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Study of planktonic diversity of river Ganga from Devprayag to Roorkee, Uttarakhand (India)

D.R. Khanna, Rakesh Bhutiani ✉, Gagan Matta, Vikas Singh and Gaurav Bhadauriya

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Abstract

Analysis of water samples for planktonic diversity has been carried out for five sampling stations of river Ganga stretched over a distance of 125 kms from Devprayag to Roorkee. The investigation was carried out for a period of one year at five different sampling sites i.e. Sampling station A (Devprayag), Sampling station B (Rishikesh), Sampling station C (Haridwar) Sampling station D (Pul Jatwara) and Sampling station E (Roorkee). In the present study of river Ganga, Among the zooplankton, Protozoa, Rotifera, Cladocera, Copepod, Ostracods constitute the main component and in phytoplankton Diatoms were dominated and class Blue green algae, green algae was found least during study period. Majority of zooplankton shows maximum occurrence and abundance during the high salinity period.

Keywords: *Planktonic diversity, zooplankton, diatom, phytoplankton*

Introduction

The River Ganga (2,525 km long) is the largest river basin in India, covering 26.2 percent of India's total geographical area. The plankton in a reservoir is an important biological indicator for evaluating the water quality of a reservoir. While phytoplankton are important primary producers and the basis of the food chain in open water some species on the other hand can be harmful to human and other vertebrates by releasing toxic substances into the water Ariyadej *et al*. (2004). Phytoplankton studies and monitoring are useful for control of the physico-chemical and biological conditions of the water in any irrigation project. Phytoplankton is increasingly being used to monitor the ecological quality and health of the water environment and also to measure the effectiveness of management or restoration programmes or regulatory actions. In India the fresh water constitutes rivers, streams, lake, wetlands, ponds and reservoirs. These fresh water bodies directly help in the growth of human civilization. The freshwater resource is becoming day by day at the faster rate of deterioration of the water quality is now a global problem. The freshwater communities *i.e*., phytoplankton, zooplankton, macrophytes and macro invertebrates are sensitive to environmental factors. Different species of plankton vary in different seasons due to the changes in physico chemical nature of water. The phytoplankton community shows high diversity with the seasonal fluctuation, which indicates the diversity in ecological niches. The zooplankton occupying the secondary level in the food chain play a key role in the transformation of food energy synthesized by the phytoplankton to the higher trophic level. Both phytoplankton and zooplankton supports the economically important fish populations Joshep *et al.* (2011).

Author's Address

Department of Zoology & Environmental Sciences
Gurukul Kangri Vishwavidyalaya, Haridwar, India
E-mail: rbhutiani@gmail.com

Material and Methods

For Plankton study samples were collected from Ganga River from March 2010 to April 2011 from five sampling sites. The samples were taken in a borosil glass bottle of 300 ml capacity and in plastic container. For qualitative analysis the plankton samples were collected with the help of standard plankton net with uniform speed. Identification of plankton was made with the help of available literature. (APHA, 1998; Edmondson, 1992 and Khanna and Bhutiani, 2004).

Study Site

Sampling was done at five different sampling sites *i.e.*-

1. **Sampling site A** (Devprayag): Latitude 30°09' N Longitude78°37'E
2. **Sampling station B** (Rishikesh): Latitude 30°07` N Longitude78°19` E
3. **Sampling station C** (Har-ki-Pauri, Haridwar) Latitude 29°58` N Longitude 78°13`E
4. **Sampling station D**(PulJatwara,Jwalapur) Latitude 29° 87' Longitude 29° 87' E
5. **Sampling station E**(Roorkee) Latitude 29° 87' N Longitude77° 88` E

Results and Discussion

The results of monthly variations in planktonic diversity are illustrated in Table 1-4. Species richness was high in summer and winter and it was minimum during Monsoon. In the present study number of phytoplankton varies between 404 unit/l to 5166 unit /l maximum monthly variation (5166 unit/l) of phytoplankton was recorded in the month February 2011 at sampling site B and minimum (404 unlit /l) was recorded in the month July 2010 at sampling site A. on the other hand zooplankton diversity was recorded maximum (890 unit/l) in the month march 2010 at sampling site B and minimum (18 unit /l) was recorded in the month July 2010 at sampling site A. The phytoplankters constitute bulk of primary producers and are the base of food chains in any water body. Similar observation was also made by Alam and Khan (1998), Anil Kumar *et al*. (2004) and Canfield and Jones (1996) during their study.

