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DIVERSITY AND SEASONAL DISTRIBUTION OF PLANKTON IN KHASTE LAKE, LEKHNATH, KASKI, NEPAL

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ABSTRACT

Planktons are the important components of aquatic ecosystem. In this study, we assessed the diversity and seasonal distribution of planktons in Khaste Lake, Lekhnath, Kaski. Samples were collected from three stations from April to September using plankton net of mesh size 60µm.The collection period included three different seasons: summer, early monsoon and late monsoon. Altogether 35 genera of plankton, 24 belonging to phytoplanktonic group and 11 to zooplankton, were recorded from April to September 2012. The recorded phytoplankton belonged to four classes namely chlorophyceae, bacillariophyceae, xanthophyceae, and cyanophyceae with fourteen, seven, two and one genera respectively, while zooplanktons belonged to three groups namely rotifera, cladocera and copepoda with three, six and two genera respectively. The dominant class in phytoplankton was chlorophyceae with fourteen genera and in zooplankton was cladocera with six genera. Eleven genera of phytoplankton and five genera of zooplankton were recorded throughout the three seasons of the study period. The rich in diversity of phytoplankton shows high level of nutrient status and the lake changing into Eutrophication Lake resulting from the surface run-off water with fertilizers from agricultural lands and sewage from densely populated area of the surrounding.

Key words: Diversity, Khaste Lake, Phytoplankton, Season, Zooplankton

INTRODUCTION

Water, the greatest factor for life, can be divided mainly into two major types based on their salt content, the marine water with high salt content (3.5%) and fresh water with low salt content 0.001% to 0.05% (Pennak, 1953). There are great varieties of fresh water bodies such as rivers, lakes, streams, reservoirs, village ponds, paddy fields, etc. The National Wetland Policy of Nepal (NWP/N 2003), has defined wetlands as the perennial water bodies originating from underground sources of water or rains. They are marshy lands, riverine flood plains, lakes, ponds, water storage areas and agricultural lands. In Nepal wetlands occupy 743,563 ha. of area, where lakes alone occupy about 0.7% of it (Majupuria, 1984-85).

Plankton community, the minute organisms that drift or float passively with water current, is a heterogeneous group of tiny microscopic organisms adapted as suspension in the sea and freshwater (Hesnen, 1887). Based on their habitat, plankton from lakes are called limnoplankton (Battish 1992), it includes blue green algae, algae, diatoms, protozoans, larvae and eggs of some aquatic animals. Plankton have immense value as food and can play an important role in disposal of sewage and in the natural purification of polluted water. They are also important in fossil fuel formation. Contrary

to the usefulness of plankton, sometimes they become serious problems to the aquatic life. Sudden excessive growth of cyanophyceaen algae due to nutrient availability and rise in temperature called "the water bloom", may be the cause of liberation of certain poisonous chemicals that may destroy the aquatic life, they also impart particular colour, foul odour and bitter taste to the drinking water supply (Prescott, 1961). Specific objective of this study was to investigate the diversity and seasonal distribution pattern of plankton in Khaste Lake.

MATERIALS AND METHODS

Study site

The selected study area – the Khaste Lake, with an area of 24.8 ha.and average depth of 2m is situated in ward no. 4, Kharane Phant, of Lekhnath municipality in the eastern part of Pokhara valley, in Kaski. This lake is surrounded by hills named Baraldanda, Dhunganathar to west and north, Rakhidanda to east and Kharane Phant to its southern part, in other words, the lake is situated at the southern base of these hills. The total area covered by it is 24.8ha and average depth of water 2m with catchment area of 2.8 sqkm (Panta, 2008).Major inlet or feeding source of Khaste Lake is Thulokhola and other few rivulets, while there is a single outlet called Gaduwakhola which arises from its south-eastern end and it is utilized completely for the irrigation purpose.The surface run-off water and sewage effluents from surrounding cultivated lands and densely populated area of uplands find their ultimate ways into this lake. Local community directly depends upon the resources of lake, for their livelihood such as fishing, grazing, as well as they use the water for washing and bathing purpose.

