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Study of Physico-chemical Factors and Seasonal Variation of Phytoplankton in Fish Pond, Machhali Ghar, Doranda, Ranchi

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ABSTRACT

Phytoplankton forms the necessary component of aquatic ecosystem, and plays a vital role as natural feed for the early life stages of various fish species. Occurrence of phytoplankton communities in the water body depends on the various properties of water quality. Hence, it absolutely necessary to understand the prevailing physico-chemical variations of water such as temperature, pH, total hardness, and electrical conductivity, total dissolved solids, turbidity, and dissolved oxygen etc. In this context, the present study was performed from July, 2020 to June, 2021 at some selected sampling stations *i.e.*, Nursery Pond, Rearing Pond and Stocking Pond of the fish pond, Machhali Ghar, Doranda, Ranchi. Four main groups of phytoplankton were identified at three sampling stations, during the investigation period. A total of 45 species were observed, out of which 22 species from class Chlorophyceae, 10 species from class Cyanophyceae, 11 species from class Bacillariophyceae and 2 species from class Euglenophyceae were identified. Abundance of Chlorophyceae in different ponds indicates appropriate oxygen level in the water body. The monthly variation of water quality parameters revealed favorable range for the growth of phytoplankton

Key Words - Chlorophyceae, Water, Physico-chemical factor, Phytoplankton

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INTRODUCTION

Phytoplankton are the foundation of food chain in the water bodies that acts as the primary producer to fix the solar energy through photosynthesis process by consuming carbon dioxide and water. The diversity, structure and dynamics of phytoplankton production in the water bodies are regulated with the changing properties of water quality parameters (Hulyal and Kaliwal, 2009). Phytoplankton are primary source of natural food for fishes in aquatic water bodies which are directly correlated to determine the productivity (Ansari *et al.* 2015). Phytoplankton serves as an ideal bioindicator to showcase the trophic status of an aquatic ecosystem (Whitton 2000). The seasonal variation of physicochemical factors determines the diversity and structure of phytoplankton community as it forms the base of the pyramid of food chain. Phytoplankton species exhibit diverse responses to the altering physico-chemical parameters such as dissolved oxygen, pH, light, temperature, turbidity, electrical conductivity, free CO_2, chloride, iron, ammonia, calcium, magnesium etc. Assessment of water quality is a potent tool to understand the pattern of seasonal variation of phytoplankton in any type of lentic water body. Phytoplankton, commonly known as microalga, are broadly classified as Cyanophyta (Blue Green algae), Chlorophyta (Green algae), Bacillariophyta (Diatoms), Euglenophyta (Pigmented flagellate or phyto-flagellated) etc. These phytoplankton species are very sensitive to physico-chemical alteration of water bodies and thus respond quickly to monitor

the ecological status. Therefore. planktons serve as early-warning indicators that imitate the 'health' status of an aquatic ecosystem.

The present study aimed to analyze the phytoplankton diversity in relation to the seasonal changes in the physico-chemical parameters of three fish ponds of Machhali Ghar, Doranda, Ranchi. Based on these data, an attempt has been made to correlate the seasonal variation of water quality with the phytoplankton diversity and to evaluate the trophic level status of the pond.

MATERIALS AND METHODS

Collection of water sample

Water samples were collected for the physico-chemical analysis and phytoplankton studies from fish pond, Machhali Ghar, Doranda, Ranchi at the interval of 10 days for the 12 months, from July - 2020 to June 2021. Samples were collected randomly at the collection points. The data thus generated were summed up as average data on the basis of seasons viz. Monsoon (July to October), Winter (November to February), Summer (March to June).