Table 1: Monthly variation of phytoplankton diversity in unit/l at all sampling site

Month	Phytoplankton *(Unit/l)*					
	SITE A	**SITE B**	**SITE C**	**SITE D**	**SITE E**	**Average**
March	1247	3406	1282	1352	1153	**1688.0±963**
April	1192	3590	1259	2449	1356	**1969.2±1041**
May	1138	1565	1257	1979	1055	**1398.8±377**
June	654	980	728	999	1280	**928.2±248**
July	404	890	517	635	989	**687.0±247**
August	674	660	1196	821	880	**846.2±217**
September	903	775	1105	1112	990	**977.0±142**
October	2033	1323	1002	693	1073	**1224.8±504**
November	2405	1471	1088	1471	2941	**1875.2±768**
December	2737	1458	2031	2431	3560	**2443.4±786**
January	3287	4628	2329	3169	4129	**3508.4±893**
February	1425	5166	2954	2369	2939	**2970.6±1375**

The phytoplanktonic community of river Ganga during the present study was represented diatoms, green algae and blue green algae (Table 3). In phytoplankton Diatoms were dominated and class Blue green algae was found least during study period. At sampling site A the number of diatom were observed maximum in the month of January of 2011 (2846 unit/l) and minimum (795 unit/l) in month of June 2010 and average value was observed as 1197.55 ± 597.60 unit/l. At sampling site B the number of diatom were observed maximum (3021 unit/l) in the month of January, 2011 and minimum (352 unit/l) in July month of 2010 and average was observed as 1101.55 ± 688.21 unit/l. At sampling site C, D and E the number of diatom were observed maximum (3721 unit/l), (4152 unit/l) and (1652 unit/l) in the month of January 2011 and February 2011 respectively. On the other hand minimum value was noted down as (665 unit/l), (562 unit/l) and (462 unit/l) in the month of July 2010 respectively. Similar study was made by Carter *et al.* (1980), Chakrabarty *et al*. (1959) and Das (2002).The most prominent phytoplankters during the study were Diatom Sharma, 1980; Solomon, 1994; Shekhawat, 1997 observed dominance of blue green algae in Udaipur lake waters. Baghela (2006) observed the dominance of Chlorophyceae in Oligotrophic Lake Jawai Dam. Algae are tiny aquatic plants that are found as single cells or in colonies of various sizes. They make a primary link in the aquatic food chain, acting as food for microscopic

animals called zooplankton. These tiny animals are eaten by many fish and other aquatic animals. As a by-product of photosynthesis, algae also release oxygen into the water that can be used by fish and other aquatic animals (Battish, 1992). During the present investigation at sampling site A Green algae were found to be highest (452 unit/l) in the month of February 2011 and lowest (155 unit/l) in the month of September 2010. The average count of Green algae was 241.66 unit/l ± 142.03. At sampling site B number of Green algae were found to be highest in the month of December 2010 (268 unit/l) and lowest 42 unit/l in August 2010. The average count of Green algae was 107.00unit/l ± 68.06. At sampling site C, D and E the value of Green algae were found to be highest (378 unit/l), (326 unit/l) and (368 unit/l) in the month of December and January respectively. On the other hand minimum value was found as (35 unit/l), (32 unit/l) and (42 unit/l) in the month of august respectively. A more or less similar observation was made by Khanna (1993), Khanna and Bhutani 2003 during his study on sati kund pond and Anil Kumar *et al*. 2004. Blue-green algae or cyanobacteria are natural to the environment's food chain and are found all over the world. They are actually a type of bacteria but, like plants, they can use sunlight to grow. Many live with other types of algae and microscopic animals collectively termed plankton (Ramteke and Moghe, 1988) At sampling site A Blue green algae showed optimum peak during the month of April in 2010 (80 unit/l) and least peak (4 unit/l ±) during the month of September 2010. The average value of Blue green algae was 45.00 unit/l ± 28.98. At sampling site B Blue green algae showed optimum peak (62 unit/l) during the month of December 2010 and least peak (1 unit/l ±) during the month of July 2010. the average value of Blue green algae was 24.44 unit/l ± 22.32.At sampling site C, D and E value of blue green algae showed maximum (82 unit/l), (85 unit/l) and (92 unit/l) during the month of December 2010 and January 2011 respectively and minimum value was recorded as (3 unit/l), (3 unit/l) and (1 unit/l) in the month of August and July respectively. Similar trend was observed by Sharma and Sarang (2004), Jeppesen *et al.* (1997), Pandit (1999) and Zehra, and Altaff (2002).Zooplankton is the intermediate link between phytoplankton and fish, which are the secondary producers in the aquatic environment (Hutchinson, 1967). In River Ganga diverse taxonomic groups of zooplankton representing Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda were found during course of study. In present investigation among zooplankton Protozoa are single-celled eukaryotes (organisms whose cells have nuclei) that commonly show characteristics usually associated with animals, most notably mobility and heterotrophy. At sampling site A Protozoa was maximum in the month of March in 2010 (178 unit/l) and minimum was found 14 unit/l in November month 2010. At sampling site B Protozoa was maximum in the month of March in 2010 (112 unit/l) and minimum was found 1 unit/l in June month. (2010). At sampling site C Protozoa was maximum in the month of January in 2011 (182 unit/l) and minimum was found 15 unit/l in august month. (2011). At sampling site D Protozoa was maximum in the month of January in 2011 (149 unit/l) and minimum was found 10 unit/l in July 2010. At sampling site E Protozoa was maximum in the month of December in 2010 (145 unit/l) and minimum was found 12 unit/l in July month. (2010). Similar study were made by Dodson (1992), Gannon and Stemberger (1978) and Mahajan (1981). Rotifers are the microscopic faunal component living mostly in fresh water, are characterized by the presence of an anterior wheel like rotating structure called "Corona". The rotifers are being considered as the most important soft bodied invertebrates (Hutchinson, 1967). At sampling site A Rotifera was found to be highest in the month of March 2010 (115 unit/l) and lowest (10 unit/l) in the month June 2010 respectively. At sampling site B Rotifera was found to be highest in the month of March 2010 (135 unit/l) and lowest (5 unit/l) in the month of July 2010. At sampling site C Rotifera was found to be highest in the month of December 2010 (115 unit/l) and lowest (15 unit/l) in the month of July 2010.At sampling site D Rotifera was found to be highest in the month of March 2010 (125 unit/l) and lowest (15 unit/l) in the month of July 2010 and February 2011 respectively.