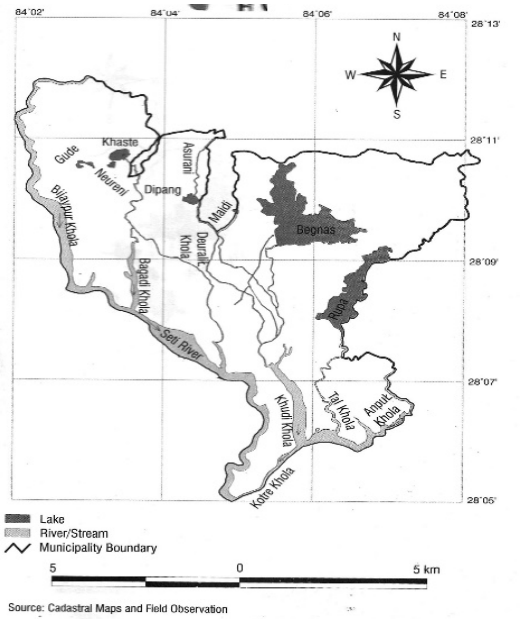


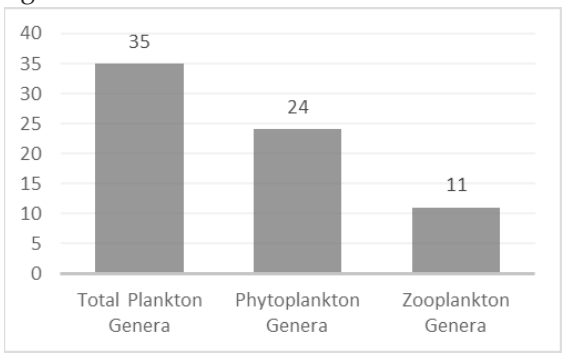
Figure 1: Study site along with other Lakes of Lekhnath area.

Data Collection

A total of three visits to the study area were made for sampling from April to September 2012, in the interval of two months each. The duration of sampling period was divided into summer (April-May), early monsoon (June-July), and late monsoon (August-September) seasons. Ten liters of surface water was taken from each sampling station and filtered through plankton net of mesh size 60µm (at 8 am to 10 am). The collected samples were preserved in the sampling bottle of 25 ml size in Lugol's iodine solution for phytoplankton and in 5% formalin for zooplankton, then brought to botany laboratory, Prithvi Narayan Campus, for further investigation. All the samples were studied under compound microscope, then identified up to their generic level with the help of reputed taxonomic literatures of G.W. Prescott (1961), R.W. Pennak (1953) and S.K Battish (1992). Finally, all the identified plankton were tabulated and analyzed in various ways.

RESULT AND DISCUSSION

The results of study on planktonic diversity in Khaste Lake are described as followings. The various members of plankton belonging to phytoplankton and zooplankton observed, examined and identified during the study period of 6 months, are shown in tabulated and figurative forms.



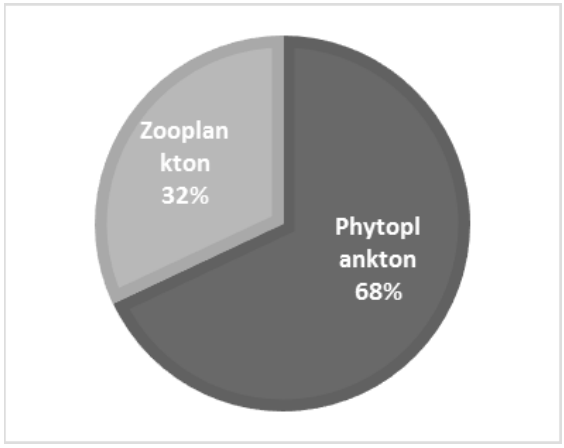


Figure 2: Number and Proportion of Planktonic Genera in Khaste Lake

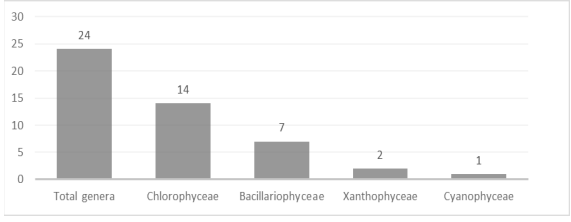


Figure 3: Class-wise Distribution of Phytoplankton Genera in Khaste Lake.

During the study period of 6 months from April to September 2012, in Khaste Lake, altogether 35 genera (Tables 1 and 2) of fresh-water plankton were recorded in which 24 (68%) genera belonging to phytoplankton and 11 (32%) belonging to zooplankton groups (Fig.2). All these phytoplankton come under 15 families, 10 orders, 4 classes and 3 divisions of algal group (Table 1 and Fig. 3). The class Chlorophyceae and Bacillariophyceae stood higher group consisting of 14 genera and 7 genera respectively but in the Cyanophyceae a single genus *Oscillatoria* was recorded. Similarly, zooplankton, out of 11 genera recorded so far, Cladocera stood the first group represented by 6 genera, followed by Rotifera with 3 genera and Copepoda by 2 genera. All the zooplankton come under 9 families,3 orders 2 classes and 2 phyla. (Table 2 and Fig. 4).

