IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Comparative Study of Macro-Invertebrates of Bhoj Wetland, Bhopal, In Relation to Water quality

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Abstract

Diversity of whole macro-benthos seems to be related only to complex ecological factors like productivity or habitat heterogeneity, while different groups of macro-benthic may be strongly affected by simple, abiotic environmental parameters. The present study was conducted on Bhoj Wetland (Upper lake or Bada talab & Lower lake or Chhota talab) of Bhopal, with special reference to Macro-benthic invertebrates Diversity. The benthic communities spread into a wide range of flora, fauna and bacteria from all levels of food web and inhabit different types of habitat such as mud, sand, rocks, stones, macrophytes and other solid organic matter.

Considerable variation of benthic organisms are recorded in both of the water bodies during the research work with comparison of their water quality. During the present study, I have recorded 3 different Phylum of Macro-benthic Organisms Mollusca, Arthropoda and Annealida from 3 different sites of both water bodies. Upper lake is richer in terms of species prosperity in comparison to lower lake. The dominance of Molluscs population in both the water bodies in terms of diversity and density has been recorded.

Keywords: Macro-benthos diversity, Water quality, Bhoj wetland.

Introduction

The macro benthic fauna are those organisms can live inside the deposit at the bottom of the water body (Idowu and Ugwumba, 2005). Including different phylum across Mollusca, Arthropoda and Annelida, macro-benthic organisms includes several species. Benthic organism plays a vital role in recalculating of nutrients in aquatic ecosystem. They mainly feed on the extracts of other animals and dead body of other animals that settle on the bottom layer of the water body and in turn serve as food for a wide range of fishes (Ugwumba, 2005). Also, they accelerate the breakdown of decaying organic matter into simpler inorganic forms such as phosphate and nitrates (Gallep et al., 1978).

Macro-benthic invertebrates are useful bio-indicators providing a more accurate understanding of changing aquatic conditions (Ikomi et al.2005).Odiete (1999) stated that the most popular biological method in assessment of freshwater bodies receiving domestic and industrial wastewaters is the use of benthic macro-invertebrates. Their composition, abundance and distribution can be influenced by water quality (Odiete, 1999).

The macro-benthic organisms comprise of an important group of aqua fauna by way of their contribution of ecosystem stability, besides acting as potential bio-indicators of trophic status, as such great emphasis was laid on for the better understanding of benthic environment, its communities and productivity all over the world. Benthic fauna support the economical important fish population especially bottom feeders and also facilitates the recycling of nutrients. Their distribution indicates the potential of water body and also serves as good indicator of trophic status. Data on macro-benthic community, their distribution and structure has been used in ecological monitoring programs, and is an important ecological tool to describe spatial and temporal changes (Rosas et al. 1985).

Many contributors have described benthos in relation to water quality. As we know that each species is important component of food chain and food webs which helps in transfer of energy to trophic levels and cycling of nutrients in any ecosystem. Macro-benthic organisms act as food for many aquatic birds and fishes also benthic organisms are used as potent pollution indicators, as the study area is Ramsar site also, so it is utmost important to document the benthic diversity. Keeping this in view an attempt has been made to document benthic diversity of Bhoj wetland Bhopal.

Materials and Methods

During the present study on macro-invertebrates samples are collected from six different station of Bhoj Wetland of four months from August to November. For the study of various benthic invertebrates and the physicochemical parameters of water of the Bhoj Wetland the samples are collected on weekly basis from the selected stations. The samples were collected at 8.00am to 10am. Physico-chemical parameters of water samples were analysis following the standard methods as given in **A. D. ADONI.** DO, pH, free CO_2, Alkalinity, Total Hardness were estimated at sampling stations in laboratory room. Hand-lens, net of mesh size was used for benthic macro-invertebrates collection and transport them to a glass bottle for identification.

Study Area

Bhopal, the capital city of Madhya Pradesh, India is known as the "city of lake" for its historical lakes. Bhoj Wetland (a Ramsar site) comprise of two man-made basins or lakes, one is the "Upper lake" and the another is "Lower lake". The Upper lake is an east-westernly elongated irregular shallow margins lake with dens growth of macrophytes, avifauna and benthic diversity. It was constructed of an earthern dam by Raja Bhoj in 11thcentury, across the river Kolans and river Uljhawan. And the Lower lake was constructed in 18th century from overflow of water from the Upper lake.

Table 1: Morphometric features of Bhoj Wetland

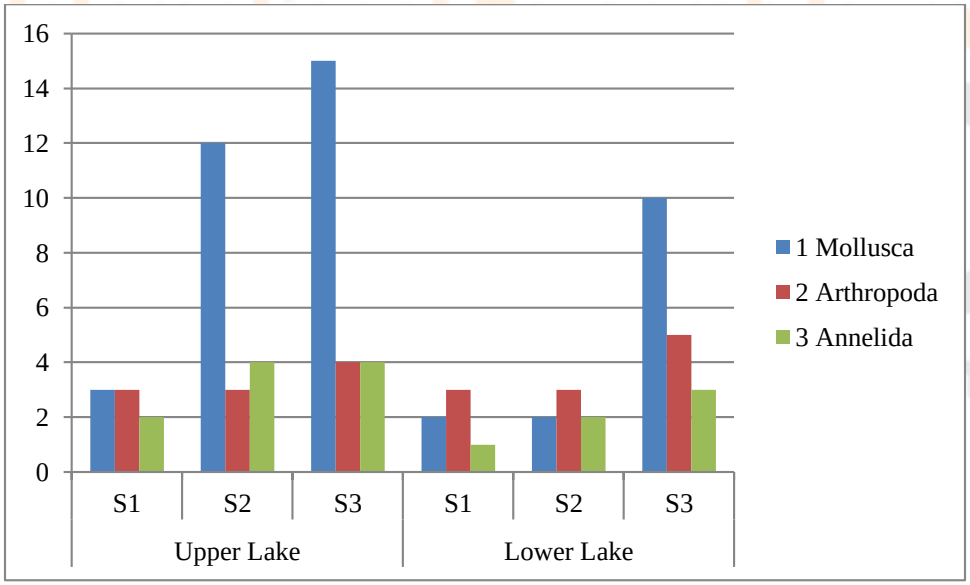
FEATURES	UPPER LAKE	LOWER LAKE
Constructed	11th century	18th century
Types	Earthen dam	Earthen dam
Latitude	23º10'-23º20'N	23º16'-23º20'N
Longitude	77º15'-77º25'E	77º25'-77º30'E
Length (km)	12.5	1.6
Width (m)	5000	954
Max. depth (m)	13	9.4
Mini. Depth (m)	6	6.16
CatchmentArea (km^2)	361	9.6
Water sources	Rain water, Kolans River, Uljhawan River	Rain water, Upper lake
Use for	Drinking, Aquaculture	Bathing, washing, Aquaculture