Analysis of water sample

The temperature was recorded at the sample site with the help of hand-held thermometer. The pH of water sample was measured pH meter (Hanna, Singapore) with a glass electrode. The pH meter was calibrated using buffer of pH 4.0, 7.0. and 10.0 prior to recording the data. The total dissolved solids and conductance of water samples were analyzed by conductivity meter (Hach, USA). Transparency was measured using secchi disk with 20cm diameter, alternating black and white quadrants. The disc was lowered into the water of a pond until it was not visible. This depth of disappearance was measured for the transparency of the water in all three ponds. Dissolved oxygen was measured by DO analyzing kit (CIFEDO, Mumbai). Rest of the physico-chemical properties like total alkalinity, chloride, ammonia, nitrite, nitrate was analyzed in laboratory following standard water test kits.

Collection and analysis of phytoplankton samples

Phytoplankton samples were collected from the three different sampling sites located in nursery, rearing and stocking pond each. Sampling was done on the regular interval for a period of one year from July 2020 to June 2021. For qualitative estimation of plankton samples, standard plankton net made of bolting silk number 14 (120µ) and 25 (64µ) was used. For laboratory analysis of samples, planktons were preserved in Lugol's Iodine solution. Species identification of phytoplankton was performed by referring the standard literature and the monographs of Desikachary (1959), Fritsch (1961) and Prescott (1975).

Table-1 : Monthly variations of water quality Parameters of Nursery Pond in Fish Pond Doranda, during July 2020 to June 2021

Seasons		Monsoon				Winter				Summer			
Sl. No.	Physico-chemical Parameters	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021
1.	Air temperature (º C)	31.54	32.86	31.23	30.15	24.86	22.73	**19.57**	21.23	25.82	29.29	**33.53**	31.26
2.	Water temperature (º C)	29.86	30.93	29.68	28.85	22.77	21.95	**17.86**	19.63	22.06	27.38	**30.37**	27.89
3.	Transparency (cm)	43	40	**38**	41	43	44	45	48	48	52	53	**55**
4.	Electrical conductivity (µS/cm)	**221.23**	243.55	267.36	271.97	242.53	250.23	243.28	267.57	298.66	305.55	**316.25**	281.14
5.	Total dissolved solids (mg/L)	**150**	154	159	152	162	169	157	178	189	193	**200**	195
6.	Total alkalinity (mg/l)	128.22	124.75	120.26	118.54	117.23	119.51	**115.84**	121.28	126.37	128.10	**132.87**	129.92
7.	pH	7.33	7.47	8.29	7.72	**7.08**	7.84	8.05	8.11	7.75	7.94	**8.12**	8.09
9.	Dissolved Oxygen (mg/L)	6.24	6.74	5.97	5.84	6.73	6.93	7.06	**7.14**	6.33	5.45	**5.17**	7.74
10.	Chloride (mg/l)	88.65	60.87	65.83	77.75	73.95	**53.98**	67.83	79.98	81.88	99.87	87.98	**95.65**
11.	Ammonia (un-ionised) (mg/L)	0.03	0.05	0.04	0.03	0.02	**0.01**	0.03	0.05	0.07	**0.08**	0.06	0.04
12.	Nitrite (mg/L)	0.07	0.09	0.05	**0.03**	0.04	0.06	0.07	0.06	0.08	0.11	**0.22**	0.09
13.	Nitrate (mg/L)	4.97	4.48	4.98	4.83	4.35	4.12	**3.80**	4.08	4.32	**5.89**	5.84	4.48

Data presented as mean, n=3

Table-2 : Monthly variations of water quality parameters of Rearing fish pond of Machhali Ghar, Doranda during July 2020 to June 2021

