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Original Research Article

PLANKTON DIVERSITY OF NATIONAL RIVER AT TWO DIFFERENT SITES WITHIN HARIDWAR CITY

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ABSTRACT
This study is focused on the plankton diversity of the Ganga River during the year 2017. Plankton samples were collected monthly from the Ganga River. During the present study, phytoplankton and zooplankton were identified under the microscope with the help of standard photographs of Edmondson (1959). During the study period, Chlorophyceae (50%) was followed by bacillariophycae (37%) and Cyanophyceae (13%). Zooplankton diversity was also identified during the study period. During the study rotifers (40%) were the dominant group followed by protozoa (34%), Cladocera (23%) and Copepoda (3%). It was also found that plankton diversity was higher during the winter season followed by the summer season and minimum during the monsoon season. It was also revealed that anthropogenic activities also reduce the plankton diversity.

Keywords: Physico-chemical parameters, Ganga River, Haridwar, Sapta Rishi Ghat, Har ki Pauri

1. INTRODUCTION
Plankton are the microscopic milieu of aquatic ecosystems. Phytoplankton are the producers of aquatic ecosystems as they store sun energy and supply the energy to higher trophic levels. They make their food by the process of photosynthesis. They provide food to zooplankton, fishes and other higher organisms in aquatic ecosystems. Plankton is the most sensitive floating community which is the first target of water pollution, thus any undesirable change in the aquatic ecosystem affects diversity as well as biomass of this community (Summerwal, 2012). The Ganga River ecosystem contains a huge biodiversity of plankton and fishes. Planktons are used as a food by large number of animal species including fishes. Phytoplankton and zooplankton constitute natural food for fish fry, fingerlings and adults and an adequate supply of these items are essential for the proper growth of fishes.

2. MATERIALS AND METHODS
To assess the plankton diversity of the Ganga River, surface water samples were collected from the two selected sites viz. Sapta Rishi Ghat and Har Ki Pauri. 100 litres of surface water selected was filtered through a plankton net of bolting silk No 20 (76 m mesh size) and a concentrated sample of 200 ml was prepared 100 ml of sieved residue was transferred to a bottle and preserved in 4%formaline for identification using standard keys (APHA, 1995, Edmondson (1959). Samples were collected monthly during the study period, from Feb. 2017 to Dec. 2018 at two sampling sites. During the present study, phytoplankton and zooplankton were identified under the microscope.

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3. RESULTS AND DISCUSSION

A total number of 40 genera of phytoplankton were encountered during the one year of study. The occurrence of various phytoplankton species at two selected sampling stations. Chlorophyceae which is green algae and accounted for the major share of phytoplankton diversity in terms of phytoplankton diversity, represented by 15 genera (*Ankistrodesmus, Chlamydomona*s, *Cladophora, Closterium, Comarium Cosmarium, Euglena, Oedogonium, Pandorina, Pediastrum, Spirogyra, Tetraspora, Ulothrix, Uronema* and *Volvox*). Bacillariophyceae (diatoms) which is brown algae, second major group in terms of phytoplankton diversity, represented by 11 genera (*Amphora, Bacillaria, Cyclotella, Cymbella, Denticula, Diatoma, Fragilaria, Frustulia, Gomphoneis, Naviculam* and *Nitzschia*) followed by the blue-green algae (Cyanophyceae) which constituted only 04 genera (*Anabaena, Nostoc, Spirulina, Ocillatoria*). During the study period, phytoplankton distribution followed the pattern, Chlorophyceae> Bacillariophyceae> Cyanophyceae.

