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Short Communication

Diversity of Zooplankton in Lesser Himalayan River Gaula at District Nainital Uttarakhand

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ABSTRACT
Zooplankton are small, microscopic, free-floating and weakly swimming animals found in all aquatic environments. They play an important role in aquatic food web and act as a vital food source for secondary and tertiary consumers. They also help to transfer energy lower to higher trophic level of organisms. Due to their shorter life span, large density, drifting nature and high species diversity they are being used as indicator organisms for the physical, chemical and biological processes in the aquatic ecosystem. The present study was carried out on diversity of zooplankton in a lesser Himalayan river Gaula at District Nainital, Uttarakhand. A total 18 species of zooplankton were recorded in which 7 belong to Protozoa, 6 to Rotifera, 2 to Copepoda, 2 to Cladocera and 1 was belong to Ostracoda. Among them Protozoa was the most abundant group throughout the study period. 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.

Key words: Zooplankton, Species Diversity, Abundance, Seasonal Distribution, Organisms, aquatic ecosystem.

INTRODUCTION

Aquatic ecosystem is the most diverse ecosystem in the world that includes rivers, streams, ponds, lakes, oceans, bays, swamps, marshes, and their associated organisms. Aquatic habitat provides food, water, shelter, and space essential for the survival of aquatic animals and plants. First life originated in the water and first organisms were aquatic. Thus, water is the most vital factor for the existence of all living organisms.

Zooplankton act as an integral component of the food web in aquatic ecosystem. These tiny animals are the second most important energy transforming organism and source of food after phytoplankton. They play an important role in maintaining the equilibrium between living organisms and abiotic factors. Zooplankton also influenced by the changes in abiotic parameters as well as biotic parameters or the combination of both in an aquatic environment (Christou 1998). They are represented by wide array of taxonomic groups as Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. Zooplankton are highly sensitive to environmental changes. As a result variations in their composition, abundance, distribution and species diversity can provide important indications of environmental disturbance (Ishaq and Khan 2013).

They exist under a wide range of environmental conditions. The communities of zooplankton are dynamic in nature changing their population on a seasonal basis. They are more sensitive to environmental conditions than phytoplankton. Any unexpected change in the physical, chemical and biological properties of the water leads to the transformation in zooplankton diversity and abundance. They influence the primary production as they consume a great quantity of phytoplankton from water environment. The constant monitoring of zooplankton can gives information about the proper management of fresh water ecosystem. There is no work has been carried out so far on the diversity of zooplankton in Gaula river. The lacuna of information on this aspect inspired for the present study.

Many researchers like Imoobe et al. (2009), Khanna et al. (2012), Kumar (2014), Dede et al. (2015) and Choudhury et al. (2017) have studied on zooplankton diversity in river water systems and have found significant variation in their distribution and abundance.

MATERIAL AND METHODS

Study area

The state Uttarakhand is blessed with various natural water resources such as spring and rain fed rivers, lakes, nolas and gadheras etc. It has immense number of rivers, springs and lakes. The river Goula is one of the most important springs 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 (Mohan 2004).

Methods

The present study was carried out from November 2018 – October 2019 to explore diversity of zooplankton in fresh water river Gaula at Nainital dist., Uttarakhand. The zooplankton samples were collected from Gaula river randomly and preserved in 4 percent formalin for further analysis. Samples were observed under microscope and identified with the help of standard books and keys as Edomndson (1959), Pennak (1978) and Battish (1992).

RESULTS

During the study period total 18 species of zooplankton were observed. Out of which 7 belong to Protozoa, 6 to Rotifera, 2 to Copepoda, 2 to Cladocera and 1 was belonging to Ostracoda. The relative abundance of Zooplankton in the Gaula river depicted in Figure 1 shows that Protozoa constituted the most dominant group contributing (39%) of the total zooplankton followed by Rotifera (33%), Copepoda (14%), Cladocera (8%) and Ostracoda (6%) during the entire study period. The diversity and seasonal abundance of zooplankton species recorded in the river has shown in Table1. Protozoa was represented by *Arcella* sp., *Difflugia* sp., *Centropyxis* sp.,*Vorticella* sp., *Entosiphon* sp., *Euplotes* sp., and *Paramecium* sp., Rotifera included *Monostyla* sp., *Cephalodella* sp., *Euchlanis* sp., *Brachionus* sp., *Trichocera* sp., and *Philodina* sp., Copepoda represented by *Cyclops* sp., and *Nauplius* sp., Cladocera include *Bosmina* sp., *Daphnia* sp. and Ostracoda included *Cypris* sp.

