UTTAR PRADESH JOURNAL OF ZOOLOGY

41(15): 52-61, 2020
ISSN: 0256-971X (P)

DIVERSITY OF PHYTOPLANKTONS & ZOOPLANKTONS IN SURYAPOKHRA POND (MANPUR, GAYA, INDIA) IN RELATION TO FISH CULTURE *Labeo rohita* & *Clarias batrachus*

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AUTHORS' CONTRIBUTIONS
This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

Editor(s):
(1) Dr. Telat Yanik, Professor, Atatürk University, Turkey.
Reviewers:
(1) Daniel Pereira da Costa, Universidade do Estado do Amapá, Brazil.
(2) Mirna Dwirastina, Marine and Fisheries Ministry, Indonesia.

Received: 20 August 2020
Accepted: 27 October 2020
Published: 28 October 2020

Original Research Article

ABSTRACT

Background: In Suryapokhra Pond, there is abundances of Phytoplanktons, Zooplanktons and fresh water fishes like *Labeo rohita* and *Clarias batrachus.*
Phytoplanktons are best studied aquatic autotrophs. Four groups of algal classes of the pond Suryapokhra Gaya, namely Chlorophyceae, Cyanophyceae, bacillariophyceae and Charophyceae were studied. Chlorophyceae genera were minimum as 5 in June while maximum was 12 in December to March. Cyanophyceae genera were minimum as4 in June while maximum was 10 in December to Feb and May 2019. Bacilariophyceae genera were minimum as 4 in June & July while maximum was 7 in March & April and Charphyceae genera were minimum as 2 in May & July while maximum was 3 in rest of months. There percentage share with the population were 60, 31, 07 and 02 respectively.
Objectives: A proper statistical analysis (Correlation with species and ecological factors) has been done which supports the species diversity and condition factors of fish species.
The diurnal variation of planktonic production, movement of organism and other related studies with relation to changes in physico – chemical factor in freshwater bodies in tropical regions have received even lesser attention. Only a few contributins are available in case of fresh water pond and reservoirs. Notables among them are Ganapati 1995), who made several contributions reganding the diurnal fluctuation of plankton in the freshwater pond and reservoirs of south India.
Results: Various ecological factors show positive and negative correlation with phytoplanktons and Zoo planktons. Various indices are important factors which show the condition factor of fish species.

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Conclusion: In the present investigation, attempt has been made to study the planktons production and their abundance in pond. The diversity of planktons controls fish species which are influenced by hydrobiological parameters. This is shown by statistical analysis.

Keywords: Diurnal fluctuation; locomotion; plankton; physico – chemical; reservoir.

1. INTRODUCTION

The plankton includes all such aquatic organisms which drift passively or whose powers of locomotion are in sufficient to enable them to move, contrary to the motion of their inhabited water mass [1].

By definition, the plankton includes all those organisms suspended in the free water. Biological tissues are denser than the water and hence only particles with large surface areas in relation to their volumes, and with slow sinking speeds are likely to remain suspended. Most organisms belonging to the planktonic community will be small, although their size is variable. Primary producers, primary and secondary consumers and decomposer organisms, are all represented in the plankton, [2] although it is the photosynthetic primary producers which are especially significant in the ecology of many aquatic habitats [3].

While observing at the bottom level of food chain, phytoplanktons bear a significant place in terms of their importance in hydrobiology. These are also related with other organisms at top levels.

Aquatic habitat in which water is the principal as well as internal medium, Fresh water habitat can be categorized into two types, one is the lentic or standing water, which include pond, lake, swamp or bog and other one is the lotic water or running water, which includes spring, stream or river [4], without water, there would not only be no ponds/ lakes, rivers and wetlands but also no life on earth, because both photosynthesis and animal metabolism depend on the availability of water. Its extra ordinary properties allow it to take part in and mediate the multitude of physical demand interactions in soil, aquatic sediments and water that allows life with in it [5]. As water falls from atmosphere to the land and enters the soil, it undergoes chemical reactions with soils and rocks that profoundly modify its composition. When water leaves the soil for rivers, ponds lakes and wetlands its new composition has a major effect on the abundance of the biota, its community structure and productivity [6]. The evaporative loss of water, not only returns water to the atmosphere but affects concentration and composition of the remaining water and thus its suitability to the biota, in turn, the water affects of condensation and evaporation on the temperature of aquatic system and the surrounding land [7].

