

# Biological Study of Seasonal Monitoring and Diversity of Zooplankton of Sapna Dam, Betul District, Madhya Pradesh, India.

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**Abstract :** Diversity of zooplankton has been investigated to account for the density, diversity and seasonal variations of zooplankton in the freshwater habitat of Sapna Dam. Monitoring of zooplankton present in dam water was compared between three seasons of two sessions. The physicochemical properties of water such as temperature, pH, TDS, DO, BOD and COD were determined by selected parameters to obtain an accurate estimate of water quality and found some small fluctuations between the three different seasons from both seasons. Five groups such as Rotifera (8, species), Cladocera (3, species), Copepoda (3, species), Ostracoda (1, species), and Protozoa (3, species) were observed, with a total of 18 different species belonging to the above groups.

Keywords: Diversity, Zooplankton, Seasons, Sapna Dam.

## INTRODUCTION

Zooplanktons are ubiquitous live in the ecosystem of the water body in different zones and it plays a role as good indicators of a healthy and sustainable environment found in freshwater dams.<sup>[1,2]</sup> The diversity of zooplankton from the freshwater reserves of the Sapna Dam is situated in the Betul district of Madhya Pradesh is well organized to investigate the condition of the seasonal variations of density and diversity of zooplanktons<sup>[3,4]</sup> sustaining in Sapna Dam a freshwater frame. Zooplankton diversity provides information with a standard parameter for determining the presence of water bodies in polluted and non-polluted habitat status of dams.<sup>[5,6]</sup>

The physicochemical properties of water are paramount for monitoring the health of aquatic species, for which physical parameters such as temperature, transparency test, and density of water have been analyzed. Depending on the density and diversity of the zooplankton, water was discussed along with various physicochemical parameters.<sup>[7,8]</sup> The physical properties of freshwater show that drinking water near favor. The expression of the variability of the Zooplankton Community in the change of a series of the freshwater body of Sapna Dam in Betul district, the impact of zooplankton's mortality rate with soluble mineral in freshwater.<sup>[5,9]</sup>

The diversity of zooplankton monitoring with biological factors and their physicochemical characteristics the study of the index identification zooplankton species related to various taxonomic groups.<sup>[10,11]</sup> Some abiotic parameters of the analysis explained the importance of water as well as the high cumulative variance of zooplankton combinations.<sup>[12,13]</sup> Sapna Dam of Betul district is known for various kinds of biological species in the rich diversity of zooplankton that have the size and shape of a cellular or metazoans living organisms sustained in water bodies' constitutional communities.

The current study is concerned about the seasonal variation of zooplankton biodiversity indices during the research investigation of encouraged to consider the species as a sensitive indicator of the aquatic system. The most important types of zooplankton in this Dam had moderate biodiversity of total zooplankton species belonging to various taxonomic groups such as Rotifera, Cladocera, Copepoda, Ostracoda, and Protozoa.

## MATERIALS AND METHODS

Sapna dam situated in district Betul on latitude and longitude 21°51'30" N, 78°0'10" E, located in a large area covered with agriculture, mountain, and forest with few small dams. The studies of zooplankton a period of two sessions (July-2016 to June-2017 and July-2017 to June-2018) were the bunch of four months indicated for a season and analyzed for seasonal changes, concerning, Monsoon (July, August, September, and October), Winter (November, December, January, and February), and Summer (March, April, May, and June).

### Sampling methods

Three stations such as the GFT sites that describe as a gate (overflow) site: S1, front site: S2, and temple site: S3 located in the three directional triangles of the Sapna Dam was selected for the collection of water samples

contained with zooplankton. The samples of water were collected from the study sites in the morning times from 7:00 am to 9:00 am. The zooplankton contained water samples were collected in sterile, wide-mouth glass bottles, vertically 1-2 meter depth from the surface level. The separation of zooplankton from the water samples collected in bottles was used Towing Henson standard zooplankton net.