Results

S. No.	Phylum	SPECIES NAME	Upper lake			Lower Lake		
			S1	S2	S3	S1	S2	S3
	Mollusca	**FAMILY- VIVALVIA**						
01.		*Bellamya bengalensis*	+	+	+	-	-	+
02.		*Viviparous sp*	-	+	+	-	-	+
		FAMILY-AMPULLARIDAE						
03.		*Pila globossa*	-	+	+	+	+	+
04.		*Pila sp*	+	-	+	-	-	+
		FAMILY-THIARIDAE						
05.		*Thiara tuberculata*	-	+	+	-	+	+
06.		*Melanoides lineatus*	+	-	+	-	-	-
07.		*Thiara pyramis*	-	+	+	-	-	+
08.		*Thiara scraba*	-	+	+	-	-	+
09.		*Melanoides tuberculata*	-	+	+	-	-	-
		FAMILY-LYMNEIDAE						
10.		*Lymnaea auricularia*	-	+	+	-	-	+
11.		*Lymneae ovate*	-	+	+	-	-	-
12.		*Lamellidens sp*	-	+	+	-	-	-
		FAMILY-BITHYNIIDAE						
13.		*Gibbia stenothyroides*	-	+	+	+	-	+
14.		*Gibbia travancoria*	-	+	+	-	-	+
15.		*Digoniostoma pulchella*	-	-	+	-	-	-
		TOTAL	03	12	15	02	02	10
	ARTHROPODA							
		FAMILY-CHIRONOMIDAE						
16.		Chironomous sp.	-	+	-	+	-	-

17.		*Spaniotoma sp.*	-	+	+	+	-	+
		FAMILY-HYDROPTILADAE						
18.		*Hydrptila sp.*	+	-	+	-	+	+
		FAMILY-PALAMONIDAE						
19.		*Palaemonetes sp.*	-	-	-	+	-	+
		FAMILY-EPHEMERELLUDAE						
20.		*Ephemerella sp.*	+	-	-	-	+	-
		FAMILY-HYDROPHILIDAE						
21.		*Berosus sp.*	-	+	+	-	-	+
		FAMILY-NEPIDAE						
22.		*Ranatra sp.*	+	-	+	-	+	+
		TOTAL	03	03	04	03	03	05
	ANNELIDA							
		FAMILY-TUBIFICIDAE						
23.		*Tubifix tubifix*	+	+	+	-	+	+
		FAMILY-GLASSIPHONIDAE						
24.		*Hemiclepsis viridis*	+	+	+	-	-	+
25.		*Glassiphonia complanata*	-	+	+	-	+	+
		FAMILY-LUMBRICULLIDAE						
26.		*Lumbriculus sp.*	-	+	+	+	-	-
		TOTAL	02	04	04	01	02	03

S. No.	**BENTHOS GROUP**	**Upper Lake**			**Lower Lake**		
		S1	**S2**	**S3**	**S1**	**S2**	**S3**
01	Mollusca	03	12	15	02	02	10
02	Arthropoda	03	03	04	03	03	05
03	Annelida	02	04	04	01	02	03