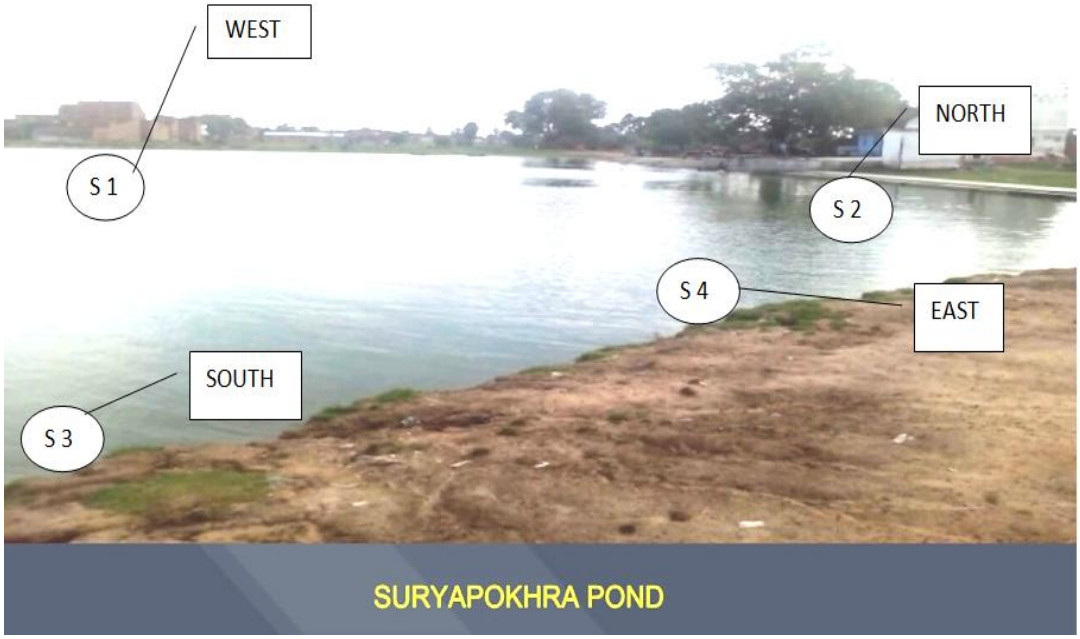


Fig. 1. Study area with 4 stations of different directions

The biological involvement of water body has mainly been focused by studying planktonic flora. This concept was highlighted by Forbes [8] and Lindeman (1942). Reports have been published for various parts of the continent which summarises the importance of algae and other interference organisms in water supplies and to water quality. The region that have been covered include New England [9], the Chespeak area (Palmer, 1958b), Indiana [10] Ohio(Palmer, 1962) Pennyslvania (Palmer, 1967a), Virginia(Palmer, 1957) California (Palmer, 1951) and south Central United States (Palmer,) 1960). Transeau (1951) studied Spirogyra species, Hustedt (1930) studied Navicula, Gojdies (1953) studied species of Euglena. Taylor (1955) studied resevoris of Metropolitanwater board and Williams (1963) studied the population dynamics of plankton. Several helpful books have been published giving list, keys description and illustration of algal forms. Examples of these are the Algae of IIIinois by Tiffany and Britton (1952), Algae of Tennessee by Forest (1954), Algae of West Great Lakes Area Prescott (1951), and the Algae of United States by Smith (1950).

2. MATERIALS AND METHODS

2.1 Study Area

Photoplanktons were collected from four different stations of Suryapokhra Pond, Manpur(Gaya). It is indicated in Fig. 1 and collected by east, west, north and southern part of the pond. These were collected by bolting silk plankton net of 77 mesh per square cm.

