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Seasonal changes of plankton of rural fish pond, Madhepura, Bihar

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Abstract- The change in plankton seasonality of rural fish pond, Madhepura, Bihar was assessed in 2021. It was found that the pond water was alkaline with 40-92 ppm, free carbon dioxide ranged 0-1ppm. The water was transparent during the winter, summer month and turbid in rainy months. The pond's water source was runoff from the surrounding field and township in rainy months. Dominant plankton genera *Spirogyra*, *Diatoms*, and *Microcystis*, indicate the pond's eutrophic nature. The phytoplankton and zooplankton showed two peaks in a year. The zooplankton peaks were followed by phytoplankton peaks. The pond is suitable for the rearing of Catla, Rohu, Mrigal and common carps. Proper and timely stocking may improve the economic status of the fisherman community of the area through high fish production.

Key words: Seasonal changes, plankton, rural pond

INTRODUCTION

Ponds in Bihar form one of the most lucrative fisheries sources, next to the reservoir. They are available in every village for domestic use, such as animal care, washing utensils and clothes and also in some part of the state for drinking water. They constitute 24.5% of total fish-prone areas of the state, excluding rivers, tributaries and creeks. Despite vast areas under the pond, much attempt has not been made to evaluate the productivity of ponds in the state. The study embodies the seasonal changes in the plankton of a rural pond in Madhepura, Bihar, from January to December 2021.

The Pond, under study have a water spread area of 1.24 ha at live storage level (4m depth), lies near the Madhepura township, The pond is surrounded by human

inhabitation and paddy fields. The pond dries during summer, leaving a small area underwater with a depth of 0.25 m. The pond's water source is rainwater from the surrounding fields and township.

MATERIAL & METHODS

Plankton samples were collected fortnightly from January - December 2021. For this purpose, 50 litres of surface water from different spots were filtered through a plankton net made of bolting silk no 25. The net was attached with a graduated glass tube of 10 ml capacity to collect the plankton samples. The plankton biomass of 50 litres of water was preserved in a 4% (V/V) aqueous formalin solution. The qualitative and quantitative analysis of the plankton was done using a Sedgewick-rafter cell of one ml capacity.¹

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Pond water samples from three spots were collected fortnightly between 0700 and 0800 hrs. Water transparency and temperature were recorded using Sacchi dist and graduate mercury thermometer. Chemical analysis of water was done following Jhingran *et al.* (1969)² and APHA (1971)¹. Dissolved oxygen, Carbon dioxide and pH of water were determined immediately after collection. Fortnight observations were pooled for presentation.

RESULTS

Table 1- Physical & chemical properties of pond water (2021).

Properties	Range
Water depth (m)	0.25-4.0
Transparency (cm)	6.50-70.5
Water temperature °C	12.0-29.5
pH	7-9
D.O. (ppm)	6.6-11.2
CO2 (ppm)	Nil-1.0
Total alkalinity (ppm)	40-92

Table 2- Dominate group and genera in the pond (2021).

Groups	Genera
Phytoplankton	
1. Cyanophyceae	<i>Microcystis sp.</i> , <i>Spirulina sp.</i> , <i>Anabaena sp.</i>
2. Chlorophyceae	<i>Volvox sp.</i> , <i>Eudorina sp.</i> , <i>Ulthrix sp.</i> , <i>Spirogyra sp.</i>
3. Bacillariophyceae	<i>Diatoms sp.</i> , <i>Synedra sp.</i> , <i>Nvicula sp.</i> , <i>Cyclotella sp.</i>
Zooplankton	
1. Rotifers	<i>Keratella sp.</i> , <i>Brachionus sp.</i>
2. Crustaceans	Sub-group 1. Copepoda: <i>Cyclops sp.</i> , <i>Diaptomous sp.</i> , <i>Limnocalamus sp.</i> , <i>Canthocampus sp.</i> , and their nauplii. Sub-group 2: Ostracoda: <i>Cypris sp.</i> , <i>Cypridopsis sp.</i> Sub-group 3. Cladocera: <i>Daphnia sp.</i> , <i>Diaphanosoma sp.</i> , <i>Sida sp.</i>
3. Turbellaria	<i>Dalvellia sp.</i>

The physico chemical parameters revealed that the transparency ranged from 6.5 to 70.cm, the temperature 12.0-29.5, pH ranged from 7-9, Dissolved oxygen ranged 6.6-11.2, free carbon dioxide ranged 0-1.0 ppm, total alkalinity ranged 40-92 ppm. The dominant zooplankton group was Rotifers, Crustaceans, and Turbellaria. In phytoplankton the dominant group was Cyanophyceae, Chlorophyceae and Bacillariophyceae.

DISCUSSION

Physico-chemical properties of water

The range of physical and chemical characteristics is given in Table 1. The data showed that pond water was

Table 3- Population dynamics of different genera of phytoplankton in community pond, Madhepura, Bihar (2021)

Months	Volvox	Eudorina	Ulthrix	Spirogyra	Diatom	Navic u/l	Synedra	Cyclotella	Microcystics	Anabaena	Spirulina
January			10	11	37			11	13	2	2
Febuary			24	56	35	13		9	15	3	3
March	28	38	9	140	18	11			16	3	2
April	3	10	1	16	8	5	4	5	18	5	4
May	36	49		262	56	15	11	18	82	35	31
June					23	6	3	5	65	13	10
July		5		9	31	6	2	2	11	6	5
August	36	41	15	233	68	19	13	16	9	4	3
September	54	63	15	275	66	19	11	15	6	2	1
October	24	25	13	16	35	10	6	7	4		
November				16	6		1	2	8		
December				11	6			1	10	2	2
Mean	15	19	7	99	32	9	4	7	21	6	5

Table 4- Population dynamics of different genera of zooplankton in community pond, of Madhepura, Bihar (2021).