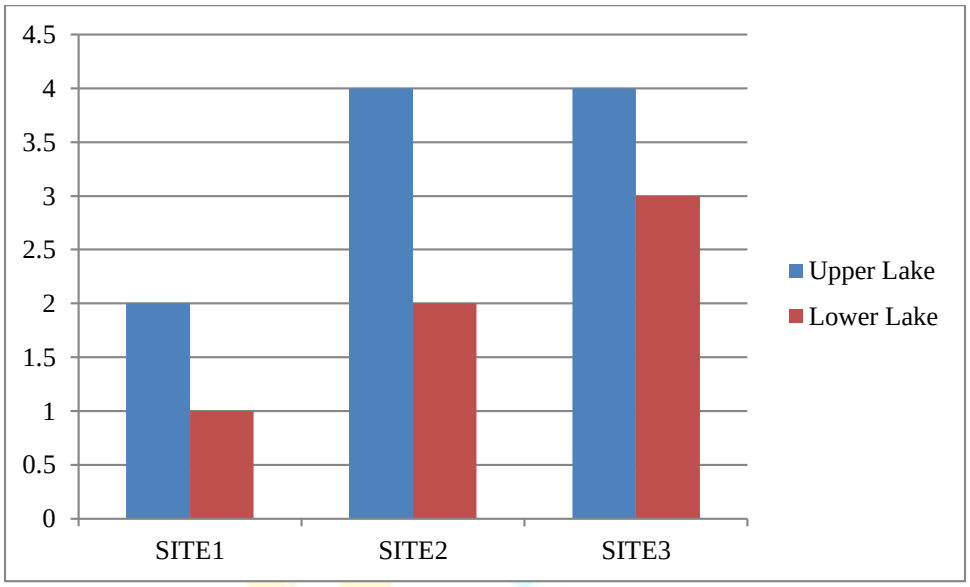


Fig: Distribution of Mollusca of Bhoj Wetland

Fig: Distribution of Mollusca of Bhoj Wetland as percentage

Fig: Distribution of Arthropoda of Bhoj Wetland

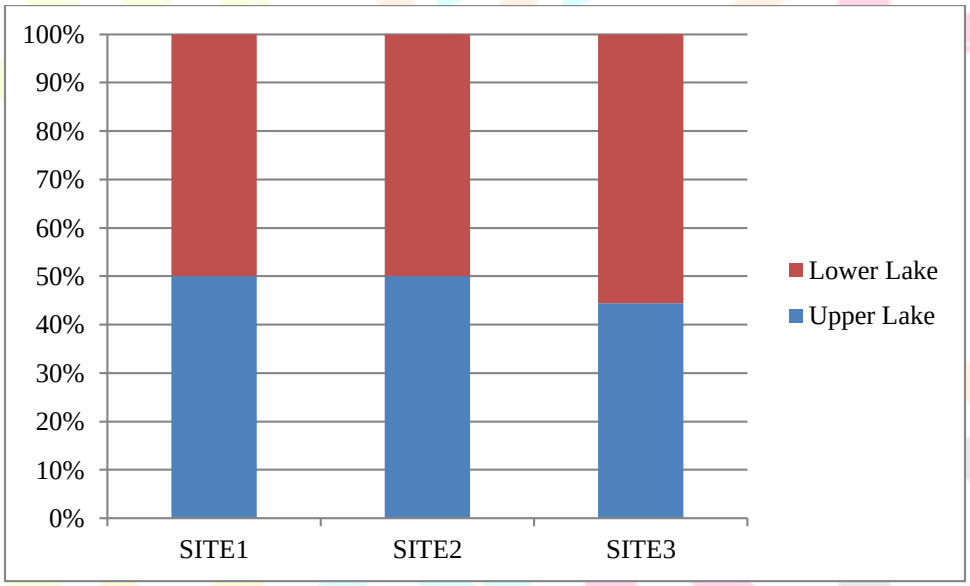


Fig: Distribution of Arthropoda of Bhoj Wetland as percentage

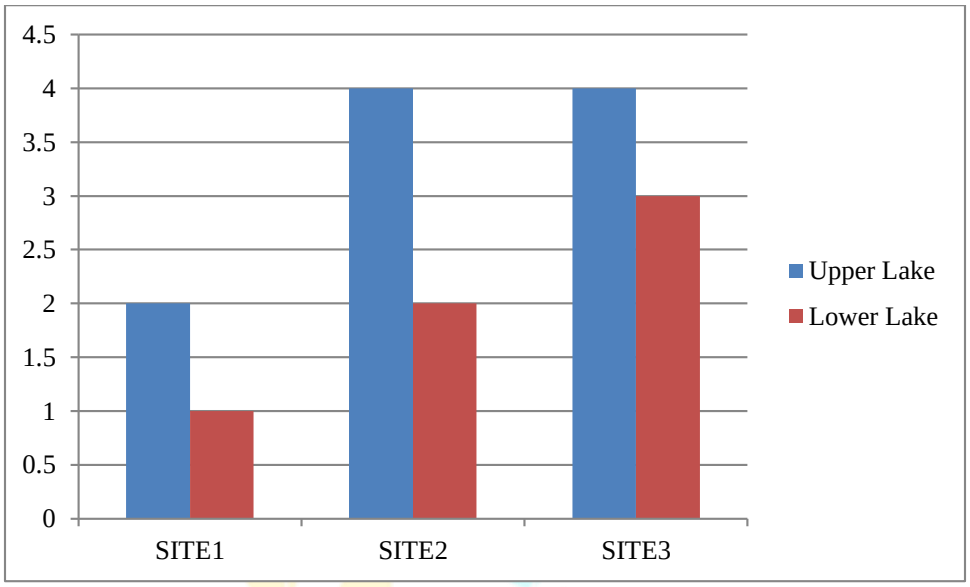
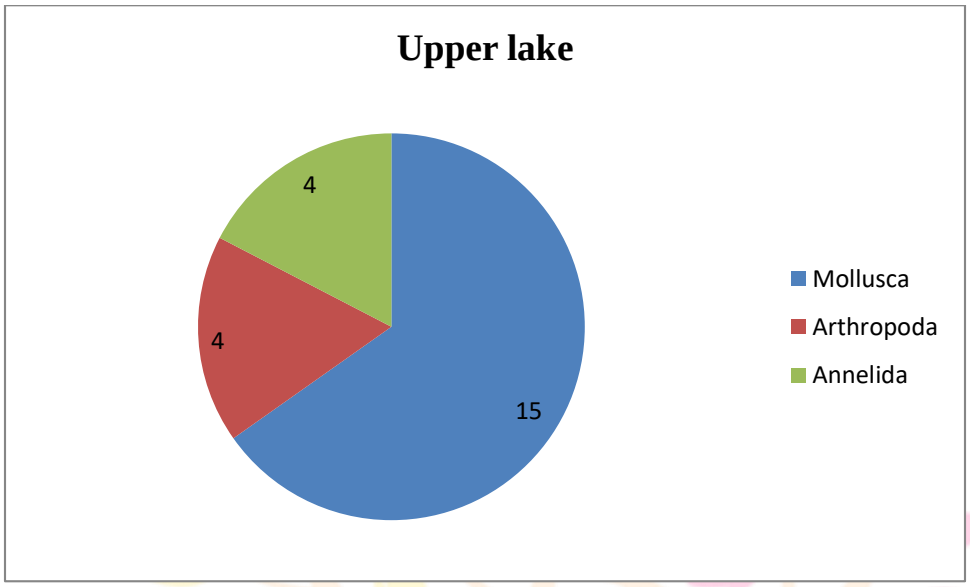
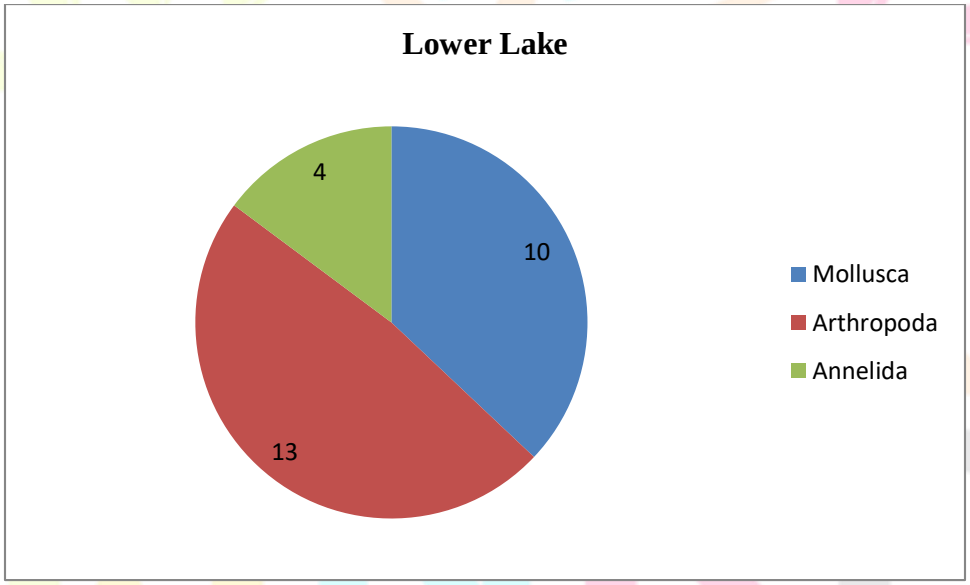


