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WATER QUALITY EVALUATION AND PHYTOPLANKTON DIVERSITY OF HOSAHALLI POND, SHIVAMOGGA, KARNATAKA (INDIA)

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ABSTRACT

The physico-chemical parameters and planktonic composition of Hosahalli pond were studied for a period of twelve months from January to December 2010. The estimated water quality parameters were compared with the standard values prescribed by the Bureau of Indian Standards (BIS) and World Health Organization (WHO). The results of physico-chemical analysis revealed that water is polluted as it possesses high BOD, free CO_2 and phosphate. Conclusively these parameters along with other physico-chemical characteristics were found to be affected by surface run-off and other excessive human activities. A total of 60 species belonging to 43 genera of phytoplanktons were recorded, of which chlorophycean and diatoms were found to be dominant among four classes. Eleven zooplanktons were identified.

Key words: Hosahalli pond, Physico-chemical parameters, Eutrophication, Algal blooms, Planktonic composition

INTRODUCTION

Hosahalli pond is an annual water body receiving water from the adjacent paddy fields, Tunga canal and waste water from Hosahalli village. It is located between 13^o 52' N latitude and 75^o 34' E longitude and is situated 5.3 km away from Shivamogga city. In India, there are enormous numbers of natural and man made water bodies used for various purposes, mainly for drinking and agriculture[1]. The quality of water resources usually

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depends on its physical, chemical and biological characteristics.

Studies on physico-chemical dynamics were reported[2-4]. Phytoplanktons play an important role in the biosynthesis of organic matter (Primary production) in aquatic ecosystems, which directly or indirectly serve all the living organisms of a water body as food[5]. The planktonic study is a very useful tool for the assessment of water quality in any type of water body and also contributes to understanding of the basic nature and general economy of the lake[6].

The total area of Hosahalli pond is about 95 acres, of which water spreads over an area of 70 acres with average depth of 6 feet. It is located in Hosahalli village of Shivamogga District. The water is used for domestic purposes like washing of clothes, vehicles and for domestic animals etc. It is surrounded by paddy and sugarcane fields in all directions. The water has undergone moderate changes in its physico-chemical properties due to ecological degradation, overflowing of water from adjacent paddy fields and other excessive human activities. The literature revealed that there is no scientific study carried out with respect to ecological characteristics of this pond. The basis of selection of Hosahalli pond was that its water is used by a large population which receives adequate waste water and periodic flooding from plains.

EXPERIMENTAL

The study was carried out during January to December 2010. During the study period, the surface water samples were collected in clean plastic cans between 8 am to 10 am once a month. Water temperature was recorded on the spot. The samples for dissolved oxygen were fixed immediately on the field itself. The remaining parameters were analyzed as per the standard methods[7]. Phytoplankton samples were collected by using plankton net (No. 1) by filtering 100 liters of water, preserved in 4% formaldehyde. Identifications of phytoplanktons and zooplanktons were made with the help[8-11].

RESULTS AND DISCUSSION

The results of physico-chemical parameters of Hosahalli pond are given in Table 1 and depicted in Figs. 1-9.

The water temperature depends on the season, solar radiations and other climatic conditions. The seasonal water temperature ranged from 19.3 to 26.2^{o}C. The minimum value was recorded in July and maximum in April. The values of turbidity ranged from 7.4 to 51.8 NTU. The highest and the lowest values were recorded in July and April, respectively. In

natural water bodies, turbidity may import a brown color to water[12]. Conductivity is an index to represent the total concentration of soluble salts. The conductivity values were found between 60.76 to 108.2 µ mhos/cm. The higher value of conductivity was observed in March due to increase in the concentration of minerals and organic matter.

