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A study of zooplankton diversity with special reference to their concentration in River Ganga at Haridwar

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Abstract

The purpose of this study was to assess the zooplankton abundance and their monthly variation in river Ganga water. Zooplankton could be the bio-indicator of health status of an aquatic system and their study. The out come of this study shows that the most abundant zooplankton species was *Ceriodaphnia* throughout the study period and total number of zooplankton is high during winter season when the temperature is relatively low.

Keywords:- *Zooplankton, Ganga river, Water quality, Abundance*

Introduction

Water plays a significant role in living environment. Water quality monitoring by different ways provide an avenue for meaningful participation of peoples and rivers are one of the easily accessible water source. Rivers are life line of human settlement but there are natural and anthropogenic factors which influence the water quality of river (Gupta and Chakrapani, 2007). Heavy exploitation of water resource and generation of large volume of waste water (Begum and Harikrishna, 2008) has given rise to a long list of challenging problems.

The major basins like Indus, Ganga and the Brahmaputra serve as the Water Towers of the Himalayas. River Ganga, the lifeline of north India originates from Gangotri glaciers and lastly terminates in the Bay of Bengal covering about 2,506.00 kms in India. The present study deals with different zooplankton species and their number observed in the Ganga river in Haridwar. For effective maintenance of water quality through appropriate control measures, continuous monitoring of large number of quality parameters is essential.

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Materials and Method

Haridwar is situated in the foothills of Shivaliks (Himalayas) along the bank of river Ganga at an elevation of 965 ft from sea level. The position of city on the globe is on latitude $29^0$58' N and longitude $78^0$13' E. Water samples were taken from five different sites in Haridwar district. The sampling sites are: Sati Ghat (Kankhal), Missharpur, Katarpur, Dhanpura (Azitpur) and Bhogpur.

The samples were taken in Borosil glass bottles of 300 ml capacity and plastic containers. The identification of phytoplankton was done according to Edmondson (1959), APHA (1998), Khanna and Bhutiani (2004).

Results and Discussion

The zooplankton in Indian rivers consists of diverse assemblage of major taxonomic groups. Many of these forms have different environmental and physiological assemblage. The number, type and distribution of these organisms present in any aquatic habitat provide a clue on the environmental conditions prevailing in that particular habitat. It is seen that many environmental factors interact to provide conditions for the growth of zooplankton both spatially and seasonally. Ray (1955) and Venkateswarlu and Menon (1979) recorded maximum values of total zooplankton during winter and minimum during rainy season. Lakshminarayanan (1965), Pahwa and Mehrotra (1966) observed the

total zooplankton maximum in river Ganga both in summer and winter.

In the present work it has been noted that the maximum average number of zooplankton were (568.03 unit/l ±259.48) in the month of March and minimum number were (55.68 unit/l ±18.71) found in the month of August. Observing the monthly variation in the number of zooplankton the maximum number observed was (856.62 unit/l ±26.45) at site-2 in the month of March and the minimum number (29.69 unit/l ±0.24) was found at site-3 in July month. Variation in the number of zooplankton at different site during the study period is tabulated in Table-1 and graphically shown in Fig. 1.

Table-1: Monthly variation in the number of zooplankton (2003-2004) at different sampling sites (Unit/l)