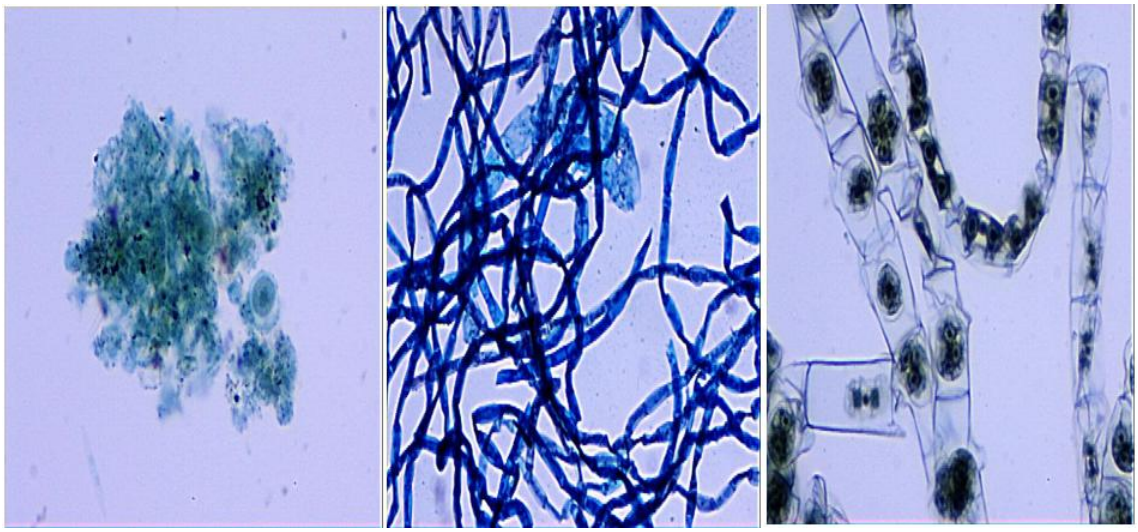
Zooplakton population were typically represented by Rhizopoda, rotifer, Cladocera, Copepoda, Ostracoda, Euglenophyta and some larval forms of higher insects.

The sample amount was taken as small enough in volume so that it may be convenient to transport. The sample was taken as a representative of all materials being sampled in the ecosystem. Variability with respect to time, area and depth was maintained. Utmost care was taken to minimize the quanta of bio-deterioration or contamination in the sample. Homogeneity in the sample was observed. Identification of various phytoplanktonic genera was made with the help of various keys and guidelines for identification (Ward and Wipple, 1959). The count was done with the help of Sedgwick Rafter counting chamber by using microscope. The sample was subjected to centrifugation with the help of Centrifuge (Remi type R-24) at 3000 R.P.M. for 20 minutes, supernatant fluid was decanted and the concentrate was thoroughly mixed and was transferred to a clean grease free microscopic slide and covered with a coverslip. The formula used for calculation of phytoplankton units, L^{-1} is mentioned below.

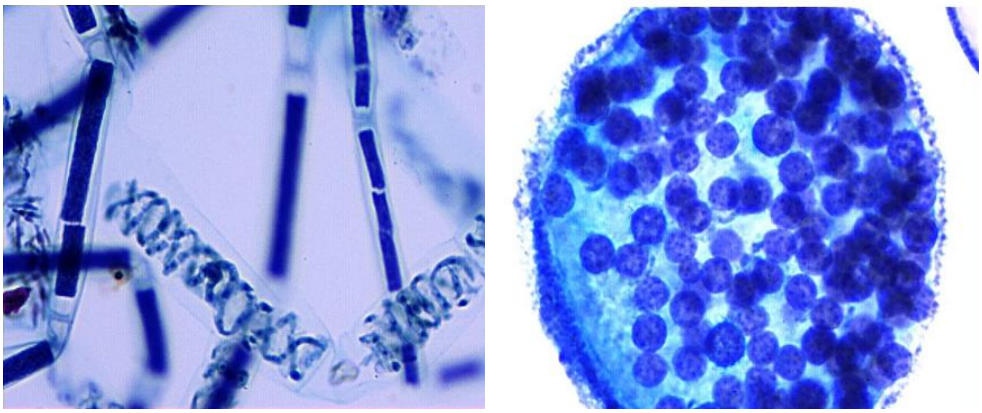
n- (ax1000) C (Welch, 1948)

Wheren =No of Plankton per litre of water
A = Average number of Plankton in me of sample
C = No of Plankton concentrate (20 ml)

Identification of the phytoplankton was done upto genera level with the help of standard keys and books (Palmer, 1980), Prescott (1938, 1981a, b), Smith (1950), APHA(1989)[11]