### Physicochemical properties

The physical and chemical properties of water determined as on the spot the place of collection sites and in laboratory tests such as temperature, pH, total dissolved solids, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, were applied standard analyzed titration and AHPA methods.<sup>[14-16]</sup>

### Zooplankton analysis

The collected species samples were preserved with a 5% buffer of formalin for laboratory analysis of quantities and qualitative analysis under the microscope.<sup>[17]</sup> The analysis measurements of species quantities were term refers to the count of zooplankton. The methods were expressed in the form of total zooplankton.<sup>[18]</sup> The microscopic observation of zooplankton in the form of unicellular and multicellular morphological structures was the identification of species.<sup>[19-21]</sup>

## RESULTS AND DISCUSSIONS

The study area of the basin lies in a stone that reflects the geographical center of India. This area is Betul District on latitude and longitude 21°51'30" N, 78°0'10" E, located in a large area covered with agriculture, mountain, and forest with few small dams and running Tapti River, which is visible in Betul.



Figure 1: Geographical Images of Sapna Dam

Monitoring of water quality and the zooplankton available was selected three sites (S1, S2, and S3) of Sapna Dam shown in figure 1. The results investigated were studies from July 2016 to June 2018 of three sessions concerning monsoon, winter, and summer.<sup>[22]</sup> Temperature is important for the development of all kinds of living organisms including zooplankton. The temperature of the water was analyzed for both sessions of all sites found in an average of seasonal variances such as monsoon at  $\approx 25^{\circ}\text{C}$ , winter at  $\approx 23.6^{\circ}\text{C}$ , and summer at  $\approx 27.5^{\circ}\text{C}$ . Water temperature fluctuates with time and changing seasons.<sup>[23,24]</sup> The pH measured had  $\text{H}^+$  ion concentration in water. The pH of the water was analyzed for both sessions of all sites found on average of seasonal variance such as monsoon at  $\approx 7.1$ , winter at  $\approx 7.7$ , and summer at  $\approx 7.4$ . Water pH fluctuations have been shown to be very slight which did not support climate change.<sup>[25]</sup> TDS has indicated the total dissolved solid substances in water common inorganic salts mg/L. The TDS of the water was analyzed for both sessions of all sites found in an average of seasonal variance such as monsoon at  $\approx 395.6$  mg/L, winter at  $\approx 277.9$  mg/L, and summer at  $\approx 183.4$  mg/L. TDS was maximum during the rainy days because soil erosion with water can accumulate solids in water during the monsoon season.<sup>[24,25]</sup> The dissolved oxygen concentration contained in the water sample of Sapna Dam was determined in mg/L. The DO of the water was analyzed for both sessions of all sites found in an average of seasonal variance such as monsoon at  $\approx 6.5$  mg/L, winter at  $\approx 6.0$  mg/L, and summer at  $\approx 7.3$  mg/L.<sup>[26]</sup> Biochemical oxygen demand in water was determined in mg/L. The BOD of the water was analyzed for both sessions of all sites found in an average of seasonal variance such as monsoon at  $\approx 4.9$  mg/L, winter at  $\approx 4.6$  mg/L, and summer at  $\approx 4.6$  mg/L.<sup>[25]</sup> The COD value of water was determined by the dichromate reflux method. The COD of the water was analyzed for both

sessions of all sites found in an average of seasonal variance such as monsoon at  $\approx 94.3$  mg/L, winter at  $\approx 90.8$  mg/L, and summer at  $\approx 109.2$  mg/L.<sup>[14,27]</sup>