Fig: Distribution of Annelida of Bhoj Wetland

Fig: Distribution of Annelida of Bhoj Wetland as percentage

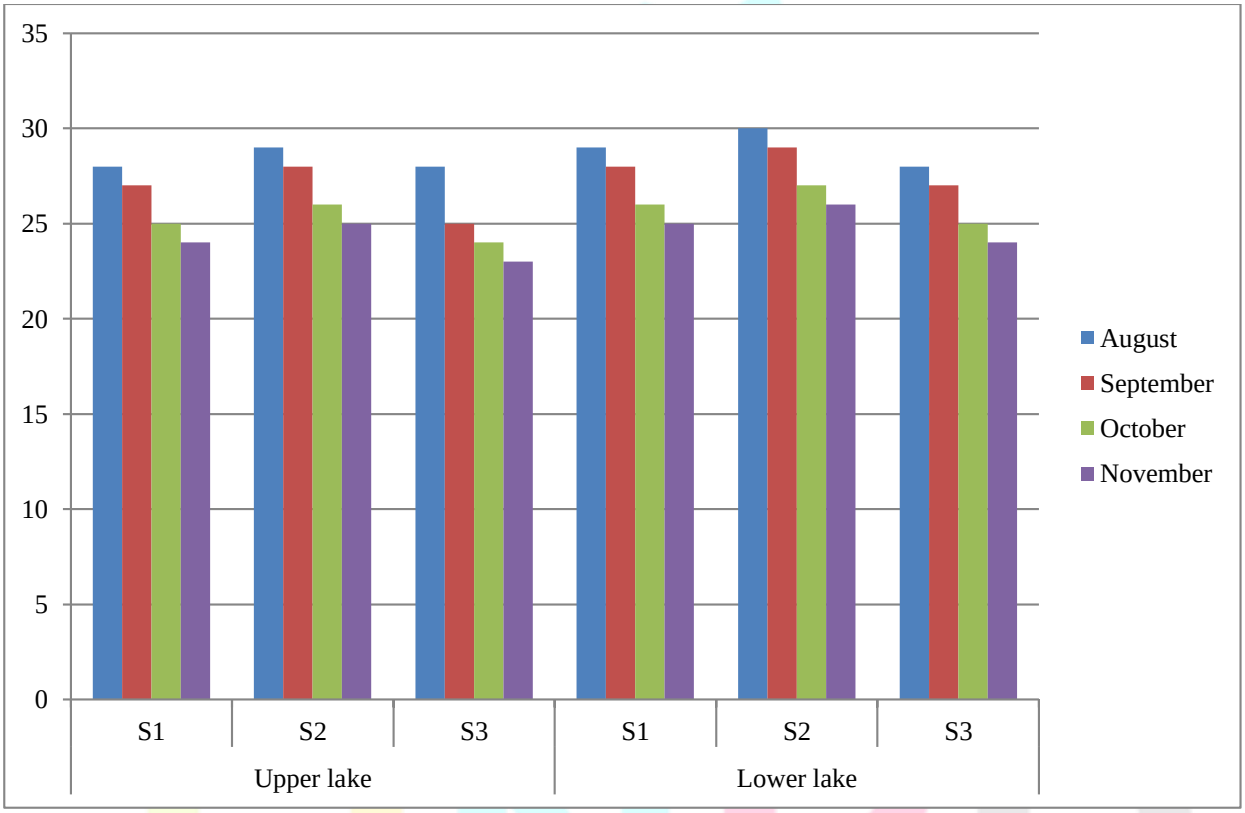
Distribution of Macro-Invertebrate of Bhoj Wetland (Upper & Lower lake)