Diatoms **Mixed Algae** **Oscillatoria**



Spirogyra **Volvox**

Fig. 2. Picture of some phytoplanktons in Suryapokhra Pond (Micropholograph)

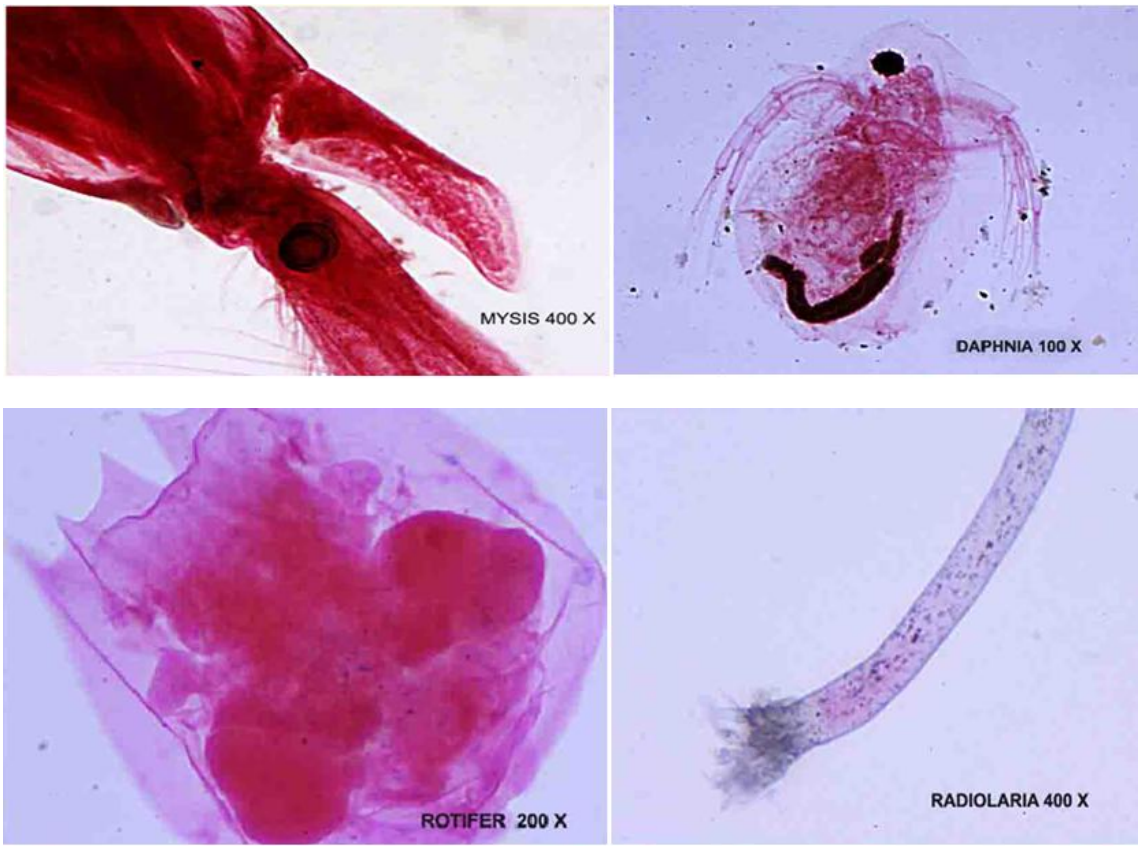


Fig. 3. Picture of Zooplaktons in the pond

Observations

Table 1. Phytoplanktonic abundance in Suryapokhra Pond during 2018-19

CHLOROPHYCEAE

		1 June	2 July	3 Aug.	4 Sept.	5 Oct.	6 Nov.	7 Dec.	8 Jan.	9 Feb.	10 Mar.	11 Apr.	12 May	Occurance in a year
1.	Chlamydomonas	+	+	+	+	+	+	+	+	+	+	+	+	12
2.	Botriococcus	+	-	+	+	+	+	+	+	+	+	+	+	11
3.	Telraspora	+	-	+	+	+	+	+	+	+	+	+	+	11
4.	Lepocinclis	-	+	+	+	+	+	+	+	+	+	+	+	11
5.	Oedogonium	+	+	+	+	+	+	+	+	+	+	+	+	12
6.	Spirogyra	-	+	+	+	+	+	+	+	+	+	+	+	11
7.	Ulothrix	+	+	+	+	+	+	+	+	+	+	+	+	12
8.	Hydrodictyon	-	+	+	+	+	+	+	+	+	+	+	+	11
9.	Palemella	-	+	+	+	+	+	+	+	+	+	+	-	10
10.	Zygnema	-	+	+	+	+	+	+	+	+	+	+	-	10
11.	Cladophora	-	+	-	+	-	-	+	+	+	+	-	-	06
12.	Pediastrum	-	+	+	-	-	-	+	+	+	+	-	-	06
Total Genera in month.		05	10	11	11	10	10	12	12	12	12	10	08	123

CYANOPHYCEAE

	1	2	3	4	5	6	7	8	9	10	11	12	Occurance in a year
1. Agmenellum	-	-	-	-	+	+	+	+	+	+	+	+	08
2. Arthrospira	-	-	-	+	+	+	+	+	+	+	+	+	09
3. Oscillatorla	-	-	-	+	+	+	+	+	+	+	+	+	09
4. Nostoc	-	-	+	+	+	+	+	+	+	+	+	+	10
5. Rivularia	-	+	+	+	+	+	+	+	+	+	+	+	11
6. Microystis	+	+	+	+	+	+	+	+	+	+	+	+	12
7. Anabaena	+	+	+	+	+	+	+	+	+	+	+	+	12
8. Nadularia	+	+	+	+	+	+	+	+	+	-	+	+	11
9. Aphanocapsa	+	+	+	+	+	-	+	+	+	-	+	+	10
Total Genera in month.	04	05	06	08	09	08	09	09	09	07	09	09	92

Bacillariophyceae	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Occurance in a year**