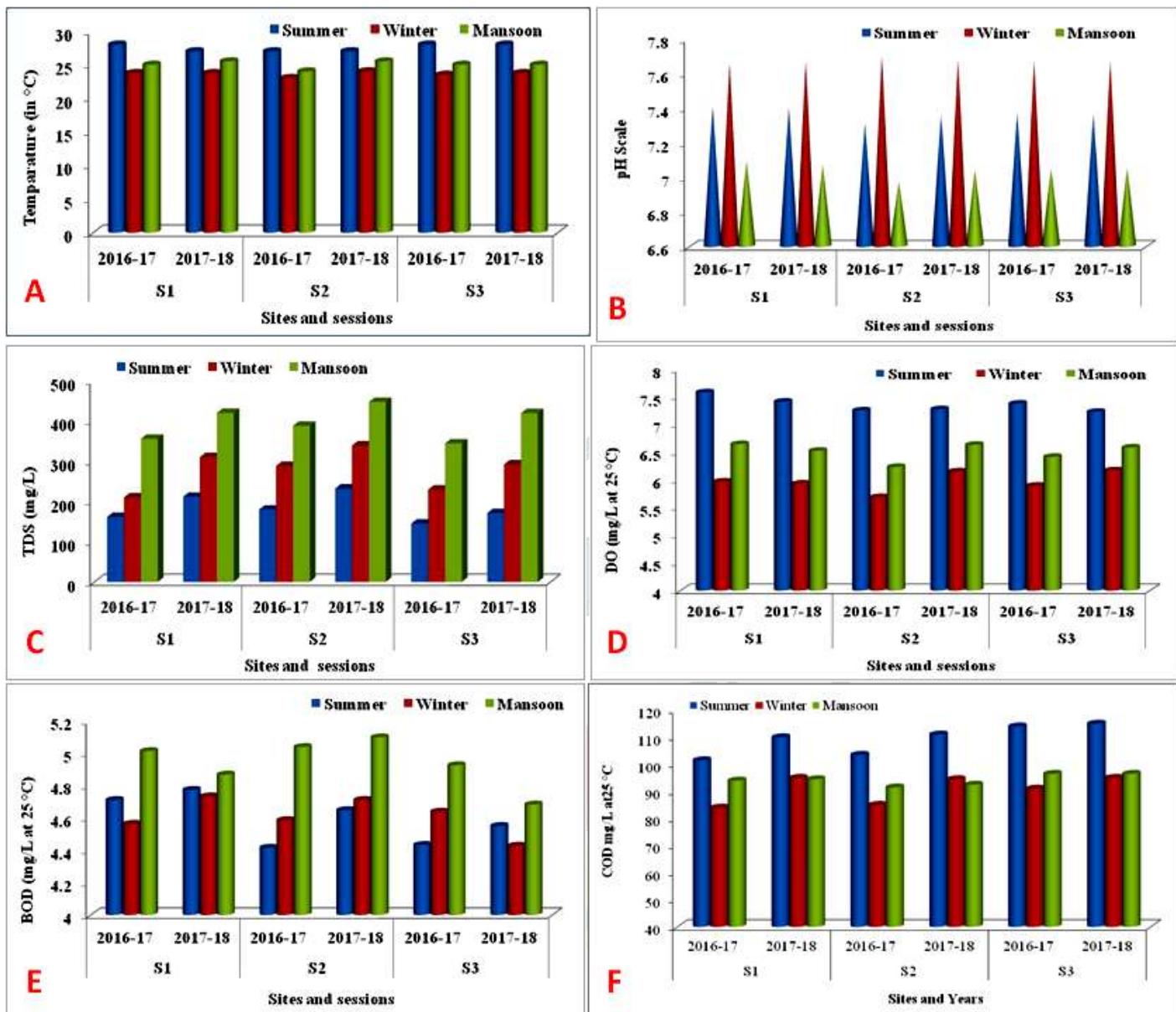


Figure 2: Physico-chemical parameters such as (A) temperature, (B) pH, (C) TDS, (D) DO, (E) BOD, (F) COD analyzed the average values of seasonal variance of water samples at three sites of Sapna Dam from two sessions.

## Zooplankton diversity

Zooplankton species were observed under a microscope and identified by textbooks and monographic structures. The identified zooplankton species were arranged in the alphabetical form with their respective frequencies. The zooplankton diversity was analyzed as distribution patterns with seasonal variability of zooplankton between five groups with a total 18<sup>th</sup> different species community in an aquatic ecosystem.<sup>[28]</sup> The descriptions follow as:

## Rotifera

The different species were found in the Rotifera group at three sites of Sapna Dam from both sessions. the seasonal (monsoon, winter, and summer) variance of Rotifera species was analyzed over the sessions and found a total of eight species such as *Brachionus sp.*,<sup>[29-33]</sup> *Colurella sp.*,<sup>[31]</sup> *Epiphantes sp.*,<sup>[31]</sup> *Euchlanis sp.*,<sup>[38]</sup> *Keratella sp.*,<sup>[29,31-33]</sup> *Lecane sp.*,<sup>[31]</sup> *Monostyla sp.*,<sup>[34-36]</sup> and *Notholca sp.*,<sup>[33]</sup> shown in Table 1. The observed from session July-2016 to June-2017, at site S1, in the monsoon season was found three species as *Brachionus sp.*, *Keratella sp.*, and *Notholca sp.* with a frequency at 13.28%, and in the winter and the summer seasons were found six species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Eucalanis sp.*, *Keratella sp.*, and *Notholca sp.* with frequencies at 28.78% and 57.94%. At site S2, in the monsoon season was found four species as *Brachionus sp.*, *Colurella sp.*, *Keratella sp.*, and *Notholca sp.* with frequency at 10.02%, and in the winter season was found six species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Keratella sp.*, *Lecane sp.*, and *Notholca sp.*, with frequency at 26.33% and in the summer season was found seven species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Keratella sp.*,

*Lecane sp.*, *Monostyla sp.*, and *Notholca sp.* with frequency at 63.65%. At site S3, in the monsoon season was found three species as *Brachionus sp.*, *Keratella sp.*, and *Notholca sp.* with frequency at 10.58%, and in the winter and summer seasons were found five species as *Brachionus sp.*, *Colurella sp.*, *Keratella sp.*, *Lecane sp.*, and *Notholca sp.* with frequencies at 28.26% and 61.16%. The total zooplankton diversity frequencies of species such as *Brachionus sp.*>*Keratella sp.*>*Notholca sp.*>*Colurella sp.*>*Epiphantes sp.*>*Lecane sp.*>*Euchlanis sp.*>*Monostyla sp.* was arranged, shown in Figure 2. The observed from the session July-2017 to June 2018, at site S1, in the monsoon season was found three species as *Brachionus sp.*, *Keratella sp.*, and *Notholca sp.* with a frequency at 10.04%, and in the winter season was found five species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Keratella sp.*, and *Notholca sp.* with frequency at 22.27%, and in the summer season was found six species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Keratella sp.*, and *Notholca sp.* with frequency at 67.70%. At site S2, in the monsoon season was found three species as *Brachionus sp.*, *Colurella sp.*, and *Keratella sp.* with frequency at 8.65%, and in the winter season was found six species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Keratella sp.*, *Lecane sp.*, and *Notholca sp.* with frequency at 25.95%, and in the summer season was found seven species as *Brachionus sp.*, *Colurella sp.*, *Epiphantes sp.*, *Keratella sp.*, *Lecane sp.*, *Monostyla sp.*, and *Notholca sp.* with frequency at 65.39%. At site S3, all seasons were found five species as *Brachionus sp.*, *Colurella sp.*, *Keratella sp.*, *Lecane sp.*, and *Notholca sp.* with frequencies at 11.93%, 25.85%, and 62.22%. The total zooplankton diversity frequencies of species such as *Brachionus sp.*>*Keratella sp.*>*Notholca sp.*>*Colurella sp.*>*Lecane sp.*>*Epiphantes sp.*>*Euchlanis sp.*>*Monostyla sp.* was arranged, shown in Figure 3.

### Cladocera

The different species were found in the Cladocera group at the same three sites of Sapna Dam from both sessions. The seasonal variance of cladocera species was analyzed over the sessions and found a total of three species such as *Bosmina sp.*,<sup>[31,32]</sup> *Chydorus sp.*,<sup>[37]</sup> and *Moina sp.*,<sup>[30-33]</sup> shown in Table 1. The observed from the session July-2016 to June 2017, at site S1, in all three seasons were found three species as *Bosmina sp.*, *Chydorus sp.*, and *Moina sp.* with frequencies at 12.65%, 41.12%, and 46.23%. At site S2, in the monsoon season was found two species as *Chydorus sp.*, and *Moina sp.* with frequency at 3.76%, and in the winter and summer seasons were found three species as *Bosmina sp.*, *Chydorus sp.*, and *Moina sp.* with frequencies at 43.28% and 52.96%. At site S3, in the monsoon season was found one species *Bosmina sp.* with a frequency at 1.96%, and in the winter and summer seasons were found three species as *Bosmina sp.*, *Chydorus sp.*, and *Moina sp.* with frequencies at 45.25% and 52.79%. The observed from the session July-2017 to June-2018, at site S1, in the monsoon season was found two species as *Bosmina sp.*, and *Moina sp.* with frequency at 5.05%, and in the winter and summer seasons were found three species as *Bosmina sp.*, *Chydorus sp.*, and *Moina sp.* with frequencies at 34.57%, and 60.37%. At site S2, in the monsoon season was found two species as *Bosmina sp.*, and *Chydorus sp.* with frequency at 2.52%, and in the winter and summer seasons were found three species as *Bosmina sp.*, *Chydorus sp.*, and *Moina sp.* with frequencies at 44.26%, and 53.22%. At site S3, all the seasons were found three species as *Bosmina sp.*, *Chydorus sp.*, and *Moina sp.* with frequencies at 4.76%, 40.90%, and 54.34%. The total zooplankton diversity frequencies of species for both sessions such as *Moina sp.*>*Bosmina sp.*>*Chydorus sp.* was arranged, shown in Figures 2, and 3.