Month\ Site	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	347.85±26.23	436.52±36.24	434.78±30.78	189.48±10.08	627.30±9.08	407.19±158.89
February	304.14±38.27	320.00±34.72	390.89±33.24	334.50±22.54	647.65±8.15	399.44±142.56
March	450.90±39.57	856.62±26.45	503.56±28.12	229.54±18.46	799.53±12.65	568.03±259.48
April	425.11±41.19	621.34±33.90	507.89±16.45	352.67±12.51	558.71±11.08	493.14±106.43
May	274.47±26.24	526.10±27.16	279.55±14.35	357.62±21.24	311.74±10.21	349.90±103.92
June	97.15±11.38	196.25±12.51	100.36±10.24	214.72±14.61	89.08±1.22	139.51±60.72
July	40.03±8.19	84.60±8.54	29.69±0.24	92.06±8.47	34.21±5.21	56.12±29.75
August	49.68±7.16	87.21±2.44	37.64±0.28	49.11±1.46	54.75±3.68	55.68±18.71
September	103.23±12.15	95.27±8.67	120.08±1.28	58.14±1.24	115.92±4.82	98.53±24.65
October	146.82±15.27	132.16±11.45	162.38±5.54	70.77±1.71	166.60±9.52	135.75±38.79
November	181.83±21.21	125.00±10.24	197.83±7.73	73.66±0.87	257.07±10.07	167.08±70.28
December	214.03±25.30	362.00±21.08	317.60±11.21	137.77±0.21	389.27±12.25	284.13±105.56

The zooplankton number is governed by factors like humans activity, season of the year and values of water parameters. The increased turbidity reduces the plankton production (Khanna *et al*., 1993). In the present study it was noted that temperature showed a negative relationship with zooplankton. The zooplankton were higher in number when the temperature was generally low in the year. Eddy (1934) and Chandler (1940) pointed out that the zooplankton production is mainly influenced by temperature. The results indicated that the zooplankton were maximum in the winter month probably due to low temperature, high content of DO and low velocity. Similar study was made by Khanna and Bhutiani (2003) and Khanna *et al*. (2000).

During the study different species of zooplankton acknowledged were *Keretala valga*, *Ceriodaphnia*, *Arcella*, *Crustacia* and *Fillinia* sp. Monthly variation at different sampling site for *Keretala valga*, *Ceriodaphnia*, *Arcella*, *Crustacea* and *Fillinia* sp. is tabulated in Table- 2, 3, 4, 5 and 6. Study revealed that the maximum number (182.63 unit/l ±12.25) of *Keretala valga* was observed at site-2 in the month of January and minimum number (6.57 unit/l ±0.00) in the month of July in the same site. Highest average number (139.66 unit/l ±30.56) was observed in January month and minimum (13.59 unit/l ±4.83) in the month of July (Table-2 and Fig. 2).

Maximum average number (112.77 unit/l ±37.43) of *Ceriodaphnia* was found in the month of March and minimum average number (10.34 unit/l ±4.37) in the month of August. Observing site basis fluctuation in the number of *Ceriodaphnia* reveals that the maximum number (192.30 unit/l ±16.51) was found for site-5 in the month of April and minimum number (5.14 unit/l ±0.01) for site-4 in the month of August

Table-2: Monthly variation in the number of *Keretala valga* (2003-2004) at different sampling sites (Unit/l)

	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	105.00±2.24	182.63±12.25	149.65±12.24	145.00±13.09	116.00±13.51	139.66±30.56
February	85.54±0.87	157.00±11.21	119.50±9.45	62.14±1.56	76.84±15.25	100.20±38.10
March	124.52±1.21	172.65±10.27	114.62±10.29	104.32±7.45	112.67±8.24	125.76±27.18
April	108.65±1.37	110.36±12.85	112.40±8.90	106.05±1.88	105.00±6.46	108.49±3.04
May	82.15±0.46	74.21±1.24	72.00±3.41	62.05±0.84	97.42±5.76	77.57±13.21
June	52.24±0.12	14.00±0.08	30.02±0.96	42.24±0.34	46.65±1.29	37.03±15.25
July	18.00±0.11	6.57±0.00	10.61±0.06	16.08±0.12	16.70±0.12	13.59±4.83
August	25.64±0.13	10.16±0.00	14.24±0.00	35.14±0.22	20.86±0.08	21.21±9.80
September	35.00±0.21	32.62±0.64	32.51±0.05	25.00±0.06	25.62±0.03	30.15±4.53
October	20.20±0.00	34.00±0.84	40.00±0.51	20.10±0.07	20.35±0.07	26.93±9.43
November	38.52±0.27	52.62±0.64	45.62±0.21	35.52±0.11	37.49±0.56	41.95±7.08
December	40.80±0.46	94.00±2.54	85.73±1.82	50.10±0.60	63.70±0.88	66.87±22.71