1. Dialoma	+	+	+	+	+	+	+	+	+	+	+	+	12
2. Synedra	+	+	+	+	+	+	+	+	+	+	+	+	12
3. Cymbella	+	+	+	+	+	+	+	+	+	+	+	+	12
4. Nizschia	+	+	+	+	+	+	+	+	+	+	+	+	12
5. Navicula	-	-	+	+	+	+	+	+	+	+	+	+	10
6. Gyrosigme	-	-	-	-	+	+	+	-	+	+	+	-	6
Total Genera in month.	04	04	05	05	06	05	06	06	06	06	06	05	64

Charophyceae

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**Occurance in a year**
1. Chara Valgaris	+	+	+	+	+	+	+	+	+	+	+	+	12
2. Zygnema	+	+	+	+	-	-	+	+	+	+	+	+	10
3. Niella	+	+	+	+	-	-	+	+	+	+	+	+	10
Total Genera in month.	03	03	03	03	01	01	03	03	03	03	03	03	32

Table 2. Phytoplanktonic populations in Suryapokhra Pond during 2018-19

	Chlorophyceae		Bacillariophyceae		Cyanophyceae		Charophyceae	
	Total Genera L'	Total 'Species L'	Total Genera L'	Total 'Species L'	Total Genera L'	Total 'Species L'	Total Genera L'	Total 'Species L'
June	5	830	4	488	4	67	2	18
July	10	615	4	215	5	70	2	15
Aug.	11	304	5	135	6	21	3	25
Sep.	11	290	5	210	8	93	2	10
Oct.	11	255	5	103	7	86	3	8
Nov.	11	232	5	85	8	103	3	12
Dec.	12	410	5	50	10	44	3	16
Jan.	12	630	5	315	10	77	2	28
Feb.	12	890	5	390	10	68	3	52
Mar.	12	1265	6	980	8	117	3	38
Apr.	11	1220	6	730	9	108	3	42
May	11	1185	5	415	10	67	2	33

Table 3. Monthly variations in the zooplankton (UTIT/L) of Suryapokhra pond (Groupwise)

	2018							2019					
	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	S.D
ROTIFRA	260	230	180	210	110	85	140	180	275	305	290	210	70.5216
CLADOCERA	65	45	29	78	33	48	77	110	30	30	14	16	29.0719
COPEPODA	5	9	5	3	3	4	2	3	4	4	3	2	1.88092
OSTARACODA			3	2	2	2	3					4	0.8165
TOTAL	330	284	217	293	148	139	222	293	309	339	307	232	67.26