Seasons		Monsoon				Winter				Summer			
Sl. No.	Physico-chemical Parameters	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021
1.	Air temperature (º C)	31.53	32.85	31.21	30.15	24.82	22.75	**19.52**	21.28	25.84	29.27	**33.57**	31.23
2.	Water temperature (º C)	29.92	31.26	30.16	29.84	23.73	21.97	**18.58**	20.14	23.53	27.98	**30.85**	28.83
3.	Transparency (cm)	45	42	**40**	41	43	47	45	50	49	52	54	**56**
4.	Electrical conductivity (µS/cm)	**223.22**	253.25	257.53	261.69	252.65	251.72	248.82	257.85	297.99	312.05	**316.20**	281.16
5.	Total dissolved solids (mg/L)	**156**	158	157	159	165	168	167	171	198	195	**205**	197
6.	Total alkalinity (mg/l)	125.25	123.79	125.28	124.58	119.26	**112.86**	118.52	116.33	128.23	122.54	**136.85**	132.36
7.	pH	**7.38**	7.51	**8.26**	7.62	7.59	7.82	8.06	8.09	7.73	7.84	8.11	8.09
9.	Dissolved Oxygen (mg/L)	6.45	6.97	5.89	5.78	6.57	6.82	**7.42**	7.33	6.54	5.96	**5.46**	7.96
10.	Chloride (mg/l)	87.62	61.87	66.82	76.79	75.95	**55.95**	68.82	78.95	82.85	**99.57**	89.99	96.68
11.	Ammonia (un-ionised) (mg/L)	0.02	0.03	0.04	0.03	0.02	**0.01**	0.03	0.05	0.07	**0.08**	0.06	0.04
12.	Nitrite (mg/L)	0.08	0.07	0.06	**0.04**	0.05	0.06	0.07	0.06	0.08	0.1	**0.2**	0.08
13.	Nitrate (mg/L)	4.96	4.44	4.92	4.86	4.46	4.24	**3.95**	4.03	4.42	5.81	**5.89**	4.98

Data presented as mean, n=3

Table-3: Monthly variations of water quality Parameters of Stocking pond in Fish pond Doranda, during July 2020 to June 2021

Seasons		Monsoon				Winter				Summer			
Sl. No.	Physico-chemical Parameters	Jul 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021
1.	Air temperature (º C)	31.58	32.86	31.28	30.14	24.87	22.78	**19.55**	21.72	25.88	29.32	**33.53**	31.26
2.	Water temperature (º C)	30.71	31.55	29.39	29.36	22.63	21.75	**17.89**	19.08	22.87	27.09	**30.08**	27.66
3.	Transparency (cm)	42	43	**39**	41	43	47	44	49	47	54	53	**56**
4.	Electrical conductivity (µS/cm)	**231.43**	245.66	268.57	272.14	245.24	240.83	245.63	268.37	293.76	310.26	**318.45**	284.89
5.	Total dissolved solids (mg/L)	192	186	178	**159**	165	168	179	189	183	198	**213**	204
6.	Total alkalinity (mg/l)	126.42	124.57	125.82	128.55	117.72	119.81	113.98	**113.24**	115.33	121.16	129.87	**130.79**
7.	pH	**7.42**	7.48	8.29	7.75	7.85	7.87	8.21	**8.22**	7.75	7.99	8.12	8.05
9.	Dissolved Oxygen (mg/L)	6.57	6.85	5.97	5.85	6.85	6.58	**7.47**	7.18	6.38	5.36	**5.22**	7.5
10.	Chloride (mg/l)	88.65	**60.87**	65.83	78.76	74.84	59.98	68.89	79.92	82.81	**98.47**	89.93	96.65
11.	Ammonia (un-ionised) (mg/L)	0.03	0.02	0.04	0.03	**0.02**	0.05	0.03	0.04	0.07	0.06	0.07	**0.08**
12.	Nitrite (mg/L)	0.09	0.08	0.04	**0.03**	0.05	0.06	0.07	0.05	0.08	0.1	**0.2**	0.09
13.	Nitrate (mg/L)	4.93	4.65	4.95	4.85	**3.36**	4.22	3.89	4.18	4.34	**5.98**	5.74	4.98