At sampling site E Rotifera was found to be highest in the month of May 2010 (72 unit/l) and lowest (12 unit/l) in the month of October 2010. Similar observations were also made by (Sinha, 1992) who had reported total absence of rotifers during the monsoon season in the Ganga river. Pandey *et al*. (2004) also found similar result during his study of river ramjan in Bihar. Cladocera popularly called as 'water flea' prefers to live in deep water and constitute a major item of food for fish. Thus they hold key position in food chain and energy transformation (Uttangi, 2001). At sampling site A Cladocera was observed in their optimum peak during April 2010 (180 unit/l) and in lowest peak during the month of July (5 unit/l) in the year 2010. At sampling site B Cladocera was observed in their optimum peak during March 2010 (112 unit/l) and in lowest peak during the month of July (3 unit/l) in the year 2010. At sampling site C Cladocera was observed in their optimum peak during February 2011 (189 unit/l) and in lowest peak during the month of July (10 unit/l) in the year 2010. At sampling site D Cladocera was observed in their optimum peak during February 2011 (137 unit/l) and in lowest peak during the month of July (11 unit/l) in the year 2010.

Table No. 2:- Monthly variation of Zooplankton diversity in unit/l at al sampling site

Month	Zooplankton *(Unit/l)*					
	SITE A	SITE B	SITE C	SITE D	SITE E	Average
March	437	890	137	135	205	**360.8±20.63**
April	214	650	357	350	380	**390.2±159.18**
May	220	465	214	211	190	**260±115.14**
June	46	315	91	80	150	**136.4±106.23**
July	18	80	48	50	65	**52.2±23.06**
August	24	35	57	40	70	**45.2±18.26**
September	73	67	130	69	90	**85.8±26.31**
October	146	164	149	73	162	**138.8±37.61**
November	181	255	188	189	303	**223.2± 53.77**
December	212	387	260	334	397	**318.00±80.40**
January	347	626	375	352	228	**385.6±146.01**
February	306	646	390	229	287	**371.6±163.38**

At sampling site E Cladocera was observed in their optimum peak during 2010 May (56 unit/l) and in lowest peak during the month of November (5 unit/l) in the year 2010. Michels *et al*. (2001), Pandey *et al*. 2004 also found similar result during their study. Coepad are a group of small crustaceans found in the sea and nearly every freshwater habitat (Kalff, 2002). At sampling site A Copepod was maximum (92 unit/l) in 2010 October and minimum was found in the month of November 2010 (10 unit/l). At sampling site B Copepod was maximum (106 unit/l) in 2011 February and minimum was found in the month of July 2010 (8 unit/l). At sampling site C Copepod was maximum (104 unit/l) in March 2010 and minimum was found in the month of July 2010 (4 unit/l). At sampling site D Copepod was maximum (98 unit/l) in January 2011 and minimum was found in the month of July 2010 (6 unit/l). At sampling site E Copepod was maximum (92 unit/l) in January 2011 and minimum was found in the month of June 2010 (8 unit/l). Similar trend was observed by (Chauhan R, 1993) in Renuka lake, Himachal Pradesh and Kaushal and Sharma, (2007).

