



ORIGINAL ARTICLE

Zooplanktonic Diversity of Kachhla Ghat (Western U.P. Region) of River Ganaga

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ABSTRACT

Investigation period was chosen from July 2017 to June 2018. Water samples were collected at regular interval of one month from observing 2 sites or spots or stations of kachhla ghat in River Ganga. Zooplankton was assessed both qualitatively and quantitatively. Highest peak was available in summer season at studied sites while minim was observed in post-monsoon season. Three major groups were observed. In fact major groups identified as Protozoa, Rotifers, small Crustaceans (Copepods, Cladocerans or Diplostraca or water fleas, ostracods), larvae and pupae of Insects. The distribution of zooplankton from site no. 1 or site 'A' (proper ghat where anthropogenic activities take place) to site no. 2 or site 'B' (exactly opposite side of site no. 1, where anthropogenic activities almost nil) is represented by total genera 66 in number, out of which 16 genera of Protozoa, 23 genera of Rotifera, 13 genera and of Cladocera, 07 genera and of Copepoda and 07 genera of ostracoda. Rotifers were recorded in maximum in number at both sites. Rotifers were rich enough to change chemistry of water and considered as pollutophilic. Values of Shannon-Weiner Species Diversity Indices falling between 1 to 2 and Equitability was fabulous above 80% showed in present paper indicating excellent grade of biodiversity of zooplankton and the level of pollution was moderate at both sites. Values of Simpson index from .22 to .24 and Simpson diversity index from .76 to .78 estimated indicating higher genus richness and evenness of zooplankton at both sites. Conclusion was made in the light of zooplankton importance in stretch of River Ganga.

Key words: Kachhla ghat, Crustaceans, Copepoda, Shannon-Weiner Species Diversity Indices

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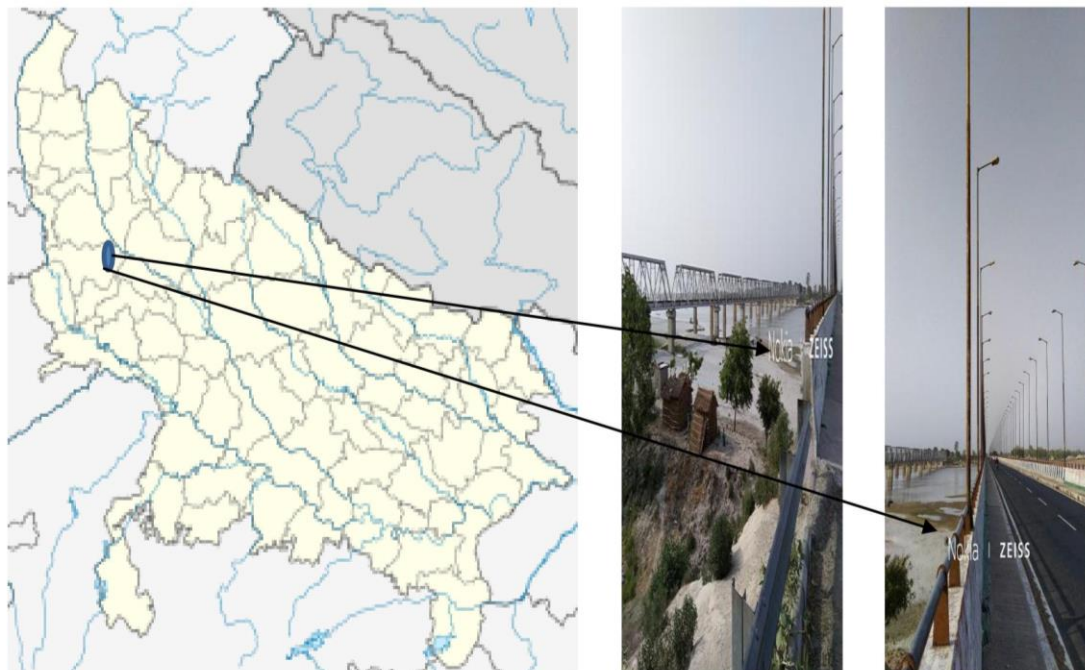
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INTRODUCTION