### Copepoda

The different species were found in the Copepoda group at the same three sites of Sapna Dam from both sessions. The seasonal variance of Copepoda species was analyzed over the sessions and found a total of three species such as *Calanoid sp.*,<sup>[32]</sup> *Cyclops sp.*,<sup>[30-33]</sup> and *Diaptomus sp.*,<sup>[29,32]</sup> shown in Table 1. The observed from the session July-2016 to June 2017, at site S1, in the monsoon season was found two species as *Calanoid sp.*, and *Cyclops sp.* with frequency at 17.68%, and in others seasons, winter and summer were found three species as *Calanoid sp.*, *Cyclops sp.*, and *Diaptomus sp.* with frequencies at 33.44%, and 48.87%. Two species as *Calanoid sp.*, and *Cyclops sp.* were found in all three seasons at site S2 with frequencies at 15.06%, 34.73%, 50.21%, and at site S3 with frequencies at 17.43%, 33.49%, and 49.08%. The observed from the session July-2017 to June-2018, at site S1, in the season monsoon were found one species *Cyclops sp.* with frequency at 11.34%, and in the seasons, winter and summer were found three species as *Calanoid sp.*, *Cyclops sp.*, and *Diaptomus sp.* with frequencies at 27.49%, and 61.17%. Two species as *Calanoid sp.*, and *Cyclops sp.* were found in all three seasons at site S2 with frequencies at 16.89%, 32.89%, 50.22%, and at site S3 with frequencies at 16.45%, 31.60%, and 51.95%. The total zooplankton diversity frequencies of species for both sessions such as *Cyclops sp.*>*Calanoid sp.*>*Diaptomus sp.* was arranged, shown in Figures 2, and 3.

### Ostracoda

One species was found in the Ostracoda group at three sites of Sapna Dam from both sessions. The seasonal variance of Ostracoda species was analyzed over the sessions and found a total of one species *Cypris sp.*,<sup>[32]</sup> shown in Table 1. The observed from both sessions of the monsoon season was not found any species from three sites. The

species *Cypris sp.* was found in two seasons winter and summer of the session from July-2016 to June-2017, at site S1 with frequencies at 29.11%, 70.89%, and site S2 with frequencies at 23.08%, 76.92%, and site S3 with frequencies at 25.00%, 75.00%. The session from July-2017 to June-2018 was observed as at site S1 with frequencies at 29.17%, 70.83%, and site S2 with frequencies at 20.00%, 80.00%, and site S3 with frequencies at 29.76%, and 70.24%. The total zooplankton diversity frequencies of species for both sessions were constant in regular form, shown in Figures 2, and 3.