Months	Keratella	Brachionus	Cyclops	Diaptomus	Nauplius	Cypris	Cypridopsis	Daphnia	Diaphanosoma	Sida	Dalvellia	Limnocalamus	Canthocampus
January	3		2	2	2			11	2		3		
Febuary	3	3	2	2	1			13	3		2		
March	4	4	13	14	10			34	8	4	7		
April	2	2	19	80	14			62	14	5	9		
May	3	5	10	6	5			36			4		
June	4	8	9	3	6			34			5		
July	13	12	14	28	18	8	12	78	25		2	11	11
August	4	1	4	5	1			33	4		7	2	1
September			1					13	4		2		
October								3	1				
November								7					
December								9	3				
Mean	3	3	6	11	5	1	1	28	6	1	3	1	1

always alkaline with a low amount of CO₂. The dissolved oxygen content was always above the critical limit (3 ppm) required for the fish culture. Water was transparent during winter and muddy in monsoon months. The water pH was above neutrality.

Plankton

The average number of plankton recorded in the pond during 2020 and 2021 was 290 and 294 units per litre (u/l), respectively. The seasonal plankton population showed two peaks. In 2020, the first peak was recorded in May (645 u/l), but the second peak was one month earlier (August with 670 u/l). This might be due to the early inflow of rainwater in the pond from the catchment area,

facilitating the nutrient enrichment of the pond with runoff soil.

The order of month-wise abundance was May > September > October > August > March > July > April > February > June > January > November > December in 2021. Different orders of abundance in different years indicated that the seasonal change in plankton population is regulated by the water depth (May) and runoff inflow of rainwater (August-September).

Throughout the year, the plankton population was represented by phytoplankton and zooplankton in 2021. Three groups dominated phytoplankton and zooplankton. The detail of the group and genera are given in Table 2.

PHYTOPLANKTON

Numerical abundance and per cent composition of phytoplankton are presented in Table-3. Phytoplankton density was very low in November and December and touched maximum values twice a year. The maximum number of phytoplankton per litre was recorded in May (615 u/l) and September (516 u/l) and May (645 u/l) and August (670 u/l) in 2021. The advancement of the second peak might be due to early rainwater inflow in the pond. In 2021, the rain was delayed by one week, which led to a delay in rain water collection, which delayed the second peak of phytoplankton production. The listing presented 11 genera comprising, 3 Cyanophyceae, 4 Chlorophyceae and 4 Bacillariophyceae groups. Genera-wise density (Table-3) and their per cent composition showed prevalence (83%) of *Spirogyra*, *Diatoms*, *Microcystis*, *Eudorina*, and *Volvox* constituted 44, 14, 10, 8 and 7% respectively of the total composition of phytoplankton other genre constituted less than 5%. The data also revealed that only *Diatoms* and *Microcystis* were present in all months during the study period. *Spirogyra* contributed maximum, but the population was absent in June. The yearly mean share of phytoplankton in the total population was 72% and 74% in 2021.

ZOOPLANKTON

Daphnia contributed the maximum percentage (40.2%) of zooplankton. It was present in all the months. In November, 100% population of zooplankton was represented by *Daphnia* only. Other important zooplankton genera in the pond water were *Diaptomus* (17%), *Diaphanosoma* (9%), *Cyclops* (9%), and *Nauplius* (7%), General *Keratella*, *Brachionus*, *Cypris*, *Cypridopsis*, *Sida*, *Dalvellia*, *Limnocalamus* and *Canthacampton* contributed

very less (5%) and also only during pre-monsoon and monsoon months. The order of yearly abundance of genera of a zooplankton was *Daphnia* > *Diaptomus* > *Cyclops* > *Diaphanosoma* > *Nauplius* > *Dalvellia* > *Keratella* > *Brachionus* > *Limnocalamus* > *Canthocampton* > *Cypridopsis* > *Sida* > *Cypris*. The zooplankton population also showed two peaks. Every peak was just before the peak of phytoplankton. The first peak of zooplankton was recorded in April, and the second peak in July. The inverse relation between the population of zooplankton and phytoplankton in different months revealed the grazer behaviour of zooplankton on phytoplankton. The increasing zooplankton population feed on phytoplankton, resulting lower population of phytoplankton. The zooplankton contributed reasonably to the total plankton population was in 2021 (26%). The general wise changes in the zooplankton population in other months are given in Table 4. Yadava *et al.* (1987)³ also reported two peaks of Phyto and zooplankton in Dighali beel in Assam.

The high population of phytoplankton during monsoon months (333 u/l) and zooplankton during summer months (109 u/l) suggested the availability of more nutrient salt in monsoon months due to runoff for plankton growth and heavy grazing by zooplankton on phytoplankton during summer months. Plankton was mainly represented by the pond's eutrophic nature.⁴ Kutkuhn (1958)⁵ classified that Myxophyceae, Chlorophyceae, Euglenoida and Centrales of Bacillariophyceae possess what is known as a eutrophic tendency. The pond's water was full of these groups during the study. The pond is suitable for major carp rearing to feed the local population and employment generation for youth.

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