The planktonic community is a group of tiny plants and animals, drifting or feebly swimming in the water mass. Zooplanktons have an influence on ionic composition and nutrient availability in fresh water. The entire morphometry, physiology and physicochemico - biological status of fresh water bodies much depend on tiny creatures known as zooplankton. Whole survey of aquatic ecology in fishing areas is affected by now and so on upon fecundity, growth, development, numericity, diversity, reproduction of zooplankton [1]. These are ecological markers in many ways especially in nutrient level and pollution. Plankton is used as a major source of food of different fish. Enrichment of plankton along with high prolific growth of nutrients leads to eutrophication. Zooplankton diversity denotes varietyfulness within their community and their diversity is most vital ecological cue as they form link between phytoplankton and nekton [1]. The species diversity and richness of the zooplankton community is necessary factor to weigh the aquacultural practices in any aquatic body.

The River Ganga or Ganges has always been sacred River in India with religious and mythological significance. Since infinite years ago it was and even now it is the life line of

innumerable people specially belongs to northern plains meeting all requirements associated with water. Nevertheless, during past years it has been seemingly that the River is struggling for its existence as it is becoming dirty and dirty due to untreated sewage, surface run off ,industrial effluents and toxic chemicals coming as various by products being dumped in to it along the cities catchment areas.

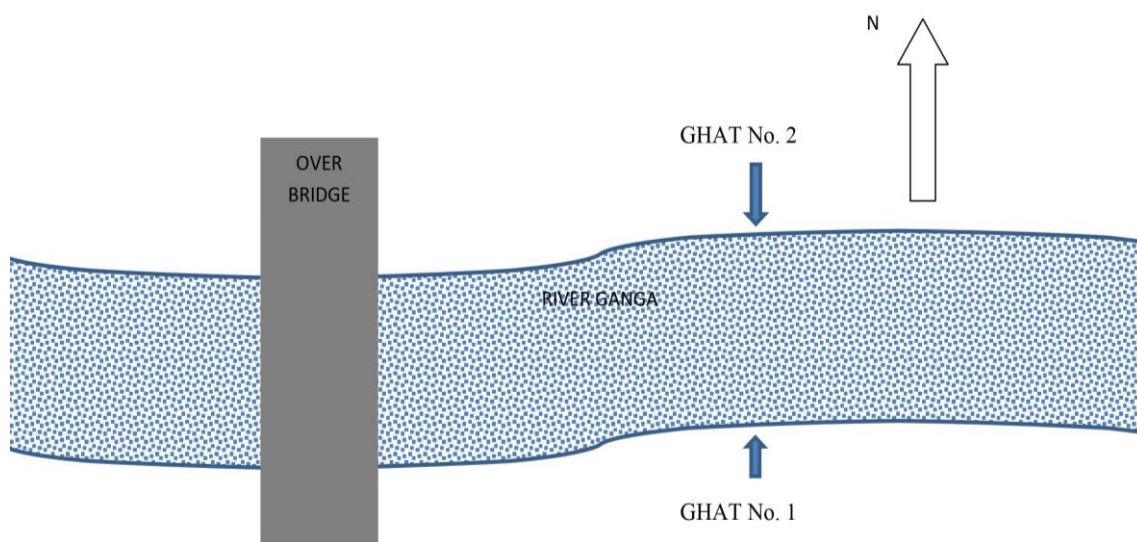


Map of Kachhla town attached with photo of overbridge



Photo at kachhla ghat

Courtsey : internet google



Schematic raw map representing experimental sites

Moreover bearing of various physico-chemical parameters on the seasonal pulse needs to be understood. Badaun district had well known to have big stretch of GANGA. But enormous habitat construction for human in proper city had made them got over. However author tried to find biodiversity of very little creatures of water as 'zooplankton' at two juxt opposed ghats (at different ends) of Kachhla in district jurisdiction. This paper stresses over exercise in identifying fresh water tiny creatures which are life line to our Rivers making survival to large fauna like nekton. Author found, identified, counted and listed basic components of lentic ecosystems i.e., zooplankton. He also compared biodiversity indices of various genera of zooplankton like Shannon-Weinner index, Simpson index and Simpson diversity index between two studied ghats at kachhla.