## Protozoa

The different species were found in the Protozoa group at three sites of Sapna Dam from both sessions. The seasonal variance of protozoa species was analyzed over the sessions and found a total of three species such as *Amoeba sp.*,<sup>[33]</sup> *Euglena sp.*,<sup>[33]</sup> and *Paramecium sp.*,<sup>[33]</sup> shown in Table 1. The observed from session July-2016 to June-2017, at site S1, in the monsoon season was found two species as *Euglena sp.*, and *Paramecium sp.* with frequency at 22.80%, and in the seasons' winter and summer were found three species as *Amoeba sp.*, *Euglena sp.*, and *Paramecium sp.* with frequencies at 14.66%, and 62.54%. At site S2, in the monsoon and summer seasons were found three species as *Amoeba sp.*, *Euglena sp.*, and *Paramecium sp.* with frequencies at 20.60%, and 65.12%, while the season winter was found two species as *Amoeba sp.*, and *Paramecium sp.* with frequency at 14.29 %. At site S3, in the monsoon season was found two species as *Euglena sp.*, and *Paramecium sp.* with frequency at 21.99%, and in the winter and summer seasons were found three species as *Amoeba sp.*, *Euglena sp.*, and *Paramecium sp.* with frequencies at 13.48%, and 64.54%. The total zooplankton diversity frequencies of species in this session such as *Paramecium sp.*>*Amoeba sp.*>*Euglena sp.* was arranged, shown in Figure 2. The observed from session July-2017 to June-2018, at site S1, in all three seasons were found three species as *Amoeba sp.*, *Euglena sp.*, and *Paramecium sp.* with frequencies at 18.61%, 11.04%, and 70.35%. At site S2, in all three seasons were found the same above three species with frequencies at 21.38%, 14.14%, and 64.48%. At site S3, above the same species in all three seasons were found frequencies at 21.75%, 13.64%, and 64.61%. The total zooplankton diversity frequencies of species in this session such as *Paramecium sp.*>*Euglena sp.*>*Amoeba sp.* was arranged, shown in Figure 3.

Table 1. Collection of zooplankton from three sites of Sapna Dam in three seasons of two sessions. "+" (Present) and "-" (Absent)

Groups	Species	July-2016 to June-2017									July-2017 to June-2018								
		Monsoon			Winter			Summer			Monsoon			Winter			Summer		
		S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3	S1	S2	S3
Rotifera	<i>Brachionus sp.</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	<i>Colurella sp.</i>	-	+	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
	<i>Epiphantes sp.</i>	-	-	-	+	+	-	+	+	-	-	-	-	+	+	-	+	+	-
	<i>Euchlanis sp.</i>	-	-	-	+	-	-	+	-	-	-	-	-	-	-	+	-	-	-
	<i>Keratella sp.</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	<i>Lecane sp.</i>	-	-	-	+	+	-	+	-	-	-	-	-	+	+	-	+	+	+
	<i>Monostyla sp.</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Cladocera	<i>Notholca sp.</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
	<i>Bosmina sp.</i>	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	<i>Chydorus sp.</i>	+	+	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
Copepoda	<i>Moina sp.</i>	+	+	-	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
	<i>Calanoid sp.</i>	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
	<i>Cyclops sp.</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ostracoda	<i>Diaptomus sp.</i>	-	-	-	+	-	-	+	-	-	-	-	-	+	-	-	+	-	-
	<i>Cypris sp.</i>	-	-	-	+	+	+	+	+	+	-	-	-	+	+	+	+	+	+
	<i>Amoeba sp.</i>	-	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Protozoa	<i>Euglena sp.</i>	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	+	+	+
	<i>Paramecium sp.</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