Similar results were also observed by Sharma *et al.* (1982) who studied on phytoplankton community analysis of lakes of Kumaon Himalaya and illustrated that fairly common species of the lakes were *Ankistrodesmus, Chlamydomona*s, *Anabaena* and *Ocillotoria.* Similarly, Bhadula and Joshi (2012) found the same pattern in the Ganga River at Haridwar. It was found that water quality is also responsible for plankton distribution. Khanna, *et al.* (1998) have studied the phytoplanktonic diversity and their role in Ganga riverine ecology within Haridwar City. Sharma and Tiwari (2018) also observed that phytoplankton diversity certainly depends on water quality. The seasonally qualitative composition of phytoplankton diversity at two spots (Sapta Rishi Ghat and Har Ki Pauri) in the Ganga River during 2019 has been depicted in Table 1. During the study period i.e. 2017 the maximum genera of phytoplankton were recorded in the winter season and the minimum was in the monsoon season. Joshi *et al.* (1993) also found similar results. They have observed that bacillariophycae were dominant over Chlorophyceae and Cyanophyceae in the Ganga River. During the study period, it was found that most of the phytoplankton were higher during the winter season followed by the summer season and minimum during the monsoon months. Major *et al.* (2017) also observed similar patterns of phytoplankton. Negi *et al.* (2013) also supports our results.

Table 1:- Phytoplankton diversity and seasonal variation at two sites viz. Sapta Rishi Ghat and Har Ki Pauri

	Sapta Rishi Ghat			Har Ki Pauri		
Genera	Winter	Summer	Monsoon	Winter	Summer	Monsoon
CHLOROPHYCEAE						
Ankistrodesmus	+	+	+	+	+	
Chlamydomonas	+	+	+	+	+	
Cladophora	+	+	-	+	+	+
Closterium	+	+	-	+	+	+
Comarium	+	+	-	+	+	+
Cosmarium	+	+	-	+	+	-
Euglena	+	+	-	+	+	+
Oedogonium	+	+	-	+	+	+
Pandorina	+	+	-	+	+	+
Pediastrum	-	+	+	-	+	+
Spirogyra	+	+	+	+	+	-
Tetraspora	+	+	-	+	-	-
Ulothrix	+	+	+	+	+	+
Uronema	-	+	+	-	-	-
Volvox	+	+	+	+	+	+
	-	+	+	+	+	-

	+	+	-	+	+	+
BACILLARIOPHYCEAE						
Amphora	+	+	+	+	+	+
Bacillaria	+	+	+	+	+	-
Cyclotella	+	+	+	+	+	+
Cymbella	+	+	+	+	+	+
Denticula	+	+	+	+	+	+
Diatoma	+	+	+	+	+	+
Fragilaria	+	+	+	+	+	+
Frustulia	+	+	+	+	+	-
Gomphoneis	+	+	+	+	-	-
Navicula	+	+	+	+	+	+
Nitzschia	+	+	+	+	+	+
CYANOPHYCEAE						
Anabaena,	+	+	+	+	+	+
Nostoc	+	+	-	+	+	+
Spirulina	+	+	+	+	+	+
Ocillatoria	+	+	+	+	+	-

ZOOPLANKTONIC DIVERSITY

Zooplankton makes a significant link in the food web operating in an aquatic reservoir and other aquatic ecosystems. Zooplankton depend on phytoplankton and provide food to higher organisms in aquatic ecosystems. Therefore a study on qualitative estimation of zooplankton is the fundamental step to estimate quality and production status of aquatic ecosystems. Zooplankton communities of Ganga River were examined for one year (from Jan. 2017 to Dec. 2018) to study the diversity at seasonal intervals at two sampling stations (Sapta Rishi Ghat and Har Ki Pauri). The zooplankton assemblage of the Ganga River was assessed to provide baseline information on an aspect of the biological characteristics of the river.

Qualitative estimation of Zooplankton: In the course of a detailed survey (from Jan. 2017 to Dec. 2018) encompassing the zooplankton diversity of Ganga River at selected sites, analysis of zooplankton samples collected at monthly intervals. The results of zooplankton diversity are given below:

During the study period i.e. 2017 total of 25 genera, belonging to four groups viz. twelve genera of rotifera (*Anura, Asplanchna, Brachionus, Filinia, Keratella, Lecane, Monostyla, Notholca, Philodina, Polyarthra, Rotaria* and *Trichocera*) which comprises about 40% of total zooplankton diversity. In the same year of study, ten genera of protozoa (*Arcella, Centrophyxis, Didinium, Difflugia, Noctiluca, Paramecium, Spathidium, Stentor, Vorticella* and *Volvox*) comprise 34% of total zooplankton diversity. During the study, seven genera of cladocera (*Bosmia, Ceriodaphnia, Chydorus, Daphnia, Diphanosoma, Moina* and *Simocephalus*) were also identified. Cladocera comprises 23% of total zooplankton diversity. One genus of copepods (Cyclops) was also identified during the study. The copepod comprises 3% of total zooplankton diversity. Negi and Pant (1983) also analyzed the Zooplankton community of Lake Khurpatal and find out that rotifers were the dominant group of zooplankton