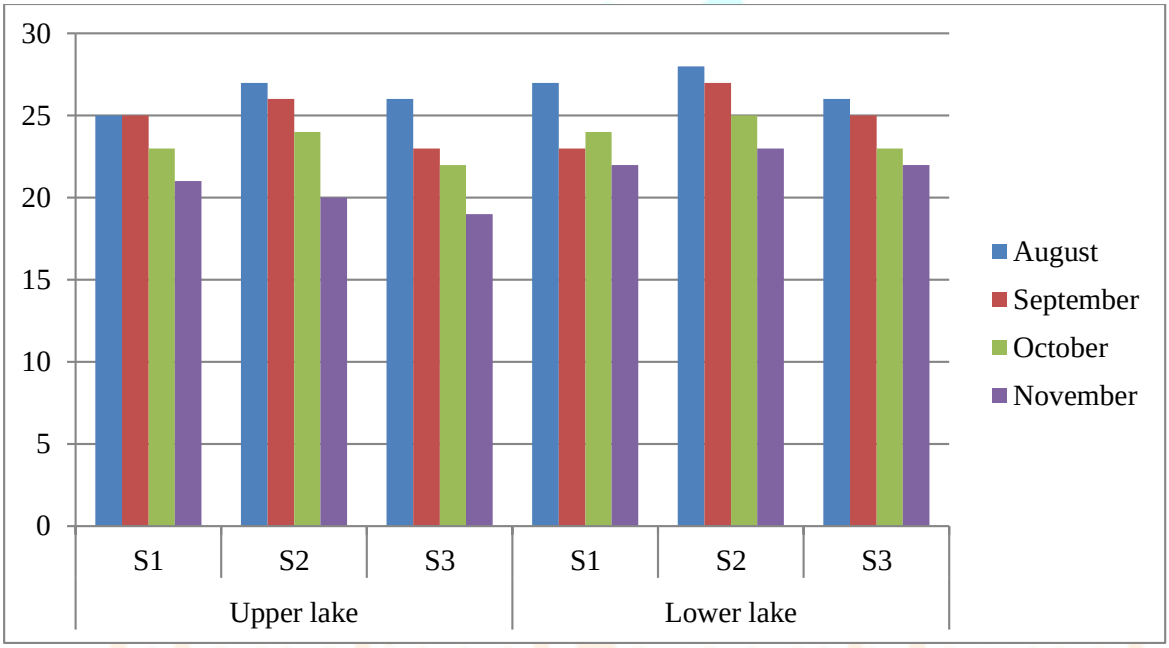
Monthly variation of Air (°c) temperature from 3 study sites of Bhoj Wetland (Upper & Lower lake)

Air (°C) Temperature	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	28	29	28	29	30	28
September	27	28	25	28	29	27
October	25	26	24	26	27	25
November	24	25	23	25	26	24



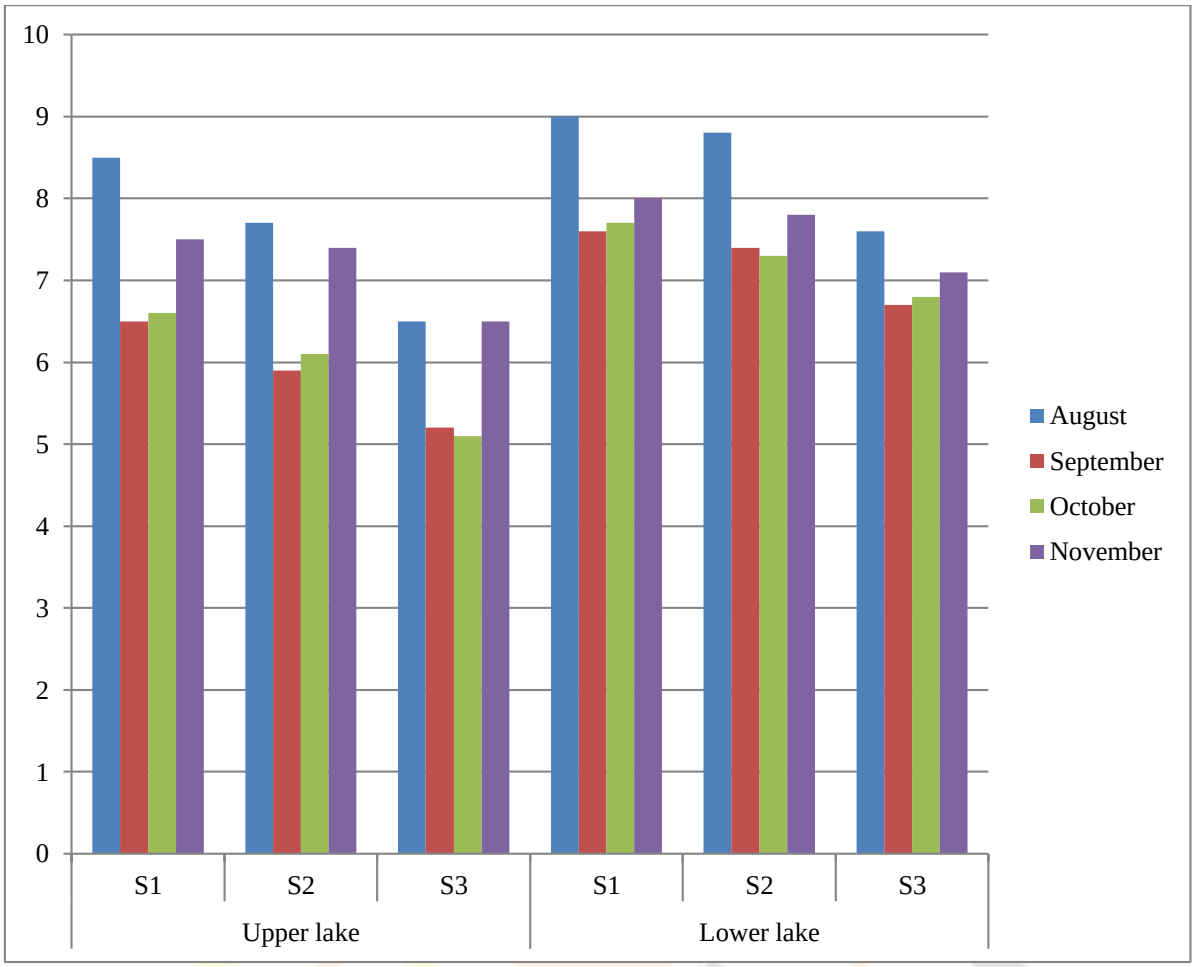
Monthly variation of Water (°c) temperature from 3 study sites of Bhoj Wetland (Upper & Lower lake)

Water (°C) Temperature	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	25	27	26	27	28	26
September	25	26	23	23	27	25
October	23	24	22	24	25	23
November	21	20	19	22	23	22