Table 1: Physico-chemical characteristics of Hosahalli pond water

Parameters	Months : 2010											
	Jan.	**Feb.**	**Ma.r**	**Apr.**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sep.**	**Oct.**	**Nov.**	**Dec.**
Temperature	22.1	21.7	25.3	26.2	26.1	21.2	19.3	20.2	22.1	23.3	23.1	20.7
Turbidity	13.0	9.0	10.2	7.4	32.2	36.0	51.8	28.3	31.0	19.0	11.2	10.2
Conductivity	65.25	62.85	108.2	71.75	78.30	82.0	107.3	64.35	61.45	66.26	60.76	63.11
pH	6.5	6.7	6.7	7.1	7.3	6.9	7.6	7.5	7.4	7.0	6.9	7.0
DO	3.7	3.9	4.1	2.8	2.7	3.8	4.6	5.2	4.7	4.1	3.8	3.9
BOD	6.9	7.3	8.4	7.2	6.8	7.3	7.0	8.2	6.7	6.9	8.1	8.9
CO_2	9.9	13.1	23.3	13.0	19.2	18.2	17.0	25.2	17.7	18.3	19.0	20.4
Alkalinity	98	86	69	81	76	69	70	62	67	59	56	66
TH	106	94	103	107	113	89	80	84	92	76	81	97
TDS	36.30	33.40	59.45	39.8	46.7	41.9	60.72	40.5	33.35	35.8	34.91	35.65
TSS	130	110	80	75	105	365	420	410	290	260	232	170
Calcium	20.2	23.1	13.4	17.3	16.3	14.42	13.95	10.2	11.24	13.25	11.71	10.77
Magnesium	5.31	4.2	4.27	5.91	6.22	2.75	1.98	2.92	1.93	0.98	2.31	1.17
Chloride	80.2	85.1	81.3	100	102.7	99.4	85.7	65.2	67.6	72.3	79.6	70.4
Nitrate	5.1	5.3	6.1	6.4	7.2	6.9	6.2	6.7	5.9	5.7	6.3	6.2
Phosphate	1.0	1.1	1.7	1.3	1.3	1.6	1.1	1.9	1.2	1.1	1.6	1.4
Sulphate	8.7	7.3	7.9	7.2	9.3	9.1	7.8	9.7	7.8	7.8	8.3	8.1
Silicate	40.2	43.1	35.3	30.9	36.5	39.3	41.4	40.7	42.3	37.3	36.4	37.7

All values are expressed in mg/L except pH, temperature (^oC), turbidity (NTU) and conductivity (µ mhos/cm)