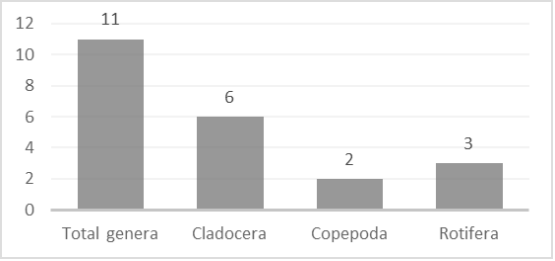


Figure 4: Group-wise distribution of Zooplankton genera in Khaste Lake

Table 1: Diversity and Seasonal Distribution of Phytoplankton in Khaste Lake, April to September 2012

S. N.	Genera	Class	Seasonal Distribution			Remarks
			Summer (April-May)	Early Monsoon (June-July)	Late Monsoon (Aug.-Sept.)	
1.	*Ankistrodesmus sp.*	Chlorophyceae	+	+	-	S+E.M.
2.	*Chlamydomonas sp.*	Chlorophyceae	+	-	-	S
3.	*Chlorella sp.*	Chlorophyceae	+	-	-	S
4.	*Closterium sp.*	Chlorophyceae	+	+	+	ALL
5.	*Cosmarium sp.*	Chlorophyceae	+	-	+	S+L.M.
6.	*Cyclotella sp.*	Bacillariophyceae	+	+	+	ALL
7.	*Desmidium sp.*	Chlorophyceae	+	+	+	ALL
8.	*Fragillaria sp.*	Bacillariophyceae	-	+	+	E+L.M
9.	Gonatozygon sp.	Chlorophyceae	+	-	-	S
10.	*Krichneriella sp.*	Chlorophyceae	+	+	+	ALL
11.	*Melosira sp.*	Bacillariophyceae	+	+	+	ALL
12.	*Navicula sp.*	Bacillariophyceae	+	+	+	ALL
13.	*Nitzschia sp.*	Bacillariophyceae	+	+	+	ALL
14.	*Ophiocytium sp.*	Xanthophyceae	+	-	-	S
15.	*Oscillatoria sp.*	Cyanophyceae	+	+	-	S+E.M.
16.	*Pediastrum sp.*	Chlorophyceae	+	+	+	ALL
17.	*Pinnularia sp.*	Bacillariophyceae	+	+	+	ALL
18.	*Scenedesmus sp.*	Chlorophyceae	+	+	+	ALL
19.	*Selenastrum sp.*	Chlorophyceae	-	+	+	E.M+L.M.
20.	*Staurastrum sp.*	Chlorophyceae	-	+	+	E.M+L.M.
21.	*Synedra sp.*	Bacillariophyceae	+	+	+	ALL
22.	*Tribonema sp.*	Xanthophyceae	+	-	-	S
23.	*Ulothrix sp.*	Chlorophyceae	+	-	-	S
24.	*Vaucheria sp.*	Chlorophyceae	-	+	-	E.M.
Occurrence in each season			20	17	15	

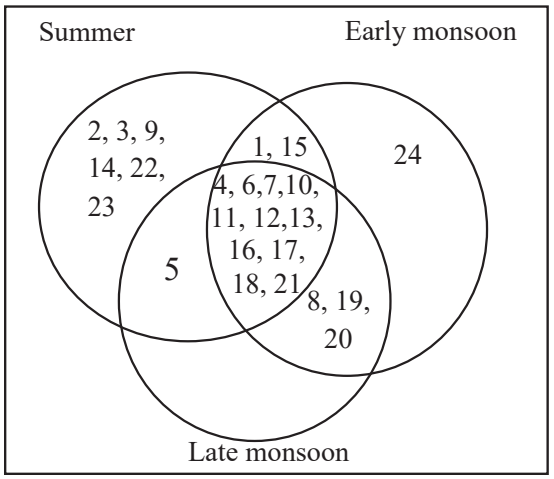
Note: + = Present, - = Absent, S= Summer, E.M.= Early Monsoon, L.M.= Late Monsoon

Table 2: Diversity and Seasonal Distribution of Zooplankton in Khaste Lake April to September 2012