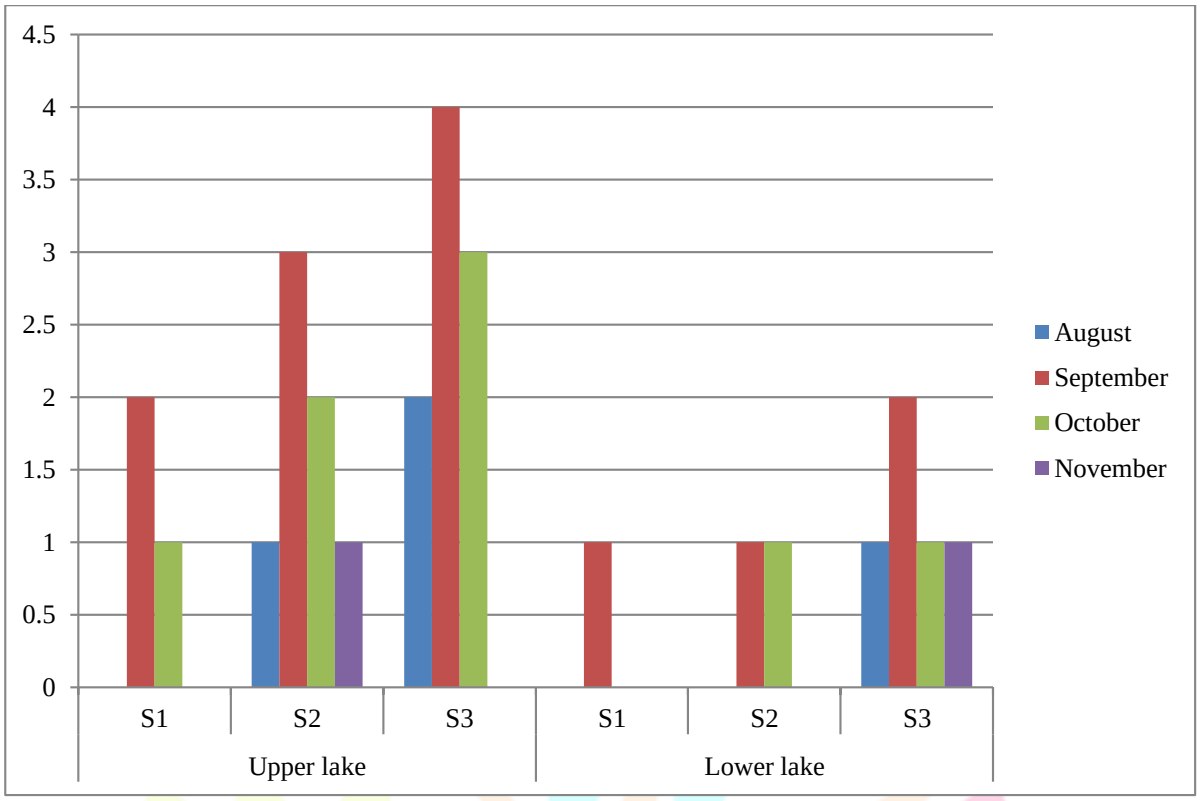
Monthly variation of DO from 3 study sites of Bhoj Wetland (Upper & Lower lake)

DO (mg/l)	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	8.5	7.7	6.5	09	8.8	7.6
September	6.5	5.9	5.2	7.6	7.4	6.7
October	6.6	6.1	5.1	7.7	7.3	6.8
November	7.5	7.4	6.5	08	7.8	7.1



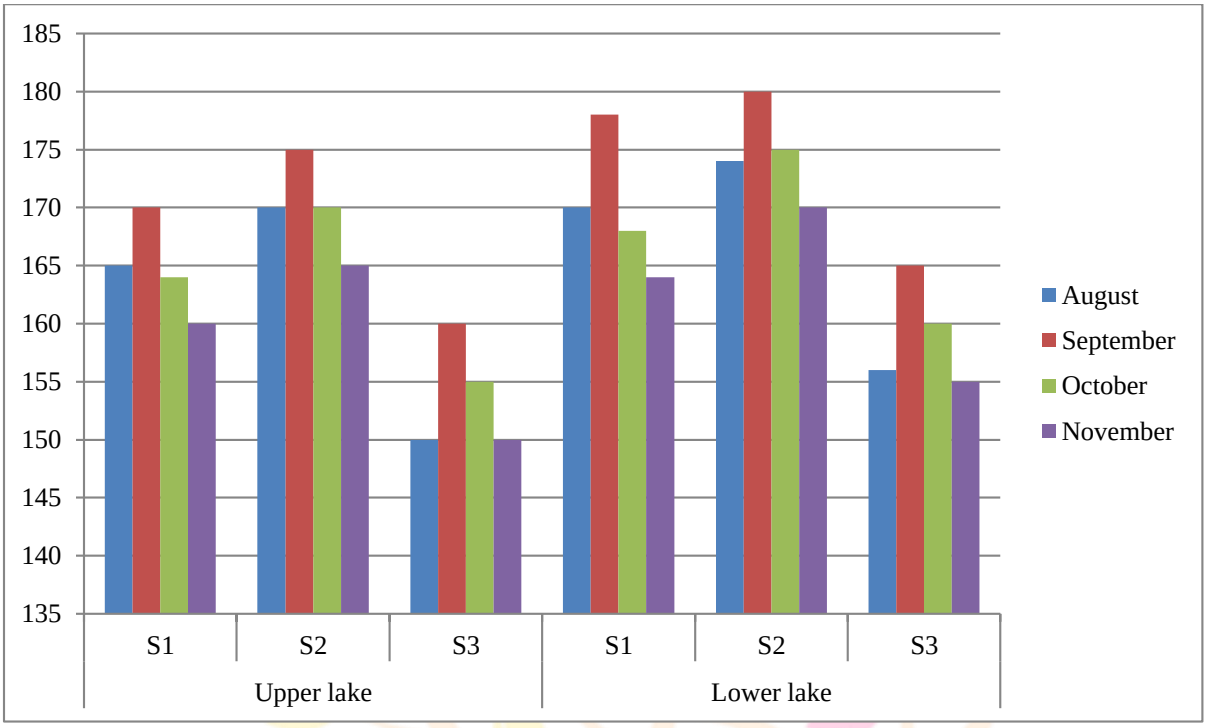
Monthly variation of Free CO2 from 3 study sites of Bhoj Wetland (Upper & Lower lake)