GEOGRAHY OF KACHHLA GHAT

Kachhla is a town settlement and a nagar panchayat lays down in Badaun district in Uttar Pradesh. Road towards at ghat no. 1 site goes to kasganj while road towards at ghat no. 2 site goes to Bareilly. Over bridge is built over the River. Both sites are juxt opposite each other and present at both opposite ends of River across the bridge. Author used boat to collect water samples from both sites. Kachhla is situated at 27°58'N and 78°53'E.

METHODS & MATERIALS

Sampling and Analysis of plankton: Monthly planktonic sample, at the experimental spots were collected by filtering 2 liter of water through planktonic net NO.25. Samples were preserved in 5% formaldehyde solution in labeled glass tube. In the laboratory, plankton were identified [2, 3, 4, 5] (Tonapi, 1980; Adoni, 1985 and Sharma (1996, 2001) and counted. Zooplankton counting was done in the Sedgwick rafter counting cell [6] (Welch, 1948). Also plankton samplers were used in this regard. Data were seasonally compiled and analysed. Seasonal variations were observed during summer (March, April and May), monsoon (June, July, August and September) post-monsoon (October and November) and winter (December, January and February). Analyses of collected data and Diversity indices analysis were done using Microsoft Excel, 2007 software.

1. The formula of Shannon-Weiner Species Diversity Index is as follows:

$$H' = - \sum_{i=1}^s p_i \ln p_i$$

2. The formula of Simpson index and Simpson diversity index are as follow:
 - A. Simpson index [D] = $\sum n_i (n_i - 1) / N (N - 1)$

B. Simpson diversity index = $1-D = [1-\sum ni (ni-1)/N (N-1)]$

OBSERVATION

Zooplankton are considered as immediate consumer of phytoplankton. As a result of qualitative and quantitative analysis the Zooplankton in four different seasons was represented by 3 major groups viz. Rotifera, protozoa and crustacea at studied stations. Total 66 genera were observed.

Table 1: Different genera of 5 groups of zooplankton present in Ganga River at both sites (A and B) during 2017-2018

Protozoa	Rotifera	Crustacea		
		Cladocera	Copepoda	Ostracoda
<i>Actinophrys sp.</i>	<i>Asplanchna sp.</i>	<i>Anura sp.</i>	<i>Cletocamptus sp.</i>	<i>Cypris sp.</i>
<i>Actinosphaerium sp.</i>	<i>Brachionus sp.</i>	<i>Bosmina sp.</i>	<i>Cyclops sp.</i>	<i>heterocypris sp.</i>
<i>Amoeba sp.</i>	<i>Euchlanis</i>	<i>Ceriodaphnia sp.</i>	<i>Heliodiaptomus sp.</i>	<i>onchocypris sp.</i>
<i>Arcella sp.</i>	<i>Filinia sp.</i>	<i>Daphnia sp.</i>	<i>Mesocyclops sp.</i>	<i>Stenocypris sp.</i>
<i>Colpedium sp.</i>	<i>Gastropus sp.</i>	<i>Daphniosoma sp.</i>	<i>Nauplius sp.</i>	<i>Lothonura sp.</i>
<i>Diffugia sp.</i>	<i>Hexarthra sp.</i>	<i>Diaptomus sp.</i>	<i>Thermocyclops sp.</i>	<i>Cypridopsis sp.</i>
<i>Euglena sp.</i>	<i>Keratella sp.</i>	<i>Leydigia sp.</i>	<i>Clanoid sp.</i>	<i>Cypria sp.</i>
<i>Euplotes sp.</i>	<i>Notholca sp.</i>	<i>Mesocyclops sp.</i>		
<i>Paramecium sp.</i>	<i>Cephalodella sp.</i>	<i>Moina sp.</i>		
<i>Vorticella sp.</i>	<i>Trichocerca sp.</i>	<i>Moinodaphnia sp.</i>		
<i>Vamprella sp.</i>	<i>polyarthra sp.</i>	<i>Nauplius larvae,</i>		
<i>Nuclearia sp.</i>	<i>Rotaria sp.</i>	<i>Simocephalus sp.</i>		
<i>Ceratium sp.</i>	<i>Diplois sp.</i>	<i>Chydorus sp.</i>		
<i>Chilomonas sp.</i>	<i>Cephalodella sp.</i>			
<i>Nebella sp.</i>	<i>Ascomorphella sp.</i>			
<i>Euglypha sp.</i>	<i>Monostyla sp.</i>			
	<i>Notomata sp.</i>			
	<i>Lecane sp.</i>			
	<i>Lepadella sp.</i>			
	<i>Phyllodina sp.</i>			
	<i>Synchaeta sp.</i>			
	<i>Platyias sp.</i>			
	<i>Testudinella sp.</i>			