Data presented as mean, n=3

RESULTS

The results of physico-chemical characteristics of water such as air and water temperature, transparency, conductivity, total dissolved solids, total alkalinity, pH, dissolved oxygen, chloride, ammonia, nitrite and nitrate of each sampling sites of nursery, rearing and stocking ponds are presented in Table 1, 2 and 3, respectively. According to the result of characteristics of the pond water, the air temperature and water temperature were found to be correlated with each other with alteration in different seasons. The water temperature ranged from 17.8°C - 30.37°C during the study period of one year in the nursery pond. The highest water temperature was recorder in the summer during month of May while lowest was recorded in winter month of January in Nursery Pond. Similar trend of highest and lowest water temperature was recorder during the month of May and January in rearing and stocking pond. Transparency of water ranged from 38-55cm, 40-56 cm and 39-56 cm in the nursery, rearing and stocking pond respectively from July 2020 to June 2021. The highest transparency was recorded during the summer whereas lowest as observed during the monsoon. Similar trend of electrical conductance in all the three ponds were recorded with maximum in the summer and minimum in the monsoon month. May month witnessed highest total dissolved solid (TDS) in all the three sampling sites with the highest of 213 mg/lt, recorded in the stocking pond. Total alkalinity ranged from 115.84-132.87 mg/lt in the nursery pond, 112.86- 136.85 mg/lt in the rearing pond and 113.24 to 130.79 mg/lt in the stocking pond. Water pH did not vary remarkably among the three different ponds and the highest value of 8.26 was observed in the rearing pond in monsoon and lowest (7.08) was noticed in the nursery pond in the winter. The dissolved oxygen level in the water was recorded

highest in winter and lowest value was observed in the summer.

Chloride values were found ranging between 53.98mg/l to 99.87mg/l in nursery pond. In rearing pond, it ranged between 55.95 mg/l to 99.57 mg/l. In stocking pond, it fluctuated between 59.98 mg/l to 96.65 mg/l, which maximum value was noticed in summer and the lowest value in winter.

The level of ammonia, nitrite and nitrate in the different seasons were almost stagnant and no remarkable change were observed. The concentration of their parameters was found to be maximum during the summer months while lower values were recorded during the winter months.

The population of phytoplankton largely depends on the physico-chemical characteristic of a water body. Phytoplankton showed variations in their occurrences during the different months of the year. The list of occurrences of phytoplankton communities in three different ponds are presented in Table 4, Table 5 and Table 6. The results of the study showed that the diversity and occurrence of major phytoplankton groups viz, cholophyceae, bacillariophyceae and cyanophyceae were abundant during the summer and winter seasons compare to monsoon season.

In the present investigation, 4 major groups of algae were identified in all the three sampling stations and the total number of species identified was 45, during investigation period of one year. Chlorophyceae was highest in both number and percentage, and consisted of 22 species (48.8%), followed by cyanophyceae, 10 species (22.23%), bacillariophyceae, 11 species (24.4%), and the least euglenophyceae, 2 species (4.4%), were identified, summarized in **Fig.1**. Chlorophyceae group presented maximum (48.8%) no. of species while Euglenophycae (4.4.%) showed minimum no. of species.

DISCUSSION

The present study demonstrates that the phytoplankton diversity of the fish ponds, Machli Ghar, Doranda, was low during monsoon season and high diversity was found during the summer and winter season. To corroborate our findings, Chaturvedi *et.al.* (1999), also reported similar pattern in the variation of phytoplankton during different seasons which might be associated due to the fact that the summer is the most appropriate season for the growth of phytoplankton. Further, it might be also correlated due to longer duration of sunshine period and trophotropic (tendency for energy renewal) actions during the summer season. High temperature and longer duration of photoperiod also favors the growth and development of phytoplankton during summer as discussed by Sharma *et.al.*, (2014). Parallel to our findings, Silambarasan *et al.* (2014) also reported maximum phytoplankton in summer and minimum in winter in relation with changing variables of water quality features of Kolavoi Lake, Chengalpet, Tamil Nadu.