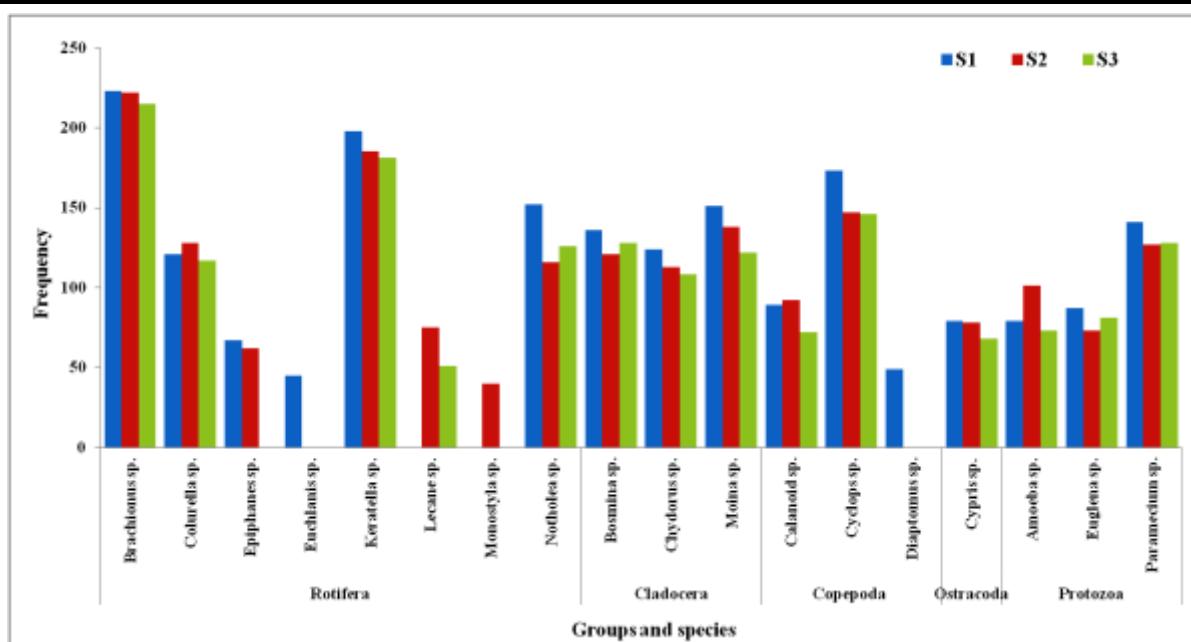


Figure 2: Total zooplankton diversity at three sites (S1, S2, and S3) in Sapna Dam from July 2016 to June 2017.

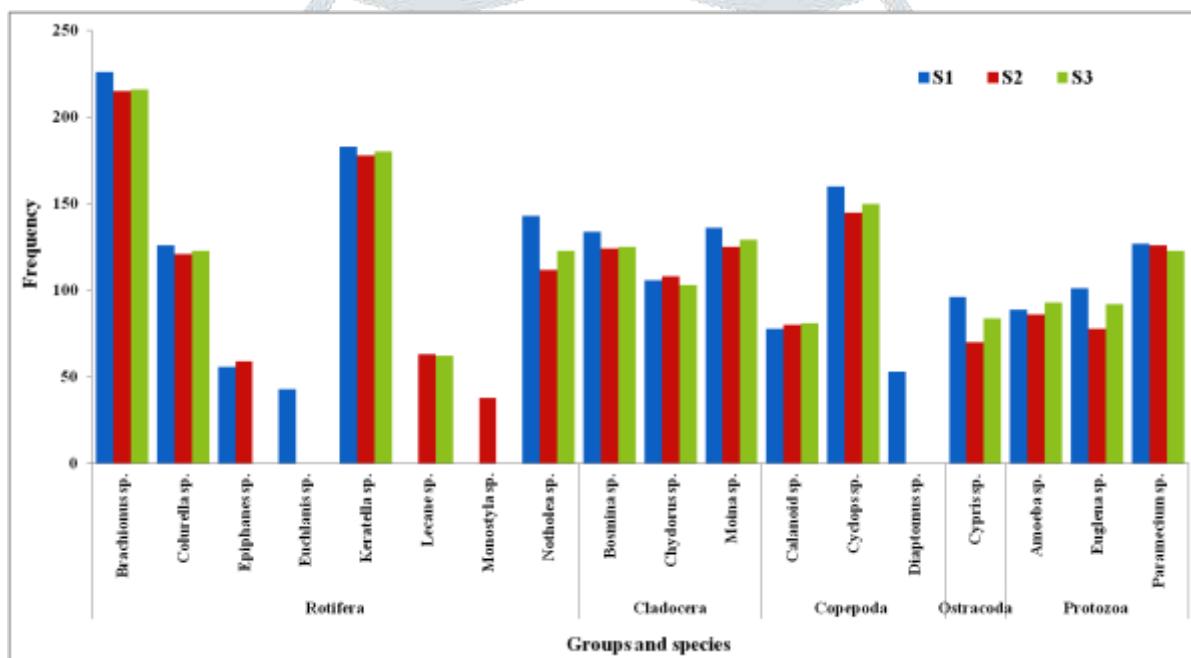


Figure 3: Total zooplankton diversity at three sites (S1, S2, and S3) in Sapna Dam from July 2017 to June 2018.

