



# Zooplankton Diversity and its Relations with Physico-chemical Parameters in Gaula River in Haldwani, Uttarakhand, India

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## Abstract

Zooplankton diversity and physico-chemical parameters are an important criterion for evaluating the suitability of water for irrigation and drinking purposes. In this study we tried to assess the zooplankton diversity and to study the physico-chemical parameters of the Gaula River. A total of- taxa were recorded: Rotifers, Copepods, Cladocerans, Ostracods and Protozoans.

**Keywords-** Diversity, Zooplankton, Gaula river and Physico-chemical Parameters.

## Introduction

The state Uttarakhand is blessed with various natural water resources such as spring and rain fed rivers, lakes, nulas and gadheras etc. It has an immense number of rivers, springs and lakes. The river Gaula is one of the most important spring-fed river among all of them. It originates from southern slopes of Gajar range near Motia pather, fed by many springs, which comes to life during monsoon, and ends in Ramganga River near Bareilly in Uttar Pradesh (Mehra & Arya 2022).

Aquatic ecosystem is the most diverse ecosystem in the world. First life originated in the water and the first organisms were aquatic. Thus, water is the most vital factor for the existence of all living organisms. Zooplanktons act as an integral component of the food web in aquatic ecosystems. These tiny animals are cosmopolitan in environment and one of the important ecological parameters in water quality assessment and act as a natural cleanser of water (Singh & et al., 2021). Zooplankton is also influenced by the changes in abiotic parameters as well as biotic parameters or the combination of both in an aquatic environment (Christou 1998). Zooplanktons act as a good indicator of variation in water quality as it is strongly affected by environmental conditions. That is why physicochemical standards play a significant role in assessing the water quality of water bodies. Zooplanktons communities respond to a wide variety of disturbance including nutrient loading, acidification and sediment input etc. The distribution and diversity of zooplanktons in aquatic ecosystem depends mainly on the seasonal variations and physicochemical parameters of water (Saba and Sadhu, 2015). It is a well suited tool for understanding water pollution status (Contreras et al., 2009). Any unexpected change in the physico-chemical and biological properties of the water leads to the transformation in zooplankton diversity and abundance. Present work was done to assess the effect of seasonal variation on diversity of zooplankton and physicochemical parameters of Guala river.

## Methodology

The present study was carried out from January 2019 – December 2019 to explore diversity of zooplankton in freshwater river Gaula at Nainital dist., Uttarakhand. The samples were collected for a period of one year from January to December from Gaula River randomly for analysis of zooplanktons and physicochemical parameters. For zooplankton analysis the samples were preserved in 4 percent formalin solution and stored in cool and dark place. For diversified study

Zooplankton Samples were taken in a Sedgwick-Rafter counting chamber and observed under light microscope under prerequisite magnification (10 X initially than followed by 40 X) and the specimens were identified with the help of standard books and keys as Edmondson (1959), Pennak (1978), Battish (1992), Michael & Sharma (1988) and Sharma & Sharma (2008). Physicochemical parameters of water like temperature, pH, CO<sub>2</sub>, DO, TDS and Alkalinity were collected using labelled plastic bottles. Water parameters were analysed as per methods described in APHA (2005). Temperature and pH were noted down on the spot with the help of thermometer and digital pH metre. Further physicochemical parameters were analysed in the laboratory.

## Results

Present study revealed 18 genera of zooplankton from the fresh water river belonging to the five groups namely Protozoa, Cladocera, Rotifera, Copepoda, Ostracoda. Out of which 7 belong to Protozoa, 6 to Rotifera, 2 to Copepoda, 2 to Cladocera and 1 to Ostracoda. The relative abundance of Zooplankton in the Gaula river depicted in Figure 2 which shows maximum abundance of Protozoa contributing (39%) of the total zooplankton followed by Rotifera (33%), Copepoda (14%), Cladocera (8%) and Ostracoda (6%) during the entire study period.

### Protozoa

Seven species of Protozoa namely Arcella sp., Diffugia sp., Centropyxis sp., Vorticella sp., Entosiphon sp., Euplotes sp., Paramecium sp. were observed. Among all seven species of Protozoa Diffugia sp and Paramecium sp. were observed throughout the year but maximum species observed in summer season.

### Rotifera

In the present study, the rotifers diversity sequence was observed. Among Monostyla sp., Cephalodella sp., Euchlanis sp., Brachionus sp., Trichocera sp., Philodina sp. six species of rotifer Monostyla sp. Observed throughout the year with high population in summer and low in rainy and winter season.

### Cladocera

Two species of Cladocera i.e. Bosmina sp., Daphnia sp. are observed. Both the species present in all seasons except Daphnia sp. which is absent in monsoon and are abundant in summer season.

### Copepoda

Two species of Copepoda namely Cyclops sp. Nauplius sp. were observed during different seasons. Cyclops is abundant in summer and Nauplius is abundant in winter.

