
Nostoc sp.	29	40	14	7	3	5	9	7	12	15	16	21
Anabeana sp.	39	40	13	9	6	8	10	17	19	21	29	35
Gleotrichia sp.	10	11	8	4	4	3	5	5	3	3	4	7
Rivularia sp.	11	17	9	5	5	3	4	4	5	5	6	9

CHLOROPHYCEAE

GENUS	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Euderina sp.	23	34	9	5	3	4	5	15	11	15	16	21
Volvox sp.	21	28	15	9	6	5	7	10	12	13	17	19
Pediastrum sp.	28	42	3	2	1	0	2	7	9	16	17	19
Chlorella sp.	17	20	5	3	1	0	3	7	6	9	10	14
Scendesmus sp.	29	42	14	7	4	4	10	11	2	15	19	21
Ulothrix sp.	35	51	18	7	5	2	5	13	15	19	24	28
Microspora sp.	15	17	8	4	3	2	3	7	5	6	9	11
Cladophora sp.	6	7	6	3	3	2	1	0	2	2	2	31
Oedogonium sp.	22	27	31	20	12	13	15	10	6	7	12	9
Spirogyra sp.	30	50	42	21	11	7	6	6	5	9	11	19
Zygnema sp.	17	21	30	22	11	7	4	4	3	4	7	11
Cosmarium sp.	3	3	5	6	3	2	3	2	0	0	2	2

BACILLARIOPHYCEAE

GENUS	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Melosira sp.	9	16	2	7	1	0	3	3	6	4	6	8
Cyclotella sp.	1	1	0	0	0	1	1	1	1	2	4	3
Synedra sp.	26	20	12	8	7	6	12	10	13	18	20	23
Navicula sp.	22	19	13	7	9	8	13	12	15	20	20	25
Pinnularia sp.	13	15	7	2	1	0	2	3	3	3	5	10
Cymbella sp.	9	12	5	4	3	3	5	7	4	5	4	7

EUGLENIEAE

GENUS	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Phacus sp.	11	12	20	9	6	3	5	2	1	2	3	8
Euglena sp.	13	18	12	19	10	5	3	2	3	5	7	12

XANTHOPHYCEAE

GENUS	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Ophiocytium sp	4	6	3	0	2	1	1	2	1	0	3	4

Biological parameters are the mirror of ecological status of aquatic ecosystem. During early phase of limnobiology stress was given only to analyze physico-chemical aspects and the biological and productivity aspects were totally neglected. Later, the importance of biological aspect of aquatic ecosystem was recognized, as result biological aspects became the integral part of limnobiotic studies.

Biological parameters denote the health of aquatic ecosystem and also serve as a tool to assess the effect of physico-chemical factors and pollutants on these biological factors which is directly related to productivity of the aquatic system. The biological parameters act as valuable tool for the assessment of quality of water and water pollution.

Aquatic ecosystem especially, fresh water lentic ecosystems are very rich in aquatic flora and fauna. They contain a variety of micro and macro organisms. Among them plankton are most important. Victor Henson (1887) for the first time used the term plankton for the heterogeneous assemblage of suspended microscopic organisms and detritus of water, which wonder on the mercy of air current and tides. Later, Welch (1953) suggested using this term only for the microscopic free floating organisms. These organisms are further divided into phytoplankton and zooplankton. Phytoplankton are autotrophic organisms mainly consisting of plants, whereas, zooplankton are heterotrophic animals. Periphytons are also very important biological factors of aquatic ecosystem. They are important contributors of productivity of water bodies. They may be micro or macrophyte and found suspended, submerged or attached submerged to any solid submerged substrate.

Phytoplankton are most important biological indicators of the pollution status of the water bodies, they also indicate the productivity of water bodies. These are main constituent of biological parameters and are main producers of the pond. These are responsible for algal bloom.