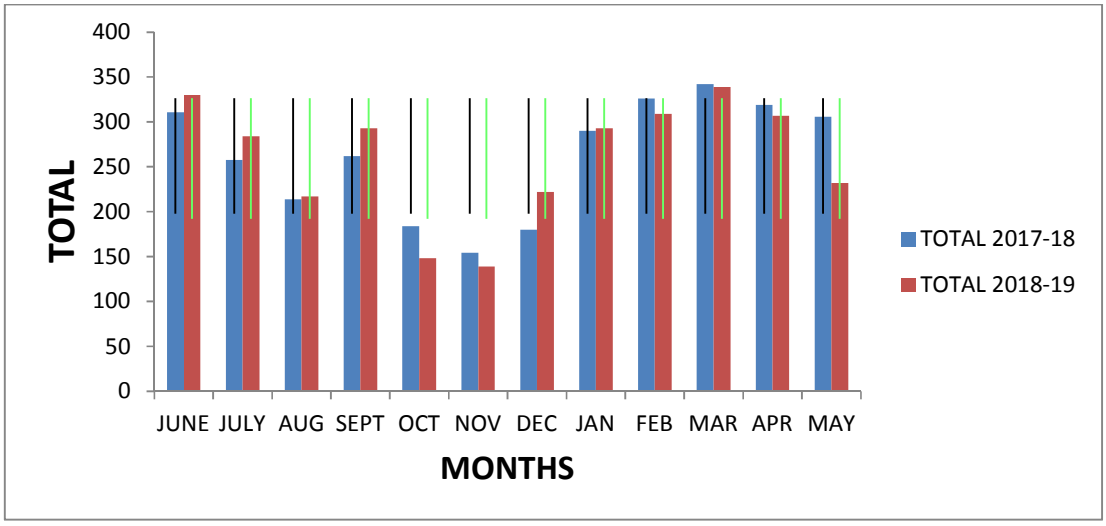
Table 4. Correlation between physico-chemical parameters and various phytoplanktons group

Parameters	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Charophyceae
Depth	0.15	-0.21	-0.18	-0.09
Transparency	-0.11	-0.03	-0.04	-0.02
Air Temp.	-0.85	-0.81	0.52	-0.32
Water Temp.	-0.77	-0.72	0.68	-0.22
pH	0.42	0.33	-0.18	-0.15
Carbonates	-0.32	-0.18	0.25	0.32
Bicarbonates	0.32	0.38	0.05	0.06
DO	0.65	0.62	-0.38	-0.22
Chloride	0.55	0.42	-0.31	-0.18
Calcium	0.26	0.12	-0.33	-0.19
Phosphate	-0.73	-0.55	0.62	-0.33
Nitrate	0.52	0.23	-0.13	-0.25

Table 5. Annual variations of phytoplanktons and biodiversity index of S1,S2,S3 & S4 of the pond

Diversity Indices	Index	S-1	S-2	S-3	S-4
Species richness	(No.)	22	24	20	26
	R1	2.23	2.16	2.12	2.21
	R2	0.26	0.23	0.28	0.22
Species diversity	I	0.14	0.18	0.15	0.20
	H	2.62	2.52	2.58	2.42
Species evenness	E	0.96	0.92	0.88	0.83
Dominance	D	0.83	0.82	0.81	0.75

No = No. of species, R1 – Margalef's Index, R2 = Menhinick index
I = Simpson Index, H= Shannon – Weiner Index, E= Equitability index
D = Dominance index



Graph 1. Monthly variations in zooplantkton (UNIT/L) of suryapokhra pond

2.2 Condition Factor of Fresh Water Fishes

The weight-length relationship was carefully compared which varies from time to time during the same year. Minor variations are of course insignificant. Relating to these factors, there are four important periods during the year, that is the winter, pre-monsoon, monsoon and the post – monsoon periods.

In the winter and pre-monsoon periods the condition factor is high. In the monsoon period the value declines mainly due to spawning activities of fishes. During the post-monsoon period this value again increases because of increasing feeding activities. The length-weight relationship has calculated by the following formula:-

$$K = \frac{w\ X\ 100000}{L^3}$$

Where W is weight in gram
L is length in mm
And K is constant.

