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## Concomitant study of seasonal variation of rotifers population in river Sikrahana (West Champaran, Bihar)

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**Abstract :** Rotifers were the most diversified group of zooplanktons and play important role between the autotrophs and other heterotrophs and form important links in food chain. Rotifers are commonly found in both the stations i.e Chautarwa (Bagha) and Hari Nagar. A total of 14 and 12 species of rotifers were recorded in station I and II respectively. The first (124 U/L) and second (110 U/L) peak was recorded in December 2010 and May 2011 respectively. The dominant rotifer sps was *B. caudatus* (24 U/L) and (26 U/L) was recorded in June 2011 and 2012. *Keratella tropica* was the second dominant species. A total No. of 17 and 21 sps was collected in first and second stations during the study of diel variations. The data collected co-related to study the condition of river Sikrahana in the light of available literature.

**Key words:** Rotifers, Seasonal variation, Diel variation, Chautarwa Chaur, Harinagar.

### INTRODUCTION

Plankton acts as integrators of variety of physico-chemical and biological conditions of water because of their relative role as grazer of algae and bacteria. Their abundance should be a measure of water body's **productivity** (Chapman et al, 1985). Sharma (1986) reported that *Brachionus angularis*, *B. Calyciflorus* and *B. rubens* indicate highly polluted state of water. Rotifers inhabiting Lake Ecosystem constitute the major components of small zooplankton. They are consumer of microorganisms such as: Bacteria, algae, ciliates. Some sps are detritivorous thus rotifers play an important role in the trophic structure in fresh water ecosystem (Radwan 1973). Being the repositories of aquatic biodiversity and fresh water ecosystem provide livelihood and support to a sizable section of the society through fishing, agriculture and no. of other ancillary activities

(Chakraborti et al 2009). It has been observed that in the recent year the wet land area is in a critical stage of ecological transition, as evidenced from the thick to very thick strands of macrophytes, indicating an advanced stage of eutrophication. The aim of the present study was to explore the seasonal variation of rotiferation of two stations of river Sikrahana one is near the origin and other passing through the Harinagar Sugar factory.

### MATERIALS AND METHODS

The rotifers (zooplankton) were collected from July 2011 to June 2012 from two stations of river by filtering 50 litres of water through the plankton net. The plankton was preserved in 4% formalin at the sites and then brought to the laboratory for qualitative and quantitative analysis. Here, the volume of sample was made to 10ml and thoroughly shaken. 1ml of material was then taken from it and was placed on a Sedgwick rafter plankton counting chamber and the lower power of the compound microscope was used. The planktons were identified up to sps level wherever possible, with the help of Needham

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and Needham (1962). Ward and Whipple (1960) Michael and Sharma (1973).

The quantities estimation of zooplankton was made by the following formula

$$N = (a.1000)C / L$$
 Where, N= No. of Plankton / Litre of water.

A = Average no. of plankton in 1ml sub sample

L = Volume of original water sample in 1 litter

C = ml of plankton concentrate

The present contribution of the in dividable species in respect to the class and group was calculated individually.

## RESULTS AND DISCUSSION

Rotifers were the most diversified group aquatic habitat zooplankton commonly found in both the station recoded in station I. The total of 14 sps of rotifers were recorded in station I. The total abundance of rotifers shows two peaks, the first peak (124u/L) was observed in May 2011 and the second peak (110u/L) in December 2010 in the first year of study. During the second year of investigation the primarily & secondary maxima (174u/2 & 104u/L) was recorded in December 2011 and June 2012. The lowest number (24u/L & 34u/L) during in first & second year of study was observed in August 11 and August 2012 respectively. Among the rotifer *Brachionus caudatus* was the dominant species. Its highest population density (24u/L & 26u/L) was recorded in June 2011 and 2012. Whereas lowest density (4u/L and 8u/L) during September 2011 and 2012, during both the annual cycles. *Keratella tropica* was the second most dominant species, its maximum density (18u/L and 24u/2) were recorded in June 2011 and 2012, where as the minimum density (2 u/L and 4u/L) in August 2011 and September. 2012. *Brachionus falcatus* and *Asplanchna* Sps. were also thickly populated, their maximum density (18u/L and 18u/L) during the first year of study were recorded in May and June 2011, while the second year of investigation their highest number (16u/L and 22u/L) was recorded in June 2012 respectively. The other species of rotifers were scarcely present throughout the study period. In station II (Hari Nagar), a total number of 12 species of rotifers were recorded during the present study. The total abundance of rotifers show two peaks in this station. The