Oriola (2003) also supports were observation when he studied zooplankton associations and Environmental factors in the Ogupa rivers. Undesirable changes in hydrobiological factors of reservoirs may create an unpleasant environment for the aquatic milieu. These undesirable changes in physical, chemical and biological properties affect their growth and other life activities (Khanna *et al.* 2011). Zooplankton are important communities for the fisheries development (Pathani and Upadhyay, 2003). During the present study, it was found that most of the zooplankton diversity was

higher during the winter season followed by the summer season. The minimum zooplankton found during the monsoon season. Similarly, Rao (2017) studied zooplankton diversity and seasonal variations in the Thandava reservoir and observed that zooplankton diversity fluctuates due to seasonal changes. Khanna *et al.* (2005), Singh (2015), Kumar and Shyam (2018), Sivakumar and Altaff (2003) and Yusuf and Qadri (1985) also support our observations.

Table 3:- Zooplanktonic Diversity at two sites in Ganga River during 2017

	Sapta Rishi Ghat				Har Ki Pauri		
Genera	Winter	Summer	Monsoon		Winter	Summer	Monsoon
Rotifera							
Anura							
Brachionus	+	+	+	+	+	+	+
Filinia	+	+	+	+	-	-	-
Keratella	+	+	+	-	-	-	-
Lecane	+	+	+	+	+	+	+
Monostyla	+	+	+	+	+	+	-
Notholca	+	+	-	-	-	-	-
Philodina	+	-	+	+	+	+	+
Polyarthra	+	+	+	-	+	+	-
Rotaria	+	+	+	+	-	-	-
Trichocera	+	+	+	-	-	-	-
	+	+	+	+	+	+	+
	+	+	-	+	+	+	-
Protozoa							
Arcella	+	+	+	+	+	+	+
Centrophyxis	+	+	+	+	+	+	+
Didinium	+	+	+	+	+	+	-
Difflugia	+	+	+	+	+	-	+
Noctiluca	+	+	+	+	+	-	+
Paramecium	+	+	+	+	+	-	+
Spathidium	+	+	+	+	+	-	-
Stentor	+	+	+	+	+	-	+
Vorticella	+	+	+	+	+	-	+
Volvox	+	+	+	+	+	-	+
Cladocera							
Bosmia	+	+	+	+	+	-	+
Ceriodaphnia	+	+	+	+	+	+	-
Chydorus	+	+	+	+	+	+	+
Daphnia	+	+	+	+	+	+	+
Diphanosoma	+	+	+	+	-	-	+
Moina	+	+	+	+	+	-	+
Simocephalus	+	+	+	+	+	+	+
Copepoda							
Cyclops	+	+	+	+	+	-	+

4. CONCLUSION

Plankton communities exhibit a major biotic component of an aquatic ecosystem and emphasis has been given to identifying various plankton species as indicators of particular types of water pollution. Abdulkarim and Ibrahim (2018) emphasized the importance of biological surveys in

monitoring water quality which is dependent on the qualitative and quantitative composition of the aquatic population. The most important effect of organic pollution in a water body is due to the enrichment of nutrients and the total number of algal species. There is a clear correlation between organic pollution and blue-green algae and also with certain diatoms like Melosira sp. (Gaikwad *et al.* 2004). During the present study, the most pollution-tolerant species of *Oscillatoria, Euglena* and *Navicula* were recorded. Among the zooplanktons, Rotifers were good indicators of water quality. Rotifers of the genus *Brachionus* and *Keratella* are abundant in the water of the reservoir. Their occurrence in eutrophic water was well documented. We conclude that there are several reasons for the higher diversity at Sapta Rishi Ghat as compared to Har Ki Pauri. Anthropogenic activities, water quality deterioration, and degradation of the riparian zone are the main reasons for the low diversity at Har Ki Pauri.

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