(1) *Labeo rohita* – It is commonly known as rohu in Hindi. Body is compressed and fusiform. There is abundance of this species in Suryapokhra Pond.

(2) *Clarias batrachus* - Body is oblong and compressed. Upper jaw is longer than the lower. Head is depressed. Caudal fin is free. Color is brownish black.
There are positive correlations observed with presence of bony fishes and plankton population.

3. RESULTS AND DISCUSSION

With reference to the relative effect of some ecological factors, correlation analysis was made between phytoplanktons and physico-chemical parameters (Table 4). The planktons exhibited effective relation with water and air temperature,pH, Nitrates etc.

The temperature is significantly and negatively correlated with chlorophyceae and bacillariophyceae. However pH is positively correlated with both species. Phytoplankton had a negative correlation with phosphates due to high rate of phytoplankton phosphorus uptake at low concentrations throughout the study periods at all stations.
Various indices such as Simpsol index (I), Shannon-Wiener index (H), Margalef's index (R1) and Equitability index (E) were used to analyse species diversity, richness and evenness respectively. The analysed data showed the maximum species diversity in terms of Shannon-Wiener index (H=2.62) at station 1. The maximum (R1=2.23) and minimum (R2=0.22) value of species richness were recorded at station 1 and lower at station 4 (Table 5).

Phytoplanktonic studies revealed four groups of algal classes such as green algae blue green algae, diatoms and euglenoid, these were the base line on which the life line of the pond depends (Table 1) Photoplanktonic abundance, distribution, bio-diversity and indices were influenced by several factors such as light, temperature, nutrient, dissolved oxygen etc. Chlorophycean genera were having minimum appearence in June as 5 genera, while maximum was witnessed in Jan, Dec. to March as 2. Their percentage share was 60%. Cyanophycean member were minimum in June as 4 and maximum in the months of December to March as 13 [12], They shared 7%. Bacillariophycean genera were minimum as 4 during June and July and maximum as 7 from March to April. Sharing 31%. Charophyceae members were least represented as 02 genus in May to July and maximum 3 genera during rest of the month of the year, they exhibited 02% share. Chlorophycean representatives consist of Chlamydomonas, Botriococcus, Tetraspora, Lepocinclis, Carteria, Spirogyra, Ulothrix. Draparnaldia, Palmella, Zygnema, Sphaerocvstis and Pediastrum. Cyanophycean representative consist of Agmenullum. Arthrospira, Oscillatroria. Nostoc, Rivularia, Microsystis, Anabaena, Nadularia and Aphanocapsa. Bacillarlophycean genera consist of Diatoma, Synedra, Gomphonema, Nitzschia, Navicula and Melosira. Charophyceae consists of Chara, Nitella and Zygnema.

Chlorophycean population were minimum in Nov as 232 specimens $L^{-1}$and maximum as 1265 specimens L^{-1} in March. Cyanophycean population were minimum in Aug as 21 specimens L^{-1} and maximum in April. As 108 specimen L^{-1}. Bacillaiaphycean population were minimum in Dec. as 50 specimen L^{-1} and maximum as 980 specimen L^{-1} in March. Charyophyceanpopulation as minimum as 108 specimens L^{-1} in Oct. and as maximum as 52 during.

Chlorophycean dominance has been observed followed by Bacillariophyceae, Cyanophyceae and Charophyceae.

4. CONCLUSION

Phytoplanktons form the bulk of floristic Composition of the community structure of a freshwater ecosystem [13]. They play a key role in the productivity of all aquatic ecosystem to properly assess the same [14]. Four groups of algal classes of the pond suryapokhra (Manpur, Gaya) namely Chlorophyceae, Cyanophyceae, Bacillariophyceae and Charophyceae were studied [15]. Diurnalvariations of phytoplanktons indicate a particular trend [16] which are beneficial for the specific primary productivity the pond [17]. Zooplanktons are responsible for secondary productivity of the pond. The abundance and diversity of Suryapokhra Pond's fishes was influenced by planktons in relation to hydrobiological factors. A satisfactory level of species diversity and species richness at all the sites shows the favourable conditions of fishery.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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