During the monsoon season, heavy rainfall induces significant stratification in water column and reduces temperature of aquatic ecosystem. As the growth of phytoplankton largely depends on the existing temperature, water turbidity, and available nutrients, therefore the phytoplankton rate is high during the summer and low during the monsoon. Our findings are also supported with the results reported by Shrinivasan *et.al.* (2014).

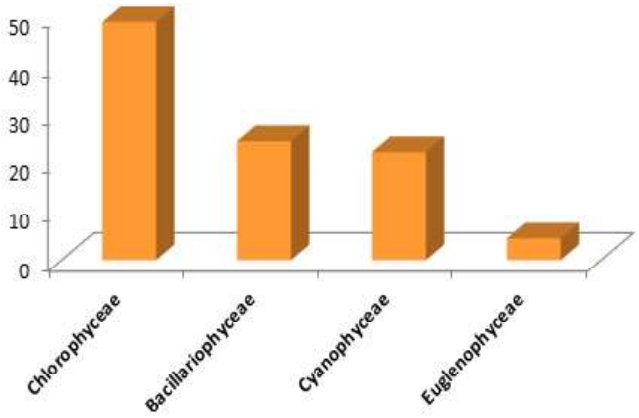

Fig.1 Percentage contribution of major phytoplankton at three sampling sites.

Table-4: Monthly variations in phytoplankton groups in Nursery pond, during July, 2020 to June, 2021

	Seasons	Monsoon				Winter				Summer			
S.N.	Name of the species	July 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	June 2021
CHLOROPHYCEAE													
1.	*Scenedesmus obliqus*	++	--	++	--	--	--	--	++	--	++	++	++
2.	*Scenedesmus accuminatus*	++	++	++	--	--	--	--	--	--	--	++	++
3.	*Scenedesmus quardiculata*	++	++	++	--	--	--	++	++	++	++	++	++
4.	*Chlamydomonas*	--	--	++	++	++	--	--	--	++	++	++	--
5.	*Chlorella vulgaris*	++	++	--	--	--	++	++	--	++	++	--	--
6.	*Chlorella pyrenoidosa*	++	++	--	++	++	--	--	--	++	++	++	--
7.	*Oedogonium*	--	++	++	--	--	--	--	--	++	++	++	--
8.	*Spirogyra varians*	++	++	++	++	++	++	++	++	++	++	++	++
9.	*Spirogyra fennica*	++	++	++	--	--	--	--	++	++	++	++	++
10.	*Pediastrum*	--	++	++	++	--	--	--	--	++	++	++	--
11.	*Coelastrium*	--	--	--	++	--	--	--	--	++	++	++	--
12.	*Cosmarium*	--	++	++	++	++	--	--	++	++	++	++	--
13.	*Selenastrum*	--	--	++	--	--	--	--	--	++	++	++	--
14.	*Rhizoclonium*	++	++	++	--	--	--	--	--	--	++	++	++
15.	*Crucigenia*	++	++	++	--	++	++	--	--	--	--	++	++
16.	*Stigeoclonium*	++	++	++	++	++	--	--	--	--	++	++	++
17.	*Mougeotia*	++	++	--	--	--	--	--	--	++	++	++	++
18.	*Cladophora*	--	--	--	++	++	++	++	++	--	--	--	--
19.	*Ulothrix*	++	++	--	--	++	++	--	--	++	++	++	++
CYANOPHYCEAE													
1.	*Spirulina*	++	--	--	++	++	++	--	--	--	++	++	--
2.	*Oscillatoria*	++	++	++	++	--	--	--	--	++	++	++	--
3.	*Phormidium*	++	--	--	--	++	--	++	++	--	--	++	++
4.	*Lyngbya*	++	++	++	++	--	--	--	--	--	--	--	++
5.	*Microcystis aeruginosa*	++	++	++	++	++	--	--	--	--	--	--	--
6.	*Microcystis flos-aqua*	--	--	++	++	++	++	++	++	--	++	--	--
7.	*Merismopedia*	++	++	++	--	--	++	++	--	--	--	--	++
8.	*Nostoc*	--	--	++	++	++	++	--	--	++	++	++	++
9.	*Gloeotrichia*	++	++	--	--	--	--	--	--	--	--	--	++
10.	*Scytonema*	++	++	--	--	--	--	--	--	++	++	++	++
BACILARIOPHYCEAE													
1.	*Surirella*	++	--	--	--	--	++	++	++	++	--	--	++
2.	*Epithemia*	--	--	++	++	++	--	--	--	++	++	++	--
3.	*Fragilaria*	++	++	++	--	--	--	--	--	++	++	--	--
4.	*Synedra*	++	--	--	--	--	++	++	++	--	--	--	++
5.	*Amphora*	--	--	--	--	--	++	++	++	++	++	++	--
6.	*Navicula*	++	++	++	++	--	--	--	--	++	++	++	++
7.	*Gomphonema*	++	++	++	--	--	++	++	--	--	++	++	--
8.	*Diatoma*	++	++	--	--	++	++	++	--	++	++	++	--
9.	*Cyclotella*	--	--	--	--	++	++	++	++	++	++	++	--
EUGLINOPHYCEAE													
1.	*Euglina viridis*	--	--	++	++	++	++	--	--	--	--	++	--
2.	*Euglina deses*	--	++	++	++	--	--	--	--	--	++	++	++