Table 1. Diversity and seasonal distribution of zooplankton in Gaula river during 2018-2019

Groups	Seasons		
	Winter	Summer	Monsoon
Protozoa			
1. *Arcella* sp.	+	+	-
2. *Difflugia* sp.	++	+++	+
3. *Centropyxis* sp.	-	++	-
4. *Vorticella* sp.	+	+	-
5. *Entosiphon* sp.	-	++	-
6. *Euplotes* sp.	+	+	-
7. *Paramecium* sp.	+	++	+
Rotifera			
1. *Monostyla* sp.	+	+++	+
2. *Cephalodella* sp.	-	+	-
3. *Euchlanis* sp.	+	-	-
4. *Brachionus* sp.	+	+	-
5. *Trichocera* sp.	+	+	-
6. *Philodina* sp.	++	++	-
Copepoda			
1. *Cyclops* sp.	+	++	+
2. *Nauplius* sp.	++	+	-
Cladocera			
1. *Bosmina* sp.	+	-	+
2. *Daphnia* sp.	-	+	-
Ostracoda			
1. *Cypris* sp.	+	+	-

Note: +++ abundant, ++ common, + rare, - absent

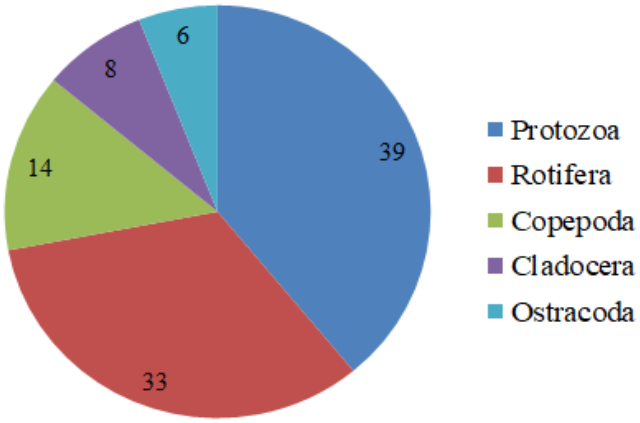

Figure 1. Species distribution of each group of Zooplankton in Gaula river

DISCUSSION

Maximum zooplankton diversity was recorded in summer (16) followed by winter (14) and minimum