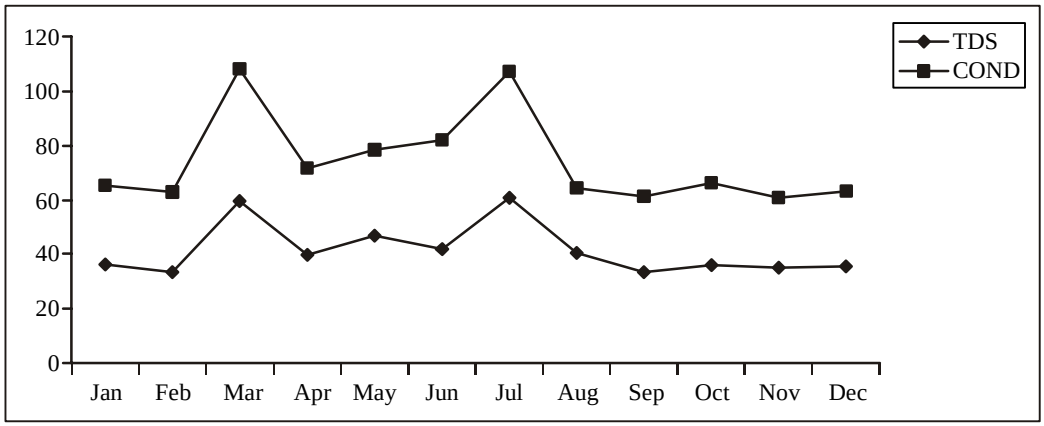

Fig. 1: Monthly variation in TDS and Conductivity

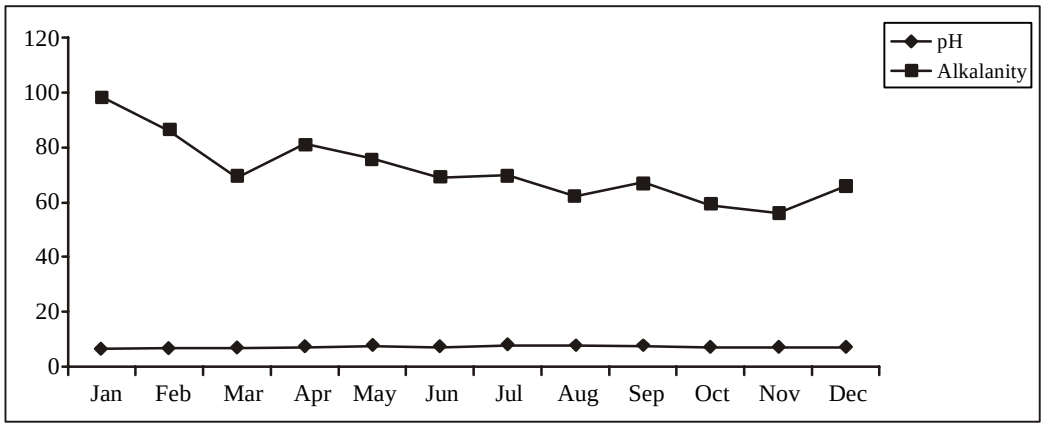

Fig. 2: Monthly variation in pH and Alkalinity

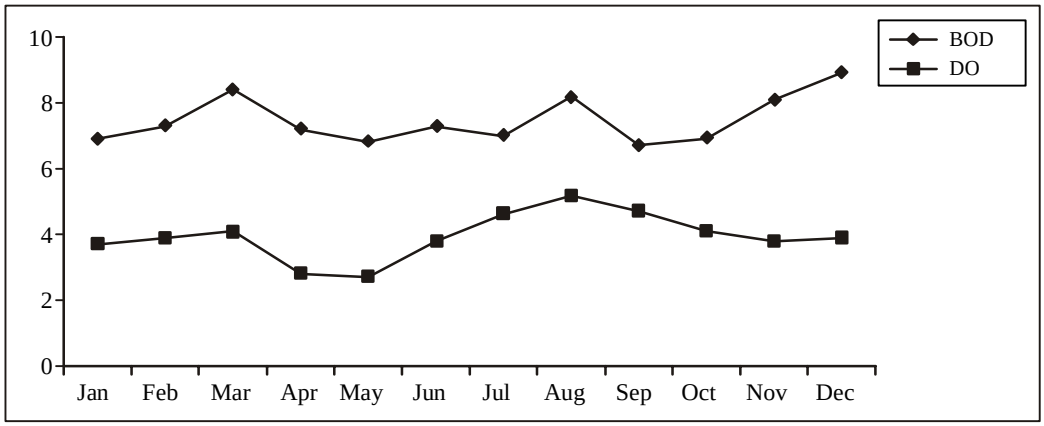

Fig. 3: Monthly variation in BOD and DO

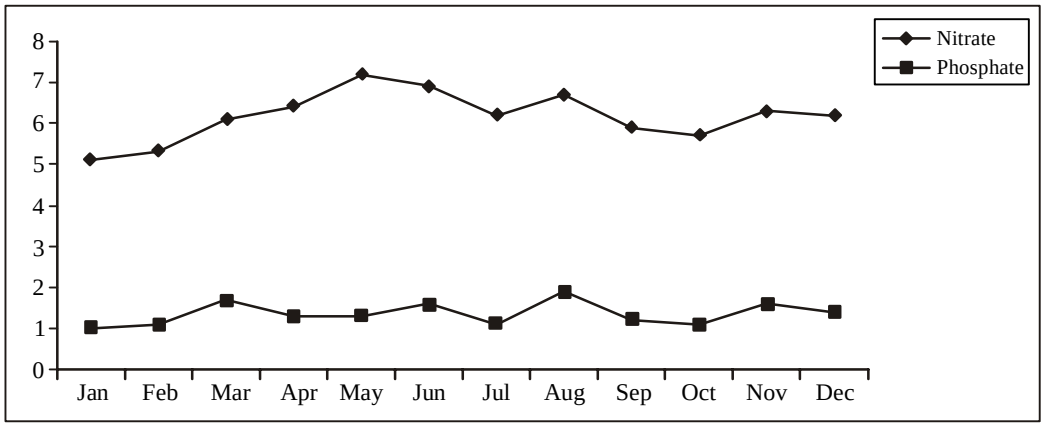

Fig. 4: Monthly variation in Nitrate and Phosphate

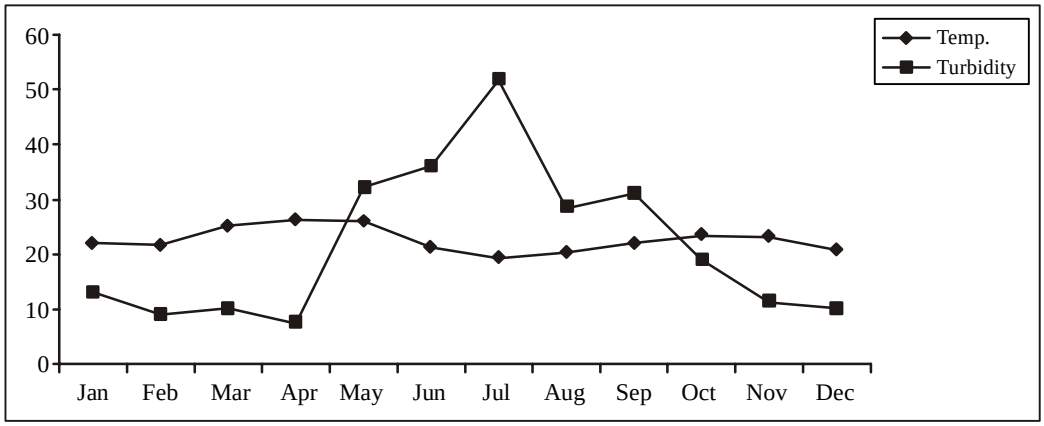

Fig. 5: Monthly variation in Temperature and Turbidity

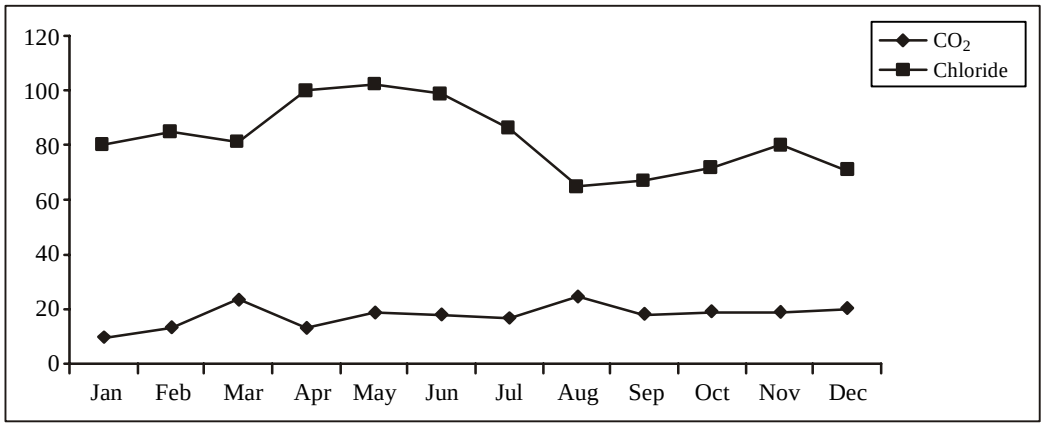

Fig. 6: Monthly variation in CO_2 and Chloride

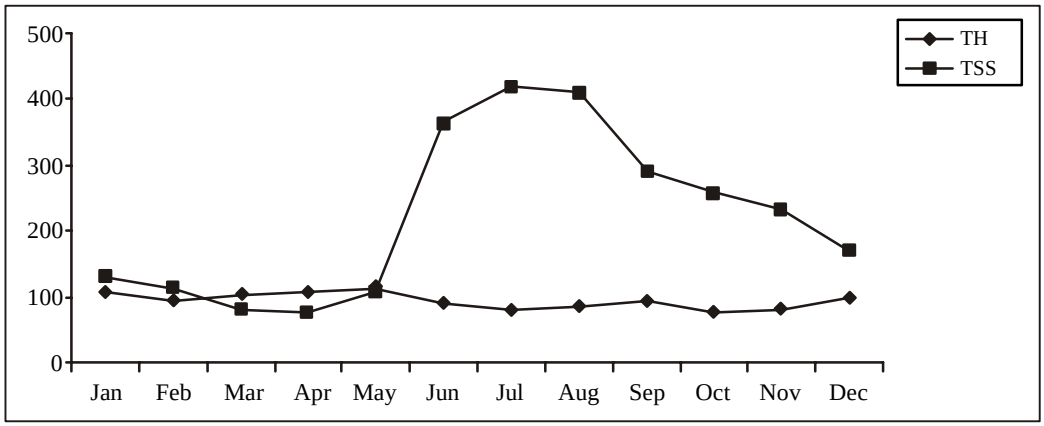

Fig. 7: Monthly variation in TH and TSS

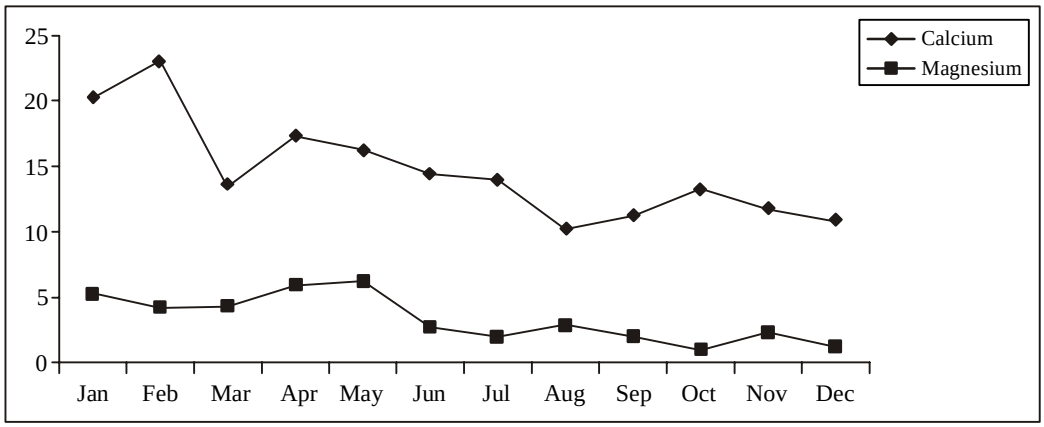

Fig. 8: Monthly variation in Calcium and Magnesium

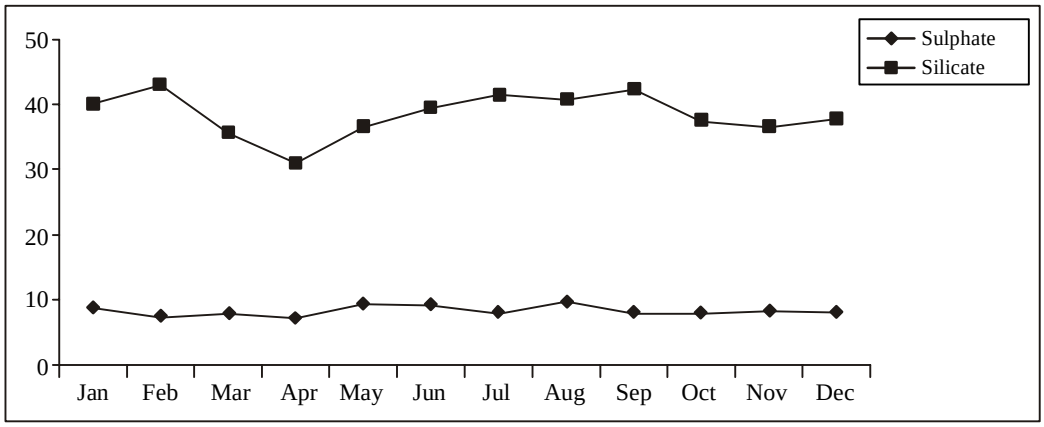

Fig. 9: Monthly variation in Sulphate and Silicate

The acidity or alkalinity of water is measured in terms of its pH or hydrogen ion concentration. Neutral water has the pH value of 7.0. If the pH value is less than 7.0, the water is acidic. Similarly, the water is alkaline, if the pH value is more than 7.0. pH values are found slightly acidic to slightly alkaline and found within permissible limit of 6.5 to 8.5 as per the Bureau of Indian Standards (BIS). The minimum value was observed during January (6.5) and maximum during July (7.6). The pH is important