Table-3: Monthly variation in the number of *Ceriodephnia* (2003-2004) at different sampling sites (Unit/l)

Month\ Site	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	78.50±3.24	106.00±10.65	21.05±0.24	68.20±2.54	116.60±13.24	78.07±37.46
February	64.24±1.49	115.64±9.08	15.64±0.05	50.10±2.08	106.92±10.41	70.51±41.32
March	86.00±2.40	149.00±10.51	150.00±12.94	66.00±3.46	112.84±12.52	112.77±37.43
April	106.00±8.64	107.20±5.81	16.72±0.09	86.00±4.85	192.30±16.51	101.64±62.70
May	85.00±2.48	78.35±2.85	64.71±4.27	65.00±4.06	53.00±0.20	69.21±12.59
June	15.62±0.59	21.71±0.18	35.40±0.65	25.62±0.85	17.00±0.10	23.07±7.95
July	6.81±0.01	12.00±0.00	11.00±0.12	16.81±0.10	5.85±0.25	10.49±4.40
August	8.14±0.51	15.52±0.85	14.20±0.08	5.14±0.01	8.70±0.01	10.34±4.37
September	32.00±0.87	30.25±1.80	25.67±0.84	12.00±0.00	52.50±0.85	30.48±14.59
October	62.00±0.56	42.80±1.46	30.27±0.40	12.00±0.00	65.00±1.41	42.41±22.17
November	72.15±0.18	68.40±5.16	48.16±1.21	52.10±0.84	85.02±2.07	65.17±15.11
December	56.52±0.07	97.24±4.46	85.60±1.81	46.12±0.12	97.22±2.45	76.54±23.79

(Table-3 and Fig. 3). Average number of *Arcella* showed highest value (33.21 unit/l ±6.92) in the month of February and lowest value (2.51 unit/l ±1.77) in August month. Site-3 showed the maximum number 56.72 unit/l ±10.01 in the month of October and minimum number 1.00 unit/l ±0.00 was shown by site-1 (Table-4 and Fig. 4) in August. This study regarding *Crustacia* reveals that the highest average value of this zooplankton species was (116.65 unit/l ±20.07) recorded in the month of March and lowest average value (5.38 unit/l ±1.97) recorded in July month. For *Crustacea* site-5 shown the lowest

Table 4: Monthly variation in the number of *Arcella* (2003-2004) at different sampling sites (Unit/l)

Month\ Site	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	15.10±1.08	17.00±1.00	12.61±0.88	12.10±0.61	17.56±1.52	14.87±2.48
February	26.20±2.42	39.68±2.12	37.25±2.24	25.20±1.85	37.70±2.29	33.21±6.92
March	32.00±2.21	28.00±1.01	23.82±1.16	22.00±0.00	45.00±13.42	30.16±9.15
April	15.61±0.85	16.53±0.98	15.64±0.78	15.01±0.38	15.62±8.09	15.68±0.54
May	10.00±0.52	12.62±0.14	1.62±0.03	10.65±0.46	16.00±0.00	10.18±5.32
June	2.15±0.06	14.68±0.28	15.20±1.08	3.10±0.13	3.25±0.21	7.68±6.65
July	4.00±0.00	2.93±0.05	2.33±0.01	5.00±0.00	1.80±0.05	3.21±1.29
August	1.00±0.00	3.26±0.01	5.24±0.25	2.00±0.00	1.08±0.01	2.51±1.77
September	5.62±0.08	7.16±0.42	7.81±0.16	6.60±0.05	6.70±0.03	6.78±0.80
October	15.36±0.21	32.80±3.45	56.72±10.01	12.30±1.04	16.20±1.58	26.68±18.61
November	3.16±0.01	4.63±0.07	8.00±0.00	2.15±0.01	4.32±0.82	4.45±2.21
December	8.56±0.35	34.32±2.24	28.54±2.37	5.16±0.05	9.40±0.61	17.20±13.25