S.N.	Genera	Group	Seasonal Distribution			Remarks
			Summer (April-May)	Early Monsoon (June-July)	Late Monsoon (Aug-Sept.)	
1.	*Asplanchna sp.*	Rotifera	+	+	+	ALL
2.	*Bosmina sp.*	Cladocera	+	+	+	ALL
3.	*Brachionus sp.*	Rotifera	-	+	-	E.M.
4.	*Ceriodaphnia sp.*	Cladocera	+	-	+	S+L.M.
5.	*Chydorus sp.*	Cladocera	+	-	+	S+L.M.
6.	*Cyclops sp.*	Copepoda	+	+	-	S+E.M.
7.	*Daphnia sp.*	Cladocera	+	+	+	ALL
8.	*Diaphanosoma sp.*	Cladocera	-	-	+	L.M.
9.	*Diaptomus sp.*	Copepoda	+	+	+	ALL
10.	*Keratella sp.*	Rotifera	+	+	+	ALL
11.	*Moina sp.*	Cladocera	-	+	+	E.M.+L.M.
-	Nauplius larvae	Copepoda	+	+	+	ALL
Occurrence in each season			8	8	9	-

Note: + = Present, - = Absent, S= Summer, E.M.= Early Monsoon, L.M.= Late Monsoon

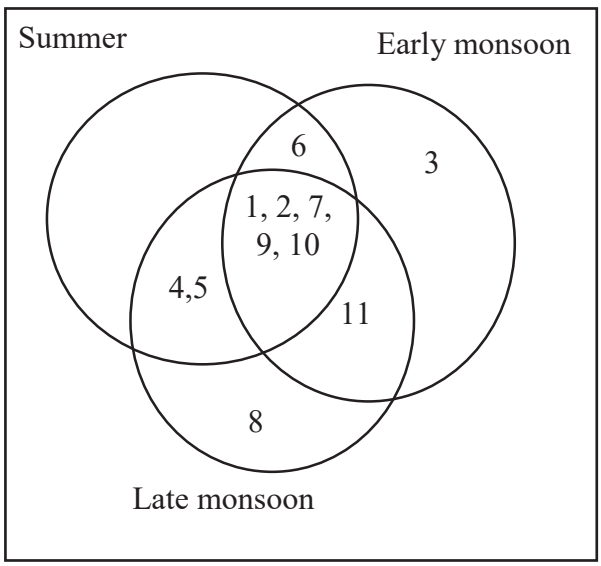
On the basis of seasonal distribution, among the phytoplankton community a total of 20, 17 and 15 genera were recorded in summer, earlymonsoon and late monsoon respectively. Out of them, 5 genera *Colsterium*, *Desmidium*, *Krichneriella*, *Pediastrum* and *Scenedesmus* from Chlorophyceae, and 6 genera from Bacillariophyceae *Cyclotella*, *Melosira*, *Navicula*, *Nitzschia*, *Pinnularia* and *Synedra* were recorded in all sampling seasons. Four genera from Chlorophyceae namely *Chlamydomonas*, *Chlorella*, *Gonatozygon*, *Ulothrix* and two genera from xanthophyceae, *Ophiocytium* and *Tribonema,* were found occurring only in summer. *Vaucheria* was recorded in early monsoon only. *Ankistrodesmus* and *Oscillatoria* were found in summer and early monsoon only. *Cosmarium* was recorded in summer and late monsoon, but the *Fragillaria*, *Selenastrum*, and *Staurastrum* were recorded in monsoon only, (Table 1 and Fig. 5).



C.N.	Phytoplankton	C.N.	Phytoplankton
1.	*Ankistrodesmus sp.*	13.	*Nitzschia sp.*
2.	*Chlamydomonas sp.*	14.	*Ophiocytium sp.*
3.	*Chlorella sp.*	15.	*Oscillatoria sp.*
4.	*Closterium sp.*	16.	*Pediastrum sp.*
5.	*Cosmarium sp.*	17.	*Pinnularia sp.*
6.	*Cyclotella sp.*	18.	*Scenedesmus sp.*
7.	*Desmidium sp.*	19.	*Selenastrum sp.*
8.	*Fragillaria sp.*	20.	*Staurastrum sp.*
9.	*Gonatozygon sp.*	21.	*Synedra sp.*
10.	*Krichneriella sp.*	22.	*Tribonema sp.*
11.	*Melosira sp.*	23.	*Ulothrix sp.*
12.	*Navicula sp.*	24.	Vaucheria sp.