### Seasonally diversity of Zooplanktons

The diversity of species at seasonally based on three sites at Sapna Dam was analyzed all three seasons from both sessions. The average values of the species in seasonal diversity from the session 2016-17 were as follows, monsoon at 219.67, winter at 527.00, summer at 1036.00, and diversity frequencies of species in seasons as summer>winter> monsoon. From the session 2017-18 were as follows, monsoon at 190.67, winter at 468.33, summer at 1097.33, and diversity frequencies of species in seasons in as summer> winter> monsoon, shown in Table 2.

Table 2: Mean values of seasonal variation in total zooplanktons.

Seasons	The year 2016-17			Mean	The year 2017-18			Mean
	S1	S2	S3		S1	S2	S3	
Monsoon	284	195	180	219.67	189	177	206	190.67
Winter	573	523	485	527.00	446	491	468	468.33
Summer	1057	1100	951	1036.00	1222	1060	1010	1097.33

### Groupwise diversity of Zooplanktons

The diversity of species from five groups of zooplankton were analyzed from three sites of Sapna Dam from the sessions of 2016-17 and 2017-18. The percentage values of the species in group-wise determined for the session 2016-17 were as follows, Rotifer at 40.07%, Cladocera at 23.84%, Copepoda at 13.90%, Ostracoda at 4.07%, Protozoa at 16.11%, and for the session 2017-18 were as follows, Rotifer at 41.73%, Cladocera at 23.08%, Copepoda

at 13.75%, Ostracoda at 4.60%, Protozoa at 16.84%. The diversity frequencies of groups for both sessions follow as Rotifer> Cladocera> Protozoa> Copepoda> Ostracoda, shown in Figure 4.

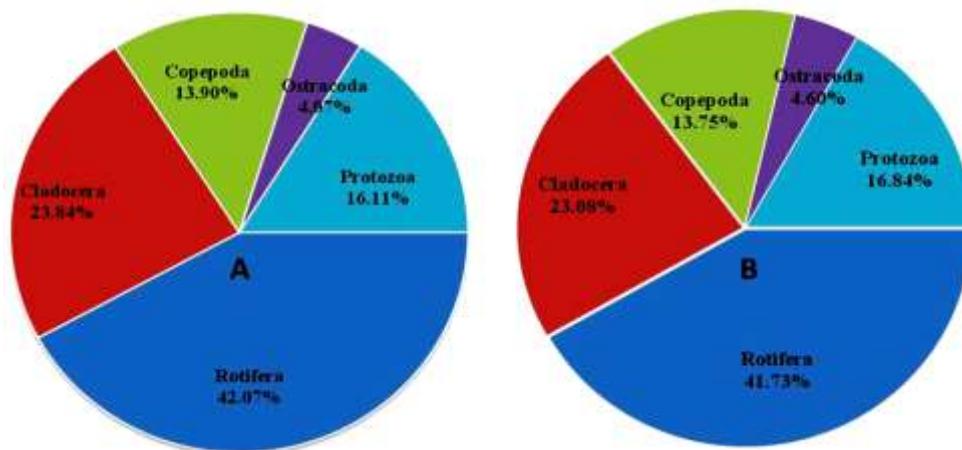


Figure 4: Groups wise distribution of total zooplankton: (A) July-2016 to June-2017 and (B) July-2017 to June-2018.

## CONCLUSIONS

Most researchers have limited time periods expend in research investigation of zooplankton and found different types of species in fresh water. Which should have given information about what kind of change took place in the next exact same time period. In this research, was investigated continuously by using the same methods and materials in different seasons of two seasons for improve the properties of water and the quantitative and qualitative changes of zooplankton were explained, the current situation changes as time changes between the two sessions. The diversity of zooplankton has investigated the status of density, diversity, and seasonal variations such as zooplankton, which persist in the freshwater waters of the Sapna dam. The physicochemical properties were improved water quality. The study of zooplankton was includes five major groups such as Rotifera, Cladocera, Copopoda, Ostracoda and Protozoa. There were eight species in the Rotifera group, and three species in the Cladocera group, and three species in the Copepoda group, and one species in the Ostracoda group was *Cypris sp.*, and three species in the Protozoa group. The diversity of species from three seasons was estimated average values of the species in seasonal diversity from both sessions. Species diversity from the five groups was estimated from the percentage values of species in groupwise diversity from both seasons.

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