Free CO2 (mg/l)	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	00	01	02	00	00	01
September	02	03	04	01	01	02
October	01	02	03	00	01	01
November	00	01	00	00	00	01



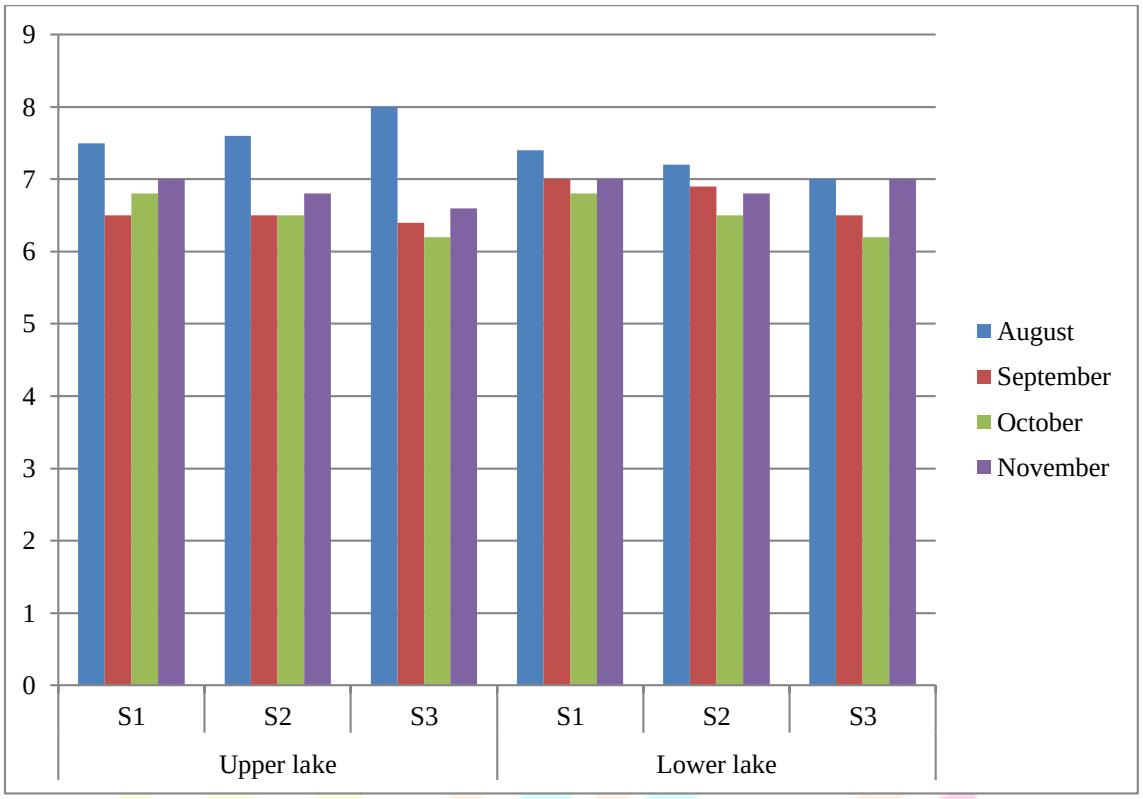
Monthly variation of Total Hardness from 3 study sites of Bhoj Wetland (Upper & Lower lake)

Total Hardness (mg/l)	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	165	170	150	170	174	156
September	170	175	160	178	180	165
October	164	170	155	168	175	160
November	160	165	150	164	170	155



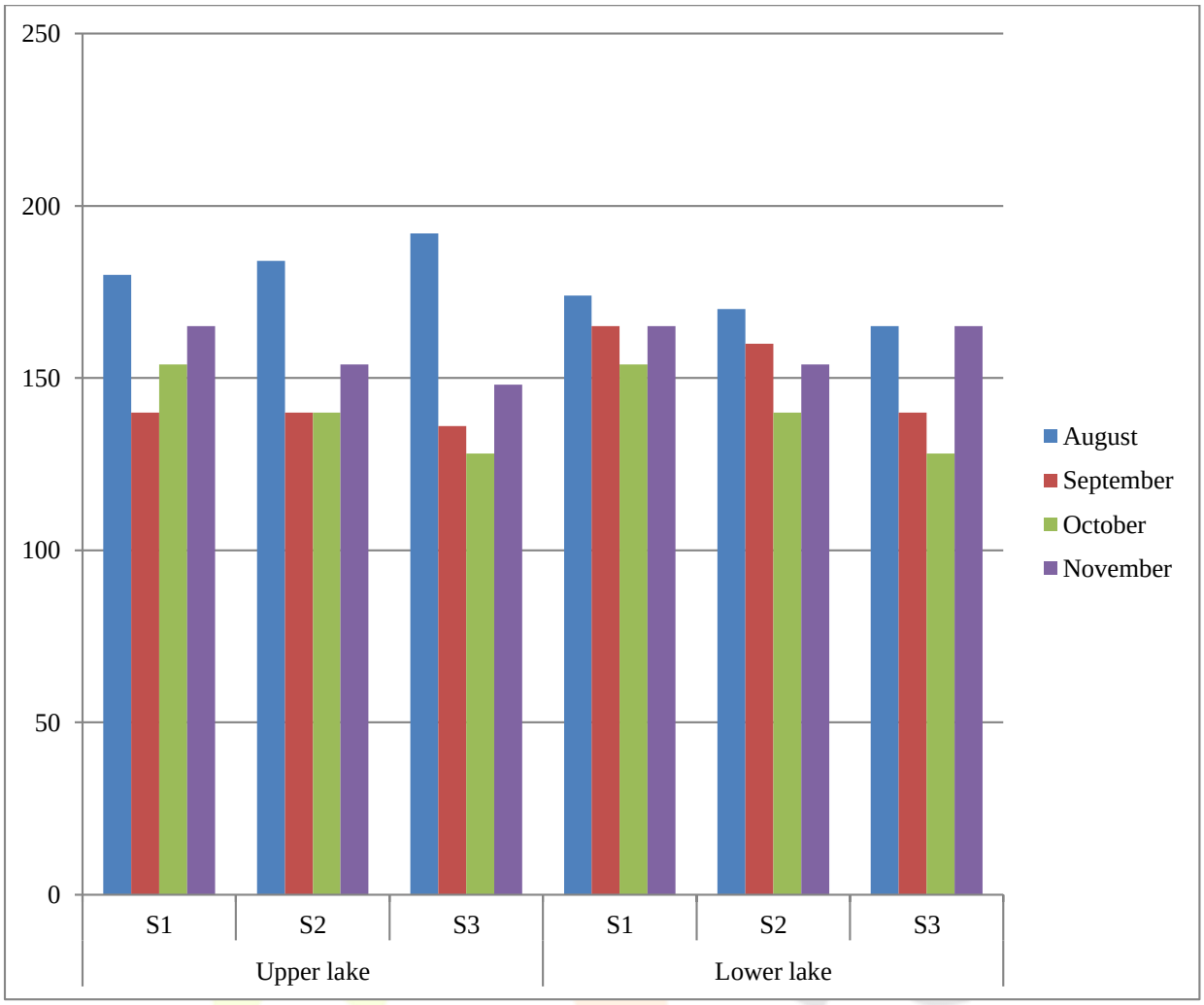
Monthly variation of pH from 3 study sites of Bhoj Wetland (Upper & Lower lake)