Table 2: Seasonal Zooplankton Density (individual /m³) of Ganga River, at Site No. 1 (Site A), Kachhla Ghat during 2017-2018

Group	No. of genera	Percentage	Summer	Monsoon	Post-Monsoon	Winter	Total	Percentage
Protozoa	16	24.24	90	54	42	60	246	13.41
Rotifera	23	34.84	270	120	85	200	675	36.80
Cladocera	13	19.69	140	95	90	110	435	23.71
Copepoda	7	10.60	98	77	70	85	330	17.99
Ostracoda	7	10.60	40	32	28	48	148	08.06
Total	66		638	378	315	503	1834	

Table 3: Seasonal zooplankton density (individual /m³) of Ganga River, at Site No. 2 (site B), Kachhla Ghat during 2017-2018.

Group	No. of genera	Percentage	Summer	Monsoon	Post-Monsoon	Winter	Total	Percentage
Protozoa	12	23.52	80	60	35	55	230	13.31
Rotifera	20	39.21	225	135	90	180	630	36.47
Cladocera	10	19.60	150	80	72	110	412	23.85
Copepoda	8	9.80	85	84	62	95	326	18.87
Ostracoda	4	7.84	44	25	20	40	129	07.46
Total	51		584	384	279	480	1727	

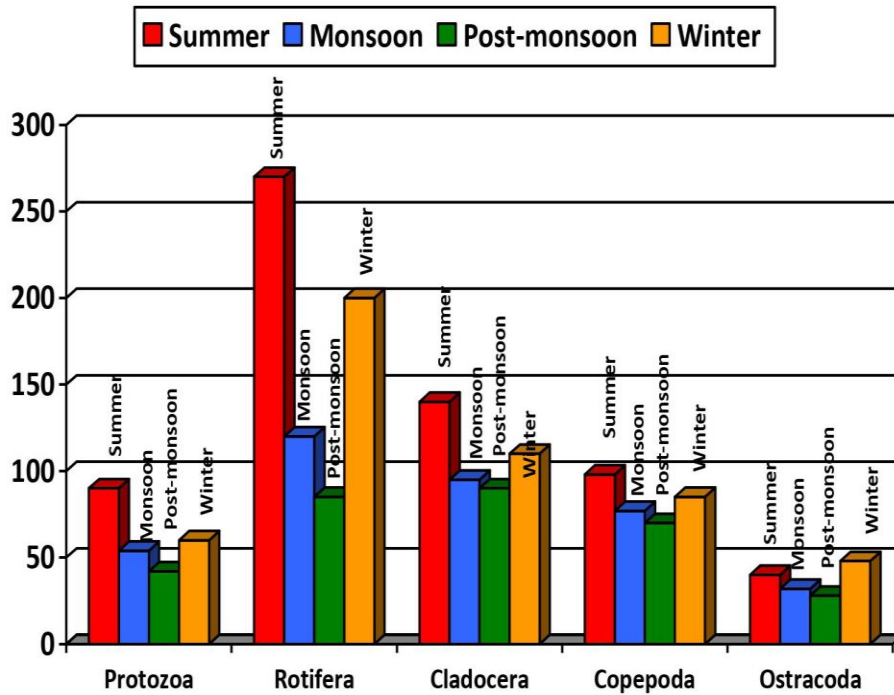


Plate No. 1 : Seasonwise quantitative values of zooplankton groups at site no. 1 (site A) in Ganga river during year 2017-18

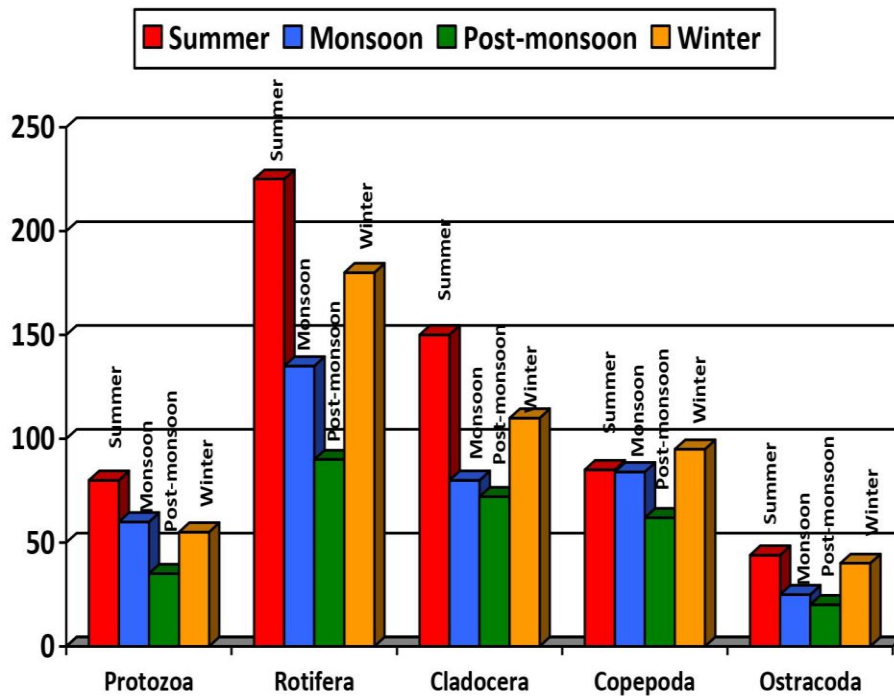


Plate No. 2 : Seasonwise quantitative values of zooplankton groups at site no. 2 (site B) in Ganga river during year 2017-18