Table-5: Monthly variations in phytoplankton groups in Rearing pond, during July, 2020 to June, 2021

	Seasons	Monsoon				Winter				Summer			
S.N.	Name of the species	July 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	June 2021
CHLOROPHYCEAE													
1.	*Scenedesmus obliqus*	++	++	++	--	--	++	--	++	--	++	++	++
2.	*Scenedesmus accuminatus*	++	++	++	++	--	--	++	++	++	++	++	++
3.	*Scenedesmus quardiculata*	++	++	++	++	--	--	--	++	++	++	++	++
4.	*Chlamydomonas*	--	--	++	++	++	--	--	--	++	++	++	++
5.	*Chlorella vulgaris*	++	++	--	--	--	++	++	--	++	++	++	--
6.	*Chlorella pyrenoidosa*	++	++	--	++	++	--	--	--	++	++	++	--
7.	*Spirogyra*	++	++	++	++	--	--	++	++	++	++	++	++
8.	*Pediastrum*	--	++	++	++	--	--	--	--	++	++	++	++
9.	*Coelastrium*	--	--	--	++	--	--	--	++	++	++	++	--
10.	*Selenastrum*	--	--	++	++	++	--	--	--	++	++	++	--
11.	*Ulothrix*	++	++	++	--	--	--	--	--	++	++	++	++
12.	*Crucigenia*	++	++	++	--	++	++	--	--	--	--	++	++
13.	*Cladophora*	--	--	--	++	++	++	--	++	--	--	--	--
14.	*Oedogonium*	--	++	++	--	--	--	--	--	++	++	++	--
15.	*Cosmarium*	--	++	++	++	++	--	--	++	++	++	++	--
16.	*Eudorina*	++	++	++	--	--	--	--	--	++	++	++	++
17.	*Pandorina*	++	++	++	--	--	--	--	--	++	++	++	++
CYANOPHYCEAE													
1.	*Spirulina*	++	--	--	++	++	--	--	--	--	++	++	--
2.	*Oscillatoria*	++	++	++	++	--	--	--	--	++	++	++	
3.	*Phormidium*	++	--	--	--	++	--	++	++	--	--	++	++
4.	*Lyngbya*	++	++	++	++	--	--	--	--	--	--	--	++
5.	*Microcystis aeruginosa*	++	++	++	++	++	--	--	--	--	--	--	--
6.	*Microcystis flos-aqua*	--	--	++	++	++	++	++	++	--	++	--	--
7.	*Merismopedia*	++	++	++	--	--	++	++	--	--	--	--	++
8.	*Gloeotrichia*	++	++	--	--	--	--	--	--	--	--	--	++
BACILARIOPHYCEAE													
1.	*Surirella*	++	--	--	--	--	++	++	++	++	--	--	++
2.	*Epithemia*	--	--	++	++	++	--	--	--	++	++	++	
3.	*Fragilaria*	++	++	++	--	--	--	--	--	++	++	--	--
4.	*Synedra*	++	--	--	--	--	++	++	++	--	--	--	++
5.	*Amphora*	--	--	--	--	--	++	++	++	++	++	++	
6.	*Navicula*	++	++	++	++	--	--	--	--	++	++	++	++
7.	*Pinnularia*	++	++	++	--	--	++	++	++	++	++	++	++
8.	*Diatoma*	++	++	--	--	++	++	++	--	++	++	++	--
9.	*Gomphonema*	++	++	++	--	--	++	++	--	--	++	++	++
EUGLINOPHYCEAE													
1.	*Euglina viridis*	--	--	++	++	++	++	--	--	--	--	++	--