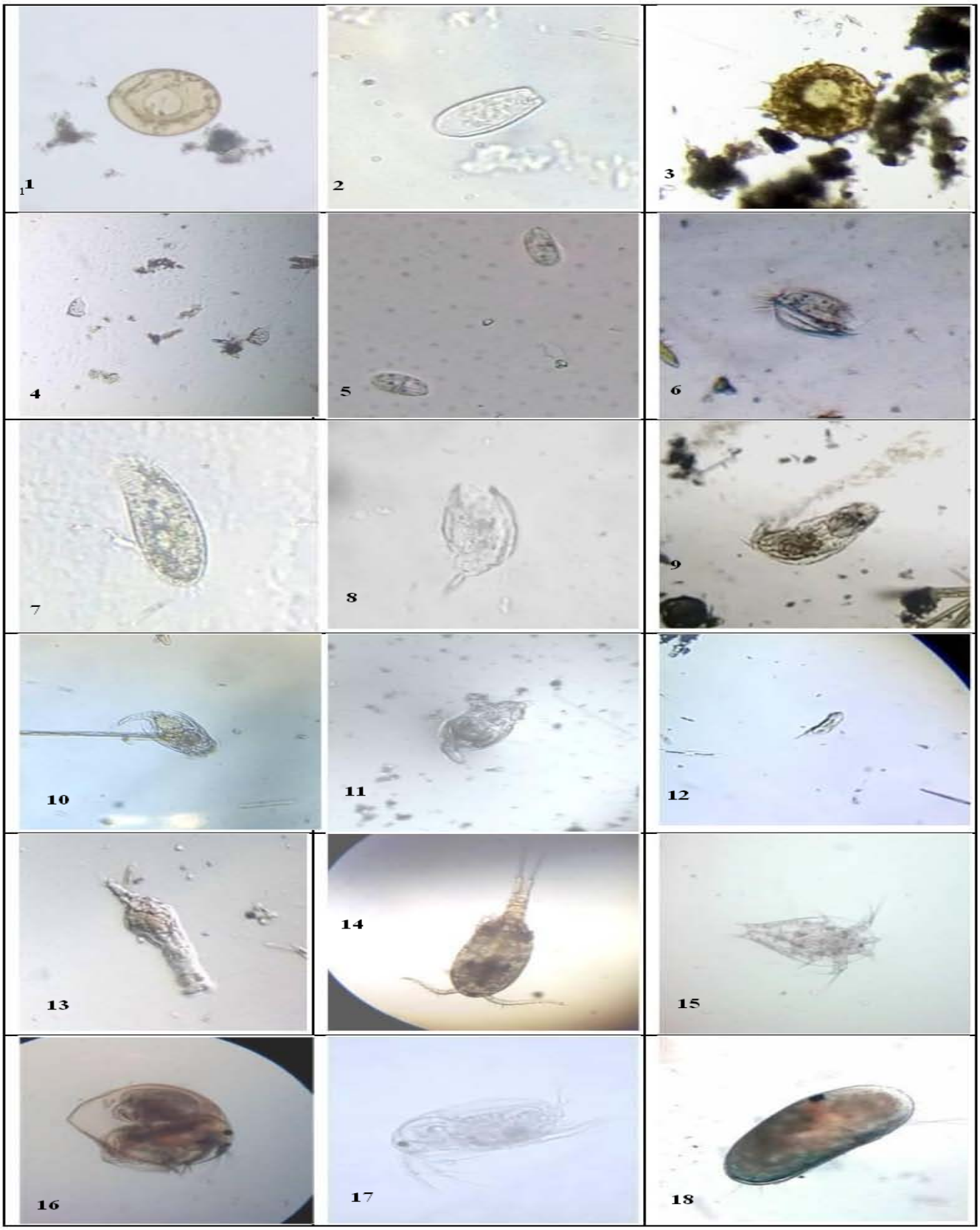

Figure 2. Zooplankton diversity in Gaula river. A. Protozoa - 1. *Arcella* sp., 2. *Difflugia* sp., 3. *Centropyxis* sp., 4. *Vorticella* sp., 5. *Entosiphon* sp., 6. *Euplotes* sp., 7. *Paramecium* sp. B. Rotifera - 8. *Monostyla* sp., 9. *Cephalodella* sp., 10. *Euchlanis* sp., 11. *Brachionus* sp., 12. *Trichocera* sp., 13. *Philodina* sp. C.Copepodab - 14. *Cyclops* sp., 15. *Nauplius* sp. D. Cladocera - 16. *Bosmina* sp., 17. *Daphnia* sp. and E.Ostracoda - 18. *Cypris* sp.

in monsoon (6) season. *Diffugia* sp. and *Monostyla* sp. were the most abundant, *Centropyxis* sp., *Epistylis* sp., *Paramecium* sp., *Philodina* sp., *Cyclops* sp., and *Nauplius* sp. were commonly founded and rest of the all were rarely distributed during entire study period (Fig. 2). 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) and Malik et al. (2012) and Watkar (2013).

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 and high availability of food for survival and the least in monsoon is due to high turbidity and high discharge of water during heavy rain fall. Zooplankton distribution followed the order of Protozoa > Rotifera > Copepoda > Cladocera > Ostracoda during the entire study period.

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Authors' contribution: The corresponding author (RA) designed, collected and analyzed data, and prepares first draft of the manuscript and co-author (RM) supervised, revised and finalized the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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