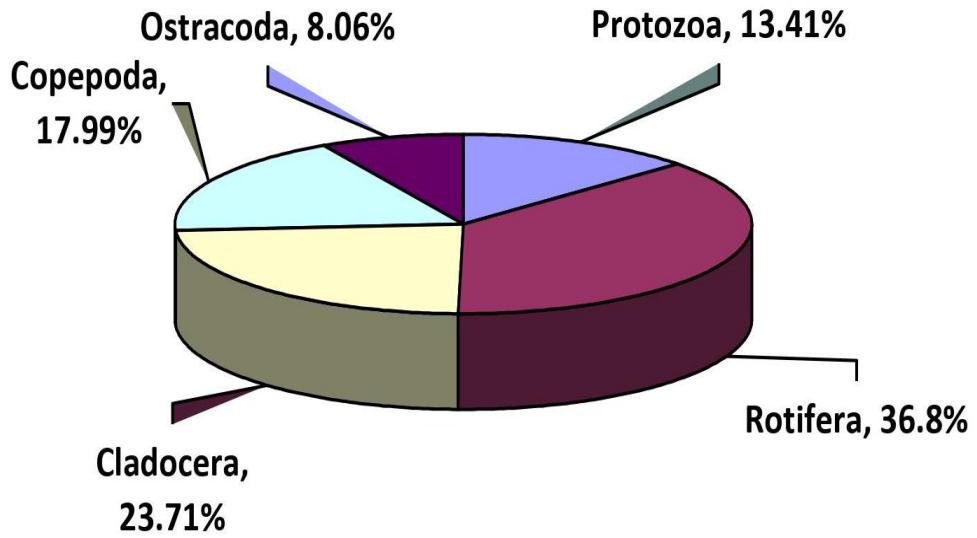


Plate No. 3 : Percentwise groups of zooplankton of Ganga river at site no. 1 (site A)

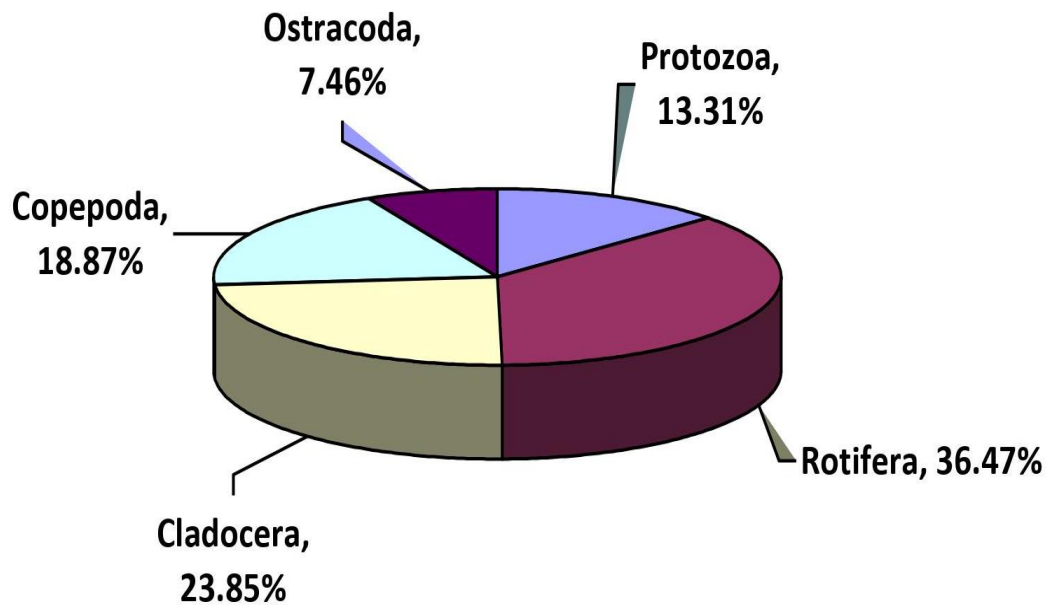


Plate No. 4 : Percentwise groups of zooplankton of Ganga river at site no. 2 (site B)

RESULT AND DISCUSSION

Total numbers of genera recorded were 66 in number (Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. A total of 21 genera of zooplankton belonging to 5 major groups viz. Protozoa (7), Cladocera (5), Copepod (1), Rotifera (7) and Ostracod (1) have been reported from Tons River in Dehradun [7].

In another study 38 genera of zooplankton comprised of Copepoda (17), Protozoa and larval forms of animals (5 genera) and Ostracoda with 3 species at River Kali at Karwar, has been described [8].

Zafar and Sultana [9] also testified the zooplankton fauna like Protozoans, Rotifers, Cladocerans and Copepods in the Ganga River at Kanpur. The dominant genera at Kanpur were Paramecium, Brachionus, Filinia and Keratella.

Untoo *et al.* [10] studied 236 km stretch of Ganga River between Narora to Kannauj and reported the richness and configuration of zooplankton. The order of abundance of various zooplankton groups was found to be Rotifera > Cladocera > Copepoda > Eggs and Nauplii. While in present study quantitative strength was observed as Rotifera > Cladocera > Copepoda > Protozoa > Ostracoda at both stations. While genera wise order was Rotifera > Protozoa > Cladocera > Copepoda > Ostracoda.