since aquatic organisms are well adapted to specific pH range and do not withstand abrupt changes in it[13]. Dissolved oxygen is another vital parameter regulating survival of aquatic life. The DO values fluctuated between 2.7 to 5.2 mg/L. The minimum value was recorded in May and maximum in August. The variations of DO depend on the primary production and respiration of aquatic organisms. Amount of oxygen required to carry out the biological decomposition of dissolved solids in sewage under aerobic conditions at standard temperature is known as the Biochemical Oxygen Demand (BOD). BOD and other microbial activities generally increase by the introduction of sewage[14]. The values ranged from 6.7 to 8.9 mg/L. The highest and the lowest values were recorded in December and September, respectively. They were found above the permissible limit of 6.5 mg/L[15].

Carbon dioxide values fluctuated between 9.9 to 25.2 mg/L. The highest and the lowest values were recorded in August and January, respectively. The variation of CO_2 was due to the absorption by plants for photosynthesis and activity of other living organisms. The abundance of carbon dioxide exerts certain specific effects on aquatic biota[16]. Alkalinity in the water samples is primarily a function of carbonate, bicarbonate and hydroxide content. It ranged from 59 mg/L (October) to 98 mg/L (January). It is within permissible limit of 600 mg/L[15]. Alkalinity around 150 mg/L has been found conductive to higher productivity of water bodies[17].

Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of Ca^{2+} and Mg^{2+} contents. In the present study, total hardness values fluctuated between 80 mg/L (July) to 113 mg/L (May). Total hardness above 200 mg/L is not suitable for domestic use in drinking and cleaning. TDS values ranged from 33.5 to 60.72 mg/L, it was minimum in September and maximum in July. The minimum value may be due to the stagnant condition of the water body. The values are within permissible limits of 1500 mg/L[18]. High values of TDS and sulphates in drinking water are generally not harmful to human beings but high concentration of these may affect persons, who may suffer from kidney and heart diseases[19]. The values of Total Suspended Solids (TSS) ranged from 75 mg/L (April) to 420 mg/L (July). The higher values during monsoon might be due to surface run-off, they were however, within permissible limits[18].

Table 2: **List of phytoplanktons, zooplanktons in Hosahalli pond**

Phytoplanktons	
Chlorophyceae	*Ankistrodesmus spiralis, Arthrodesmus sp., Coelastrum microporum, Coelastrum reticulatum, Crucigenia retangularis, Dimorphococcus lunatus, Eudorina lelgans, Kirshikoviella limnetica, Oocystis gigas, Pediastrum simplex, Pediastrum tetras, Scenedesmus dimorphos, Scenedesmus quadricauda, Selanastrum abundance, Selanastrum acuminatus, Tetraedon longispinum, Tetraedon caudatum*
Cyanophyceae	*Anacystis sp., Anabaena aphnizimenoides, Agmenellum* sp., *Arthospora* sp., *Gloecapsa* sp., *Merismopedia aeruginosa, Merismopedia glauca, Merismopedia tenuissima, Microcystis aeroginosa, Nostoc microscopium, Oscillatoria formosa, Phormidium* sp., *Rivuleria* sp., *Spirulina* sp., *Synechocystis* sp.
Euglenophyceae	*Euglena acus, Euglena gracile, Euglena elongata, Euglena oxyalis, Phacus longicauda, Phacus pleuronectes, Phacus menson, Strombomonas gibberosa, Trachelomonas robasta.*
Bacillariophyceae	*Anomoeonies sphaeophora, Colonies pulchra, Cymbella tumida, Cymbella affinis, Diatoma vulgare, Fragillaria intermedia, Gomphonema abbreviatum, Gomphonema lanceolatum, Gyrosigma elongaa, Melosira granulata, Navicula pupula, Navicula pigmea, Navicula radiosa, Nitzchia amphibia, Pinnularia major, Pinnularia microstauron, Surirella capronii, Synedra ulna, Tabullaria flocculosa.*
Zooplanktons	*Brochines sp., Colpoda* sp., *Cyclopes* sp., *Daphnia* sp., *Elphidia* sp., *Euplotes* sp., *Keratella* sp., *Paramoecium caudata, Paramoecium* sp., *Polyathra* sp., *Uronema* sp.