Table-6: Monthly variations in phytoplankton groups in Stocking pond, during July, 2020 to June, 2021.

	Seasons	Monsoon				Winter				Summer			
S.N.	Name of the species	July 2020	Aug 2020	Sep 2020	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	June 2021
CHLOROPHYCEAE													
1.	*Scenedesmus obliqus*	++	--	++	--	--	--	--	++	--	++	++	++
2.	*Scenedesmus accuminatus*	++	++	++	--	--	--	--	--	--	--	++	++
3.	*Scenedesmus quardiculata*	++	++	++	--	--	--	++	++	++	++	++	++
4.	*Chlamydomonas*	--	--	++	++	++	--	--	--	++	++	++	--
5.	*Chlorella vulgaris*	++	++	--	--	--	++	++	--	++	++	--	--
6.	*Chlorella pyrenoidosa*	++	++	--	++	++	--	--	--	++	++	++	--
7.	*Spirogyra*	++	++	++	++	++	++	++	++	++	++	++	++
8.	*Pediastrum*	--	++	++	++	--	--	--	--	++	++	++	--
9.	*Coelastrium*	--	--	--	++	--	--	--	--	++	++	++	--
10.	*Selenastrum*	--	--	++	--	--	--	--	--	++	++	++	--
11.	*Ulothrix*	++	++	++	--	--	--	--	--	--	++	++	++
12.	*Stigeoclonium*	++	++	++	++	++	--	--	--	--	++	++	++
13.	*Cladophora*	--	--	--	++	++	++	++	++	--	--	--	--
14.	*Volvox*	++	++	++	++	--	--	--	--	++	++	++	++
15.	*Oedogonium*	--	++	++	--	--	--	--	--	++	++	++	--
16.	*Cosmarium*	--	++	++	++	++	--	--	++	++	++	++	--
CYANOPHYCEAE													
1.	*Spirulina*	++	--	--	++	++	++	--	--	--	++	++	--
2.	*Oscillatoria*	++	++	++	++	--	--	--	--	++	++	++	
3.	*Phormidium*	++	--	--	--	++	--	++	++	--	--	++	++
4.	*Lyngbya*	++	++	++	++	--	--	--	--	--	--	--	++
5.	*Microcystis aeruginosa*	++	++	++	++	++	--	--	--	--	--	++	++
6.	*Gloeotrichia*	++	++	++	--	--	--	--	--	++	++	++	++
BACILARIOPHYCEAE													
1.	*Surirella*	++	--	--	++	--	++	++	++	++	--	--	++
2.	*Epithemia*	--	--	++	++	++	--	--	--	++	++	++	++
3.	*Fragilaria*	++	++	++	++	--	--	--	--	++	++	--	--
4.	*Synedra*	++	++	++	--	--	++	++	++	--	--	++	++
5.	*Amphora*	--	--	++	++	++	++	++	++	++	--	--	--
6.	*Navicula*	++	++	++	++	--	--	--	--	++	++	++	++
7.	*Gomphonema*	++	++	++	--	--	++	++	--	--	++	++	--
8.	*Cyclotella*	--	--	--	--	++	++	++	++	++	++	++	--
EUGLINOPHYCEAE													
1.	*Euglina viridis*	--	--	--	++	++	++	--	--	--	++	++	--