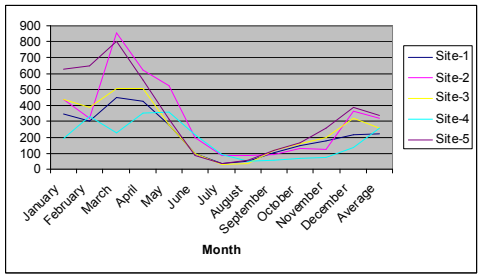

Fig. 1: Variation in the number of zooplankton during 2003-2004 at different sampling sites

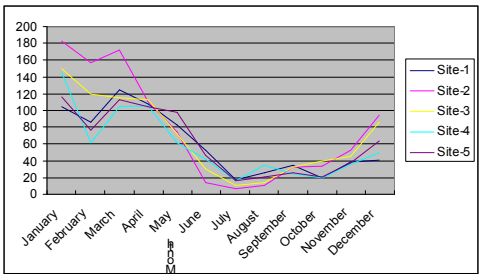

Fig. 2: Variation in the number of *Keretala valga* during 2003-2004 at different sampling sites

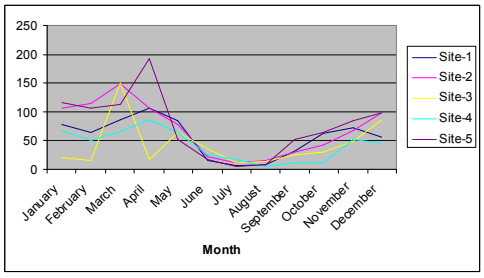

Fig. 3: Variation in the number of *Ceriodaphnia* during 2003-2004 at different sampling sites

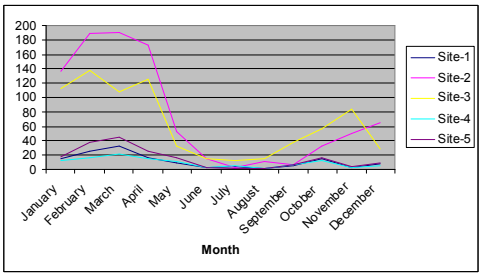

Fig. 4: Variation in the number of *Arcella* during 2003-2004 at different sampling sites

number (3.24 unit/l ±0.27) in July month and site-3 has showed the highest number (138.27 unit/l±16.34) in the month of March (Table-5 and Fig. 5). The *Fillinia* sp. recognized has shown the maximum average number 102.46 unit/l± 11.13 in the month of March and minimum average number 5.39 unit/l ± 2.93 in July month. *Fillinia* sp. was observed maximum (118.05 unit/l±14.28) in the month of March at site-5 and minimum (2.10 unit/l ±0.18) at site-5 in the month of July (Table-6 and Fig. 6).These findings are

Table 5: Monthly variation in the number of *Crustacea* (2003-2004) at different sampling sites (Unit/l)