The phytoplanktonic analysis of Sen Pokhar of Nonihat, Dumka during the study period of investigation showed that, a large number of phytoplankton were present throughout the year while, some were present in particular season. Seasonality in phytoplankton may be due to their short life span, and specific pattern of life cycle. It was found that the number and types of species, varied from month to month and season to season. In Sen Pokhar of Nonihat, Dumka phytoplankton were

represented by five classes – Cyanophyceae, Chlorophyceae, Xanthophyceae, Euglenieae and Bacillariophyceae. In this pond, the largest class was Chlorophyceae, having largest number of genera. It had twelve genera and eighteen species. It was followed by Cyanophyceae with seven genera and eighteen species, Bacillariophyceae with six genera and nine species. Euglenieae with two genera and five species and Xanthophyceae had lowest one genus and one species. This shows the wide range of adaptability in the members of Chlorophyceae and Cyanophyceae. These findings are similar to the findings of Saha (1985), Singh (1991), Khare (1998), Prasad etal (2001), Patralekh (2004), Sinha (2007) and Kumar (2008).

In the present investigation, phytoplankton community consisted of altogether 28 genera and 51 species. This finding is similar to the findings of Rutner (1952), George (1966), Pant etal (1985), Hegde and Bharti (1985), and Kumar (2008).

During the present study the population density of phytoplankton was highest during summer (May) and lowest during rainy season (September). This finding is contrary to the findings of Singh (1991) and Khare (1998) but, very much similar to the findings of Moitra and Bhattacharya (1965), Vashist (1968), Jana (1976), Patralekh (2004), Sinha (2007) and Kumar (2008).

In the present investigation different groups of phytoplankton showed different population density in different season. The member of class Chlorophyceae, Cyanophyceae, Bacillariophyceae and Xanthophyceae showed their maxima during the summer (May), while, members of class Euglenieae showed their maxima in rainy (July). Abundance of Chlorophyceae during the summer month has also been reported by Vashist (1968), Singh (1991), Khare (1998) and Patralekh (2004). The population of Chlorophyceae in summer season may be due to the high tolerance of Chlorophyceae for high water temperature, high salt concentration, high pH and high light intensities. This view is also supported by the findings of Singh and Srivastava (1991), Khare (1998), Pandit (1998), Mishra and Prasad (2000), Patralekh (2004), Sinha (2007) and Kumar (2008). Members of Chlorophyceae showed one annual peak of the year. This peak might be due to the enrichment of water with inorganic and organic matter during pre and post monsoon season. Members of Cyanophyceae, Bacillariophyceae and Xanthophyceae showed similar pattern of population density to that of the Chlorophyceae. They showed only one peak annually. They showed their maximum population density in May. This might be due to their tolerance for high water temperature, high pH, high light intensity and high value of transparency. This finding is supported by the findings of George (1966), Munawar (1974), Rai (1978), Jana etal (1980), Saify (1981), Singh (1990), Pandey etal (1993), Khare (1998), Prasad (2000), Patralekh (2004), Sinha (2007) and Kumar (2008).

Members of class Euglenineae showed their maximum population density during the rainy season. They showed only one peak annually. This finding is similar to the findings of Gonzalves and Joshi (1946), and Bharti and Hosmani (1973), but, contrary to the findings of Singh and Ahmed (1990), and Prasad (2001). Their high value in rainy season may be due to the presence of high concentration of organic matter and low turbidity.

Among the members of class Chlorophyceae Spirogyra sp, Scendesmus sp. and Eudorina sp. were dominant species. Oscillatoria spp. Anabeana spp. and Nostoc spp. were dominant species among blue green algae. Navicula sp. Synedra sp. and Cymbella sp. were dominant among diatoms, while, Euglena sp. was dominant among Euglenineae. Among all phytoplankton the most dominant sp. was Oscillatoria sp fallowed by Anabeana sp. and Spirogyra sp. This might be due to their tolerant nature and ability to grow in wide range of limnetic conditions.

Phytoplankton showed positive co-relation with almost all parameters considered for this study. They showed negative co-relation with total solid, carbonate alkalinity, dissolved Oxygen, free CO_2, BOD and NPP. Statistical data computed at P = 0.05 (5% level), showed positive significance with almost all

parameters considered for this study except, total solid, carbonate alkalinity, dissolved Oxygen, free CO_2, BOD and NPP.

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