### Ostracoda

One species of Ostracoda i.e. Cypris sp. is present only in summer and monsoon seasons with high population in summer.

### Physicochemical parameters

Water temperature ranged between 13.4°C to 26.1°C, pH ranged from 7.5 to 8.6, Dissolved oxygen vary from 8 ppm to 10.5ppm, Alkalinity ranged between 56.33ppm to 73ppm, TDS ranged between 48ppm to 77.3ppm and CO<sub>2</sub> vary from 2.4ppm to 4.6ppm.

## DISCUSSION

Present work indicates the diversity pattern of zooplanktons of Gaula river in one year time span. Occurrence of very few zooplanktons were observed in monsoon and winter season. The highest abundance of Zooplankton was recorded in summer (44%), medium in winter (39%) and least in monsoon (17%) season, similar result was also reported by Pathani et al. (2006), Malik et al. (2012), Watkar (2013) and Mehra and Arya (2022). Rotifers respond more quickly to environmental changes than other planktonic species. The possible reason behind high population of rotifers in summer and deprived in winter was high population of bacterial species and organic matter of dead and decaying vegetation. This result was also in resemblance with Verma et al. (2013) and Kar and Kar (2016). The study of Physico-Chemical status of

the Gaula river is also required to understand the population density of zooplankton as physico-chemical parameters have a high impact on the existence of zooplankton. Physico chemical parameters were assessed on a monthly basis for a one year period from January 2019 to December 2019. Sarkar and Chowdhury, (1999) reported that the fluctuation of abiotic factors i.e concentration of dissolved oxygen, temperature, total alkalinity, and pH can influence the growth of zooplankton. Aquatic organisms are affected by the pH of water because most of their metabolic activities are pH dependent. Dissolved oxygen and high temperature increases in its assimilation for biodegradable organic matter by organism. Increases in alkalinity might be due to increased photosynthesis. Decrease in dissolved oxygen in summer is probably attributed to increase in water temperature which affects oxygen solubility in water. Consequently upon enhanced air water interplay the oxygen concentration increases in winter season.

## CONCLUSION

Zooplankton was represented by five groups Protozoa, Rotifera, Copepoda, Cladocera and Ostracoda. The abundance of zooplankton varies with seasons. During the present study it has been found that seasonal abundance of Zooplankton was highest during summer, moderate in winter and lowest during monsoon season. The higher abundance of zooplankton in summer is due to low discharge of water, suitable physico-chemical parameters for their growth and high availability of food for survival. Zooplankton distribution followed the order of Protozoa > Rotifera > Copepoda > Cladocera > Ostracoda during the entire study period. The recorded diversity in Zooplankton and Physico-chemical parameters during study period is under the permissible limits of water for drinking and irrigation.

**Table 1- Physico-chemical Parameters of Gaula river from January 2019 to December 2019**

Months	Temp.	pH	CO <sub>2</sub>	DO	TDS	Alkalinity
January	14	8.6	2.4	10.5	54.3	71.6
February	15.4	8.3	2.7	10.1	56	71
March	17.2	8.1	2.9	9.9	58.3	67.6
April	20.4	8	3.5	8.5	58.3	64.6
May	24.8	7.8	3.9	8.1	62.3	63.3
June	26.1	7.7	4	8.3	64.3	60.6
July	22.5	7.6	4.3	8	71.6	57.6
August	22	7.5	4.5	8.4	77.3	56.3
September	19	7.9	4.6	8.5	66	61.3
October	16.2	8.1	4.3	9.2	60	63
November	14.1	8.3	3.9	10	50	68.6
December	13.4	8.5	3.4	10.1	48	73

**Table 2- Diversity of Zooplankton in Gaula river from January 2019 to December 2019**

	Genera	Winter	Summer	Monsoon
<b>Protozoa</b>				
1	Arcella sp.	++	-	-
2	Diffugia sp.	++	+++	+
3	Centropyxis sp.	-	++	-
4	Vorticella sp.	++	+	-
5	Entosiphon sp.	-	++	-
6	Euplotes sp.	++	-	-
7	Paramecium sp.	+	++	+
<b>Rotifera</b>				
1	Monostyla sp.	+	+++	+
2	Cephalodella sp. -	-	+	-
3	Euchlanis sp.	+	-	-
4	Brachionus sp	-	++	-
5	Trichocera sp.		++	-
6	Philodina sp.	++	++	-
<b>Copepoda</b>				
1	Cyclops sp.	+	++	+
2	Nauplius sp.	++	+	-
<b>Cladocera</b>				
		+	++	+
1	Bosmina sp.	+	++	+
2	Daphnia	+	++	-
<b>Ostracoda</b>				
1	Cypris sp.	-	++	+

++ common, + rare, - absent,+++Abundant

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