Sinha *et al.* [11] reported that the zooplankton is dominated by Rotifers (Brachionus sp., Keratella sp. and Anura sp.) with relatively few Cladocera (Moina sp.) and Copepods (Cyclops sp. and Diaptomus sp.) at Kanpur.

In this study also, maximum share of zooplankton composition went in favor of Rotifers (36.80% at site A and 36.47% at site B respectively) followed by Cladoceran (23.71 % at site A and 23.85% at site B respectively), Copepods (17.99% at site A and 18.87% at site B respectively), Protozoan (13.41% at site A and 13.31% at site B respectively) and least by Ostracods (8.06% at site A and 7.46% at site B respectively). Genera wise diversity went maximum in favor of Rotifers (34.84% at site A and 39.21% at site B respectively) followed by Protozoan (24.24 % at site A and 23.52% at site B respectively), Cladoceran (19.69% at site A and 19.60% at site B respectively), Copepods (10.60% at site A and 9.80% at site B respectively), and least by Ostracods (10.60% at site A and 7.84% at site B respectively).

Maximum number was observed in summer (638 at site A, 584 at site B) while minimum in post monsoon (315 at site A, 279 at site B). Among these groups of zooplankton, rotifers are markers of eutrophication and pollution while Cladoceran and Copepods can be used as indicator of freshwater aquatic environments. [12]

Richness and dominance of rotifera is commonly reported in most of water bodies including Indian Rivers [13,14]. This pattern is common including present study over River Ganga and in many fresh water bodies like lakes, ponds, reservoirs, Rivers or streams [15]. In present study on quantitative share basis, genera of Arcella, Paramecium, Actinophyrus, Actinosphaerium, Ceratium, Euglena, Diffulgia and Vorticella were the most abundant among Protozoa. Among Rotifera, genera of Brachionus, Asplanchna, Keratella, Gastropus, Notholca, Rotaria, Filinia, Lecane and Testudinella were abundant.

Abundance of Brachionus is common in almost freshwater Rivers perhaps depend on physical and chemical nature of water [16].

Genera of Bosmina, Monia, Daphnia, Diaptomus, Nauplius larvae and Diaphanosoma were found prominent among Cladocera. It was determined that the density of Cladocera is governed by food supply as it is direct proportional to food supply [17].

Genus Cletocamptus, Cyclops, Thermocyclops sp. among Copepoda were found abundant in present investigation.

Genus namely cypris, Lothonura and Stenocypris of Ostracoda was found throughout the study period at both stations. Abundance of species of Vorticella, Brachionus, Keratella, Bosmina, Daphnia, Diapanosoma and Moina were also reported also in Tons River at Dehradun [7]. Bosmina sp with 46.15% in ChhariGanga Oxbow Lake drawn from the River Ganga in Nadia, WB has been reported [18]. These observations corroborating the

results of present study it is imperative and also logically justified that zooplankton and fresh water biotic communities has been a subject of study in india and lot of researchers have been engaging for last six decades [19] parallel to them other workers were concerned about utility of zooplankton in assessing the water quality for population level and interaction with physico-chemical parameters including nutrient enrichment [20, 21, 22, 23, 24, 19, 25, 26].

It is a fact that zooplankton can exist under a wide range of environmental cue like oxygen, temperature, turbidity, depth, nutrients etc. They play an important role in denoting the numericity of certain fish species [19]. Whatever the author studied in present work that summer peak of zooplankton was supposed to be of higher temperature, raised solar illumination, rich availability of food and nutrients [27, 28]. Temperature enhancement could raise the level of brood production and moulting [29]. Due to all feasible conditions and much anthropogenic and zoogenic activities at site A had more diversity index and evenness as compare to site B at kachhla. Optimum presence of limnoplankton leads to healthy production of macrofauna and fishes which is a good sign in order to enhance aquacultural practices. No single factor could govern the production of limnoplankton.