Out of the four major groups of phytoplankton identified in the present study, the chlorophyceae group was the most dominant contributing 48.8 %, whereas euglenophyceae was least. The chlorophyceae group was majorly represented by *Chlorella* sp., *Pediastrum* sp., *Scenedesmus* sp., *Spirogyra* sp., *Closterium* sp. etc. To support out findings, Hegde and Bharati (1985) indicated that alkaline pH might be one of the key factors that regulated the occurrence of chlorophyceae in water bodies.

In the present study alkaline pH were recorded at three sampling stations in Fish Pond, Doranda. Singh (2016) summarized that temperature affects the growth of algae, as low temperature is suitable to induce the multiplication of euglenophyceae while high temperature favored the growth of Chlorophyceae. The maximum diversity of chlorophyceae in all three-pond water might be related to the seasonal variation in water temperature dissolve oxygen, pH, alkalinity which might have played a significant role in scattering of Chlorophycean members. In line with our results, Rajgopal *et al.* (2010) also noticed similar findings in two perennial ponds in Sattur area, Tamil Nadu. Singh and Pandey (2016) in their research findings reported similar nature of chlorides content in freshwater tank which is also correlated with the increased in summer.

Bacillariophyceae group contributed 24.4% from the total phytoplankton population. The group was mostly represented by *Synedra* sp., *Navicula* sp, *Microspora*, *Amphora* sp., *Pinnularia* sp., *Surirella* sp., and *Fragilaria* sp. etc. Harikrishnan *et al.* (1999) reported that alkaline pH favors the copiousness of diatomic population. In the present studies alkaline pH were recorded at three sampling station of in Fish Pond, Doranda.

Cyanophyceae group contributed 18.5% from the total phytoplankton population. The group was mostly represented by *Microcystis aruginosa*, *Microcystis flos-aqua*, *Merismopedia sp., Oscillatoria* sp. *Phormidium* sp. and *Spirulina* sp. etc. In the present investigation, the diversity of Cyanophyceace in all water bodies was observed to be high during summer seasons which is supported with the findings of Zafar; (1964) Hedge and Bharati, (1985) who opined that upsurge in temperature led to the luxuriant growth of blue-green algae. Another reason for the increase in the temperature might be associated with the enhance total hardness during summer months which induces higher concentration of salts by unwarranted evaporation.

Two species of Euglenophyceae were identified during investigation period that includes *Euglena viridis* and *Euglina deses* from the Fish pond, Machhali Ghar, Doranda during the summer season. Seeneyya (1971) also pointed similar findings and speculated that temperature above 25°C might be suitable for the better growth of Euglenophyceae.

CONCLUSION

To summarize the findings, phytoplankton diversity highly fluctuated in the rainy, winter and summer seasons throughout the study period. The phytoplankton growth exhibited lesser diversity in rainy season compare to other two seasons. Physicochemical parameters such as pH, transparency, DO, temperature etc. observed to be correlated with algal development. The obtained results indicate that phytoplankton species diversity is highly variable in fresh water fish pond. Overall results indicated that the temperature, sunlight exposure duration, sunlight penetration, water pH, DO, transparency, might be related to stimulate variability in the phytoplankton distribution and their diversity in the pond.

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