Figure 5: Seasonal Distribution of Phytoplankton genera in Khaste Lake

Among the zooplankton community, a total of 8,8 and 9 genera were recorded in summer, early monsoon and late monsoon respectively, out of these, *Asplanchna*, *Bosmina, Daphnia*, *Diaptomus* and *Keratella* were found in all seasons of sampling period; whereas *Brachionus* was noted in early monsoon and Diaphanosoma *in* late monsoon only. The cladocera members *Chydorus* and *Ceriodaphnia* were recorded in summer, not recorded in early monsoon but reappeared in late monsoon. The genus *Moina* was not observed during the summer, similarly *Cyclops* was not observed in late monsoon. (Table 2 and Fig. 6)



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C.N.	Zooplankton
1.	*Asplanchna sp.*
2.	*Bosmina sp.*
3.	*Brachionus sp.*
4.	*Ceriodaphnia sp.*
5.	*Chydorus sp.*
6.	*Cyclops sp.*
7.	*Daphnia sp.*
8.	*Diaphanosoma sp.*
9.	*Diaptomus sp.*
10.	*Keratella sp.*
11.	*Moina sp.*

Figure 6: Seasonal Distribution of Zooplankton genera in Khaste Lake

Baral (1996) reported large number of genera from chlorophyceae, bacillariophyceae and xanthophyceae from various lakes, rivers and streams including lakes of Pokhara valley, of which, most of them were plantonic algae. Bista *et al.* (2000) recorded the genera *Cyclotella*, *Melosira* and *Synedra* from bacillariophyceae and large number of genera from chlorophyceae and cyanophyceae

throughout the year in Phewa Lake and Rupa Lake. Rai (2000) described the abundance of phytoplankton in lakes of Pokhara valley indicating the trends of eutrophication of lakes. Dhewajoo (2007) has reported the phytoplankton genera belonging to chlorophyceae, bacillariophyceae and euglenophyceae with the dominance of chlorophycean from Buduwa (Kamal Pokhari) in Pokhara, indicating the water body rich in nutrients. Rai and Bista (2001) found bacillariophyceae, chlorophyceae and cyanophyceae as dominant phytoplankton groups in Phewa and Begans lake where *Cyclotella* and *Synedra* were recorded in all seasons.

All these findings mentioned above clearly showed that, there was no sharp differences in seasonal distribution pattern in the planktonic diversity. Among the phytoplankton groups, members of chlorophyceae, bacillariophyceae and cyanophyceae were predominant in all season. Although some of them show little fluctuations in their appearance that may be due to some seasonal climatic and nutritional variations. Present study in Khaste Lake was found to be correlating with the findings of earlier investigations especially with reference to the lakes Phewa, Begnas and Rupa of Pokhara valley.

During the period of six months of investigation from April to September 2012 in Khaste Lake, it was found that from the point of view of diversity and seasonal distribution of phytoplankton, the chlorophyceae were dominant followed by bacillariophyceae and other classes. Among chlorophyceae *Closterium, Desmidium, Krichneriella, Pediastrum* and *Scenedesmus* and from bacillariophyceae, *Cyclotella, Melosira, Navicula, Pinnularia, Synedra* and *Nitzschia* were recorded in all seasons during study period.

Among the zooplankton, Sewell (1934) reported 15 species of cladocera, 10 species of copepoda, 10 species of rotifera and one species of ostracoda from the fresh water tank inside Indian museum compound. Chacko and Krishnamurthy (1954) recorded few species of cladocera and copepoda from there freshwater fish ponds in madras city, India. Nasar (1973) reported 16 species of rotifers from Bhagalpur, India. Pokharel (1995-96) reported 6 genera of cladocera, two of copepoda and three of rotifera in his studies in Balaju, Kathmandu: Dhewajoo (2007) reported 6 genera belonging to protozoa, rotifera, cladocera, ostracoda and copepoda from Buduwa (Kamal Pokhari) in Pokhara. Husen and Dhakal (2009) noted the fluctuations of plankton diversity in different season in Phewa lake.

The above findings favored in most of the aspect of the present study. It was found that some genera of zooplankton occurring throughout the study period while other showed their absence in certain season and reappeared later. Although most of the zooplankton species survive under a wide range of environmental conditions and their growth and density depends on number of physical, chemical and biological factors. The amount of food available to zooplankton is one of the vital factors along with other environmental conditions which control the zooplankton abundance and diversity in the lake (Swar and Fernando, 1980). The absences in regular records of some genera in this study supported the above fact

There is a significant relationship between growth of plankton and nutrients resulting from surface run-off water and sewage effluents from populated surrounding area of water bodies. The excessive growth of plankton clearly indicates the changing of aquatic habitat into eutrophication (Prescott, 1961).

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