In present study summer pulse was due to higher temperature, pH and alkalinity, moderate transparency, while minimum trench or minimum numeracy was recorded in post monsoon due to less D.O., less sunlight and photosynthesis and higher turbidity.

The major part of zooplankton was vested in rotifers. These fascinating creatures are present in diversified aquatic habitats especially in fresh waters. Their reproduction, growth, development and dominance make them prevalent forms around 20-50% [30]. They play tremendous role in grazing, suspension feeding, predating among zooplankton. Brachionus was found as dominant group. It was observed in much in number at more polluting site A as compare to site B. Thus rotifers were known as pollutophilic [19]. The present strength of rotifers was found in accordance with works of Allen [31], Byars [32], Yousuf *et. al.* [21] Nayak & Khare, [33] Sharma [5], Reddy [23].

Shannon-Weiner Species Diversity Index:

1. At site 1 value was calculated as $H' = 1.5$, Equitability H'/H_{max} ; $(1.5/1.6) = 0.93$ means (93% of max. diversity)
2. At site 2 value was calculated as $H' = 1.4$, Equitability H'/H_{max} ; $(1.4/1.6) = 0.87$ means (87% of max. diversity).

From above Values of Shannon-Weiner Species Diversity Indices falling between 1-2 showed in present study that higher (excellent) grade of biodiversity of zooplankton was present at both Sites No. 1 & 2 and Equitability was fabulous as observed 93% & 87% of maximum possible diversity at stations 1 & 2 respectively. The level of pollution was moderate at both stations in accordance with values of Shannon-Weiner Species Diversity Indices.

1. (i). Simpson index : $D = \sum ni(ni-1)/N(N-1)$
At site 1, it was calculated .22
(ii). Simpson diversity index: $1-D = [1-\sum ni(ni-1)/N(N-1)]$
At site 1, it was calculated as .78,
2. (i). Simpson index: $D = \sum ni(ni-1)/N(N-1)$
At site 2, it was calculated .24
(ii). Simpson diversity index: $1-D [1-\sum ni(ni-1)/N(N-1)]$
At site 2, it was calculated as .76

From above values of Simpson index and Simpson diversity index it can be enumerated that at Site No. 1, 78% chances that if we pick up 2 genera or individual at random and would they be the same or the different species. SDI in this case means there is 78% chance that 2 individuals selected at random from this community would be different from different species or genus. Its means 78% chances that 2 individual selected random

from this community would from different species or genus (Simpson diversity index). OR 22% chance that 2 individual selected random would be from same species or genus (Simpson index). SDI means the chance of the individuals being from different species. Likewise at Site No. 2, 76% chances that if we pick up 2 genera or individual at random and would they be the same or the different species. SDI in this case means there is 76% chance that 2 individuals selected at random from this community would be different from different species or genus. Its means 76% chances that 2 individual selected random from this community would from different species or genus (Simpson diversity index) OR 24% chance that 2 individual selected random would be from same species or genus (Simpson index). SDI means the chance of the individuals being from different species.

CONCLUSION

It was concluded by author that this was an attempt to study, richness, distribution, quantum of genera, monthly variations, varietyfulness etc. of lovely creatures zooplankton at two investigated sites (ghats) in River Ganga at kachhla. Rotifers were recorded in maximum in number at both sites.

Diversity and evenness was little higher at site no. 1 as compared to site no. 2., which was justified and calculated by using Shannon – weinener index , equitability, Simpson index and Simpson biodiversity index. Anthropogenic and zoogenic activities were higher at Site No. 1 as compare to No. 2. Many reasons described above were proved to have little more and rich biodiversity of zooplankton at Site No. 1. The water at studied sites was moderately polluted, not severely polluted.

Tremendous biodiversity of zooplankton at kachhla may be usefull in aquaculture practices like pisciculture vis-à-vis other aquafauna cultures and stability of the River Ganga. Author did all that whatever mentioned and proved above was the purpose of his study under the title diversity of zooplankton.

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