Calcium ranged from 10.92 mg/L (August) to 20.2 mg/L (January) and magnesium concentration varied from 0.98 mg/L (October) to 6.22 mg/L (May). Magnesium usually occurs in lesser concentration than calcium due to the fact that the dissolution of magnesium rich minerals is slow process and that calcium is more abundant in earth's crest[20].

Water quality can be assessed by its chloride content. Low chloride content indicates pure water. High chloride content indicates polluted water. In the present analysis, the chloride content varied between 65.2 mg/L (August) to 102.7 mg/L (May). Chloride present in sewage and farm drainage, control the salinity of water and osmotic stress on biotic communities[21]. Chlorides increase the degree of eutrophication[22].

The maximum nitrate (7.2 mg/L) was observed in the month of May, possibly due to higher rate of oxidation and minimum (5.1 mg/L) in the month of January. Phosphate is considered as the most critical single element for biological productivity[23]. Increased concentration of phosphates is taken up by phytoplanktons, which leads to algal blooms. Phosphate content ranged from 1.0 mg/L (January) to 1.9 mg/L (August). It is much above the permissible range of 0.10 mg/L.

The values of sulphate were found between 7.2 to 9.7 mg/L. The minimum value was recorded in April and maximum in August. It is within permissible limit of 200 mg/L[18]. Silicate is an essential element as it is required for the growth of diatoms[24]. Silicates thus affect the growth of phytoplanktons. In natural water, normally the ranges of silicates remain from 2 to 25 mg/L[25]. During the present investigation, the range of silicates was observed between 35 to 43.1 mg/L. The minimum value was recorded in March and maximum is February.

A total of 60 phytoplanktons and eleven zooplanktons were identified (Table 1). The percentage of phytoplankton is depicted in Fig. 10. Among phytoplanktons, members of *Chlotophyceae* and *Bacillariophyceae* appear to be dominant as compared to other classes. *Cyclopes*, *Keratella* and *Uronema* were noted among zooplanktons. The acidic pH favors the abundance of chlorophycean members.

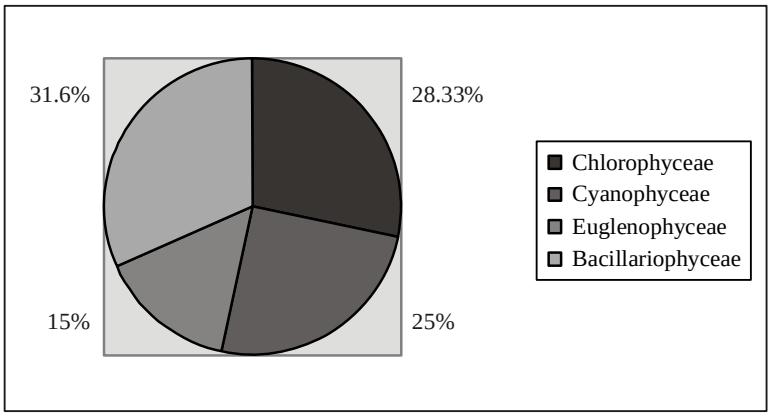

Fig. 10: Distribution of phytoplankton in Hosahalli pond

The results of physico-chemical analysis have revealed that the Hosahalli pond is contaminated due to human disturbances, influx of domestic waste and agricultural run-off from the adjacent area of pond. The presence of bioindicators of pollution (phytoplanktons and zooplanktons) indicates the occurrence of organic pollution. In the light of standard water quality recommended by WHO, the pond water should not be used by human beings

especially for drinking and cooking. It is recommended that the domestic wastes has to be properly treated before discharged into the pond. The anthropogenic activities should be prevented by organizing awareness programs. Proper scientific planning is needed to use this pond water effectively.

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