pH	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	7.5	7.6	8	7.4	7.2	7
September	6.5	6.5	6.4	7.0	6.9	6.5
October	6.8	6.5	6.2	6.8	6.5	6.2
November	7	6.8	6.6	7	6.8	7



Monthly variation of Total Alkalinity (mg/l) from 3 study sites of Bhoj Wetland (Upper & Lower lake)

Total Alkalinity (mg/l)	Upper lake			Lower lake		
	S1	S2	S3	S1	S2	S3
August	180	184	192	174	170	165
September	140	140	136	165	160	140
October	154	140	128	154	140	128
November	165	154	148	165	154	165



Discussion

The Bhopal city is called the "City of Lake" for the presents of the two lakes named Upper lake and Lower lake. 1.4 million of population are depends upon the Bhoj Wetland for drinking water and their daily uses. Both lakes are situated in Bhopal, M.P. the Bhoj Wetland is very rich in biodiversity, but now a days due to the Industrialization which is growing faster, has become a threat to the aquatic biodiversity of these water bodies. Macro benthic-invertebrates are common inhabitants of lakes and streams and are important in energy flow through the food webs. Benthic invertebrates are the most commonly used biological indicators for freshwater resources, because they are Sedentary i.e. stay in one place and generally abundant, can be easily collected from any water body, long-lived to reflect cumulative impacts, respond to wide range of stressors and key part of food web that ecological important.

During the present study total 26 no of Benthic species were found from the study stations in the study area. These species are belongs from three several phylum *viz.*, Mollusca, Arthopoda and Annelida. The Mollusca community was presented by 5 family and total no. of species were 15, Arthropoda was presented by 6 family and total no of species is 7, Annelida was presented by 3

family and 4 species. Only 4 species of Annelida are found. During four month study I found total 26 species, 15 Mollusca, 7 Arthropoda, 4 Annelida. In the upper lake mostly found Mollusca species whereas in Lower lake found Arthropoda. In Upper lake the family observed from three station during the study period was 12, having 24 species of benthos, these are belongs to 3 phylum. In Lower lake the family observed from three station during the study period was 13, having 21 species of benthos, belongs to three phylum. In Upper lake from site1 3 Mollusca, 3 Arthropoda, 2 Annelida, site2 12 mollusca, 3Arthropoda, 4 Annelida, Site3 15 Mollusca, 4 Arthropoda, 4 Annelida were found. In Lower lake from site1 2 Mollusca, 3 Arthropoda, 1 Annelida, site2 2 Mollusca, 3 Arthropoda, 2 Annelida, site3 10 Mollusca, 5 Arthropoda, 3 Annelida were found. Distribution of Mollusca species in Upper lake excellent from Lower lake. In Lower lake more population of Arthropoda is rich than other phylum.

Physic-chemical parameters: Water quality were analyzed as per **A. D. Adoni**. On investigation showed variation in different aquatic habitats. Fluctuation of water parameters can effect on the biological diversity of water body. On the present study shows that the water temperature range between 20°c-28°c and air temperature ranges between 23°c-30°c. The highest water temperature was recorded at site 2 of the Upper lake and lowest temperature of water was recorded at site 2 of Lower lake. The pH of the water varies between 6.2-8, maximum value 8 at site 3 Upper lake and minimum value 6.2 at site3 of Upper lake in August. The pH is function of hydrogen ion concentration. The highest range of alkalinity was 194 mg/l at site 3 of Upper lake, and lowest at site 3 of Lower lake. High amount of alkalinity indicates a bad water quality. In Upper lake highest Co_2 was 4mg/l at site 3 and lowest Co_2 was 0mg/l at site1 and site 2 of Lower lake. DO was observed ranging 5.1-8mg/l in Upper lake and 6.7-9mg/l. high range of DO is clearly indicate a good quality of water quality. Through the experiment of the water quality it can clearly shows Lower lake has a better water quality than the Upper lake.

Conclusion

During the present study total 26 no of Benthic species were found from the study stations in the study area. These species are belongs from three several phylum *viz.*, Mollusca, Arthopoda and Annelida. The Mollusca community was presented by 5 phylum and total no. of species were 15, Arthropoda was presented by 6 family and total no of species is 7, Annelida was presented by 3 family and 4 species. In the upper lake mostly found Mollusca species whereas in lower lake found Arthropoda. Only 4 species of Annelida are found. During four month study I found total 26 species, 15 Mollusca, 7 Arthropoda, 3 Annelida. By this we can conclude has that Lower Lake is more better than Upper Lake according to its water quality. In Upper lake site1 is cleaner than site2 and site3 according to water quality. In Lower lake site3 is indicate polluted than site2 and site3 according to its water quality.

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