Table 3: Showing Number of different Group among the Phytoplankton at all Sampling Sites

Month	Site A			Site B			Site C			Site D			Site E		
	Unit/l														
	Diatom	Green algae	Blue green algae	Diatom	Green algae	Blue green algae	Diatom	Green algae	Blue green algae	Diatom	Green algae	Blue green algae	Diatom	Green algae	Blue green algae
Mar.	1104	178	78	965	198	8	1190	242	30	1075	252	25	1065	212	5
April	895	180	80	1005	125	40	1750	265	55	2108	282	58	1108	102	48
May	840	405	65	1110	60	35	1900	90	40	1861	85	32	1161	65	30
June	795	350	45	806	65	5	980	105	35	856	98	45	656	68	4
July	980	390	30	352	45	1	665	65	10	562	64	9	462	54	1
Aug.	975	250	5	788	42	2	780	35	3	786	32	3	586	42	3
Sept.	1080	155	4	658	65	15	805	55	15	985	85	42	615	65	8
Oct.	1820	182	46	565	105	22	865	125	82	1020	186	30	835	168	16
Nov.	1957	406	30	1214	202	55	2614	262	65	960	265	9	868	262	10
Dec.	2129	433	42	2101	268	62	3100	378	82	2172	326	84	968	315	72
Jan.	2846	364	75	3021	102	46	3721	362	46	3032	326	85	1210	368	92
Feb.	1100	452	76	2205	106	58	2765	146	28	4152	278	56	1652	242	67

Table 4: Showing Number of different Group among the zooplankton at all Sampling Sites

Month	Site A					Site B					Site C					Site D					Site E				
	Protozoa	Rotifera	Cladocera	Copepod	Ostracods	Protozoa	Rotifera	Cladocera	Copepod	Ostracods	Protozoa	Rotifera	Cladocera	Copepod	Ostracods	Protozoa	Rotifera	Cladocera	Copepod	Ostracods	Protozoa	Rotifera	Cladocera	Copepod	Ostracods
	Unit/l																								
Mar.	178	115	132	82	112	112	135	112	98	78	105	112	68	104	57	25	125	46	92	57	67	40	36	29	36
April	151	102	180	60	126	46	120	32	62	16	100	106	85	94	40	17	117	96	84	45	136	15	48	57	20
May	15	34	22	14	18	55	95	35	57	35	86	56	55	50	32	12	52	52	45	12	62	72	56	60	15
June	22	10	10	16	12	1	15	15	12	15	56	24	12	17	10	11	25	16	12	9	52	52	24	8	8
July	55	42	5	55	32	5	5	3	8	5	25	15	10	4	5	10	15	11	6	6	12	35	12	14	7
Aug.	142	62	14	50	55	6	8	5	18	5	15	16	17	8	17	15	25	15	10	14	15	26	16	10	6
Sept.	108	72	20	89	67	2	30	21	16	20	16	25	32	25	25	28	36	24	18	35	18	30	25	16	16
Oct.	62	53	14	92	14	20	62	15	24	25	34	42	32	28	28	40	30	56	22	56	20	12	12	14	15
Nov.	14	14	18	10	16	38	72	3	36	32	52	68	49	36	50	45	48	84	32	63	50	46	5	52	36
Dec.	18	22	34	35	28	40	56	8	62	46	94	97	64	72	60	85	85	28	82	75	145	68	12	55	54
Jan.	22	16	32	25	28	105	78	15	85	64	182	106	137	86	115	149	21	112	98	40	104	66	22	92	68
Feb.	72	49	90	35	52	85	64	26	106	25	157	115	189	64	121	119	15	137	58	90	62	50	16	86	15

Ostracods are bivalve and have shape like small seeds. They inhabit all kinds of fresh water and marine environments. The freshwater Ostracods occur in lakes, tanks, pools, swamps, streams and even polluted waters. The abundance of these provides a good food for aquatic organisms. At sampling site A Ostracods sp. was observed in their optimum peak during 2010 April (126 unit/l) and in lowest peak during the month of june (12 unit/l) in the year 2010.At sampling site B Ostracods sp. was observed in their optimum peak during 2010 March (78 unit/l) and in lowest peak during the month of July and August (5 unit/l) in the year 2010. At sampling site C Ostracods sp. was observed in their optimum peak during February 2011 (121 unit/l) and in lowest peak during the month of July (5 unit/l) in the year 2010. At sampling site D Ostracods sp. was observed in their optimum peak during February 2011 (90 unit/l) and in lowest peak during the month of July (6 unit/l) in the year 2010.At sampling site E Ostracods sp. was observed in their optimum peak during January 2011 (68 unit/l) and in lowest peak during the month of August (6 unit/l) in the year 2010. Similar observations were also made by Sunkad and Patil (2004) in Fort lake of Belgaum (Karnataka) and Joshep and Yamakanamardi, (2011) in Kukkarahalli Lake of Mysore.

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