	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	85.00±12.25	86.00±3.00	84.00±2.00	55.00±10.00	106.00±12.00	83.20±18.21
February	106.00±15.94	64.30±4.62	65.30±2.37	86.00±15.00	115.26±11.93	87.37±23.16
March	102.38±12.30	135.27±12.54	138.27±16.34	92.35±13.54	115.00±21.00	116.65±20.07
April	98.00±10.29	85.62±9.46	84.62±10.08	68.00±17.00	100.62±8.65	87.37±12.98
May	62.32±5.13	53.71±16.95	54.71±5.63	52.02±9.68	55.65±8.53	55.68±3.95
June	12.00±2.00	14.39±3.65	15.39±12.12	10.00±3.00	15.60±6.28	13.48±2.41
July	8.12±0.37	3.71±0.61	5.71±0.84	6.12±0.42	3.24±0.27	5.38±1.97
August	12.36±2.35	15.28±8.64	14.18±9.08	11.36±2.13	15.00±12.00	13.64±1.71
September	15.61±4.62	17.87±11.34	15.88±6.46	14.61±4.85	15.26±10.21	15.85±1.22
October	24.20±12.41	28.35±10.85	30.25±12.05	14.20±7.63	28.12±12.21	25.02±6.44
November	36.00±11.43	36.42±12.20	33.40±11.20	26.00±9.00	35.00±13.00	33.36±4.28
December	62.15±8.81	72.82±7.52	70.52±13.25	52.10±15.42	95.28±13.69	70.57±16.03

Table-6: Monthly variation in the number of *Fillinia* sp. (2003-2004) at different sampling sites (Unit/l)

	Site-1	Site-2	Site-3	Site-4	Site-5	Average
January	64.25±12.76	75.67±13.09	60.25±5.88	54.20±13.65	78.62±9.56	66.60±10.32
February	25.16±2.05	21.03±1.82	30.10±2.01	35.10±14.50	54.17±2.46	33.11±12.90
March	106.00±13.21	102.61±11.46	87.63±4.65	98.00±11.00	118.05±14.28	102.46±11.13
April	96.85±6.31	83.00±9.00	65.36±2.13	82.56±10.46	84.35±7.62	82.42±11.22
May	35.00±13.00	32.85±7.50	31.42±5.62	25.00±3.00	27.48±2.56	30.35±4.06
June	15.14±11.24	24.30±5.23	12.31±3.02	11.10±0.49	17.86±3.10	16.14±5.26
July	3.10±0.14	9.00±1.00	7.66±0.46	5.10±0.06	2.10±0.18	5.39±2.93
August	10.54±1.31	13.53±6.76	15.92±6.33	14.50±5.67	13.00±1.00	13.50±1.99
September	25.00±12.00	28.02±4.55	40.40±16.45	17.56±8.08	20.00±4.00	26.20±8.93
October	25.06±10.29	28.65±8.46	46.71±10.27	35.06±12.05	32.71±3.91	33.64±8.25
November	32.00±14.00	40.00±9.00	43.21±8.71	22.00±8.00	36.00±14.00	34.64±8.22
December	46.00±12.00	60.89±13.21	75.80±13.92	56.00±16.00	52.00±12.00	58.12±11.28

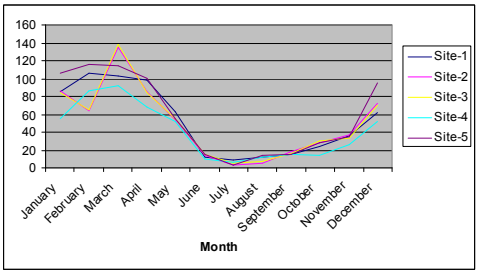

Fig. 5: Variation in the number of *Crustacea* during 2003-2004 at different sampling sites

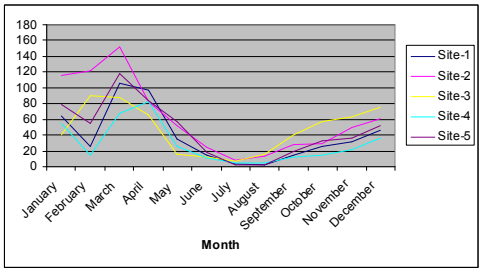

Fig. 6: Variation in the number of *Fillinia* sp. during 2003-2004 at different sampling sites

similar to that of Khanna (1993), Khanna *et al*. (2000), Prasad and Singh (2003) and Khanna *et al*. (2007).

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