primary maxima (202u/L) was recorded in December 2011 and the secondary maxima (206u/L) in May 2012 in the first year of study. The first and second maxima (232u/L and 112u/L) during the second year of study were recorded in June 2012 and January 2013. The lowest density (38u/L and 42u/L) were recorded in August 2011 and 2012. Among the rotifers, *Brachionus anagularis* was the most dominant species, its highest number (36u/L and 46u/L) was recorded in May 2011 and June 2012 and the lowest number (4u/L and 6u/L) in September 2011 and 2012 respectively. *Brachionus forficula* was the second most dominant species, its highest density (38u/L) was recorded in June 2012 and lowest density (6u/L) in September 2011. During the first year of investigation, In the second year of study its maximum (32u/L) and minimum (10u/L) density were recorded in May 2012 and October 2011, *Brachionus falcatus* was thickly populated. Its highest number (28u/L and 10u/L) during first and second year of study were observed in May 2011 and June 2012; while the lowest (4u/L and 2u/L) in August 2011 and September 2012. The maximum density (22u/L and 120u/L) of *Brachionus caudatus* during the both year of study were recorded in May 2011 and June 2012 respectively. *Keratella cochlearis* was one of the dominant species of rotifers. Its highest density (24u/L and 28u/L) was recorded in May 2011 and June 2012, where as the lowest (4u/L and 2u/L) in September 2011 during the first and second year of study respectively. The other species of rotifers were thinly populated and scarcely present throughout the study.

### DIEL VARIATION:

During the study of diel variation a total number of 17 species were collected at station I and 21 species in station II. The rotifers population were dense during the night hour.

The maximum member (98u/L) of total rotifers was recorded at 0600 hrs in station I and at 0300 hrs. (136u/L) in station I, where as minimum (20u/L and 12 u/L) at 1500 hrs in both station during the winter seasons. In summer, the highest number (120u/L and 128u/L) of total rotifers were recorded at 0300 hrs in station I and at 0600 hrs I station II, while the lowest (18u/L and 14u/L) at 1500 hrs in both stations. In monsoon the maximum density of rotifers was recorded at 0300 hrs (64u/L) and (56u/L) in station I and II respectively. whereas, the

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minimum density(8u/L) and (6u/L) at 1800 hrs in station I and II respectively.

In station I, during the winter the *Brachionus caudatus*, *Brachiourus falcatus* and *Keratella tropica* were observed as the most abundant species. The highest number (18u/L) of *B. caudatus* was recorded at 0900 hrs and the lowest (4u/L) at 1800 hrs. The maximum density (16u/L) of *B.falcatus* was noticed at 0600 hrs. and the minimum (6u/L) at 1500 hrs. *B. froficula* and *Keratella tropica* shows their maximum density (14u/L and 14u/L) at 0600 hrs and 0900 hrs while the minimum density (2u/L and 4u/L) at 1500 hrs respectively. In station II *B.*

*falcatus*, *B. quadridentata*, *B. calyciflorus* and *Keratella cochlearis* were recorded as the most abundant species during the study of winter diel variation. The highest density (18u/L) of *B. falcatus* was recorded as 0300 hrs and the lowest density (2u/L) at 1800 hrs *Brachions calyciflorus* shows their highest density (7u/L) at 1500 hrs. *B.quadridentata* was observed as the most dominant species during diel study. It shows their highest abundance (34u/L) at 0300 hrs and the lowest (2u/L) at 1800 hrs. *Keratella cochlearis* was found only in station II. The maximum density (16u/L) of this was observed at 0900 hrs and the minimum (2 /L) at 1500 hrs.

**Table 1: Monthly Variations Of Rotifers Population (indv./L) at station 1( from july 2010 to june 2011)**

Months/ Orgaganism	Jul	Aug	Sep	Oct	Nov	Dec	11	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec	12	Feb	Mar	Apr	May	Jun
ROTIFERA																								
<i>Branchionuscaudatus</i>	8	6	6	10	12	16	18	12	6	18	22	24	14	10	8	12	16	22	20	10	14	18	24	26
<i>B. falcatus</i>	4	6	8	8	8	12	14	4	4	6	10	18	10	6	10	12	14	16	12	6	6	8	14	16
<i>B. calyciflorus</i>					2	6	6			4	6	10	2		4		6	8	4		4	8	10	12
<i>B. quadridentata</i>					2	4			2	6	10	6	2				4	4			4	6	8	12
<i>B.forficula</i>	4	6	10	4	8	8	10					14	8	6	12	8	8	10	6	8	10	12	16	14
<i>B. rubens</i>	2			4	8	8	4								2									
<i>Asplanchna sp.</i>			4	6	10	14	12	8	12	14	18	8	4	2	2	6	8	12	14	10	12	16	12	22
<i>Filiniologiseta</i>	2			2	4	6	2		4	6	10	6	4			4	4	4	8	2	4	6	10	12
<i>Filiniaterminalis</i>		2			4	4	4		2	4	8	4	2		6			2	2		2	2	4	6
<i>Keratellatropica</i>	4	2	4	4	8	2	1	1	1	8	2	1	1	1	1	4	4	6	8	2	0	8	4	20
<i>K.cochlearis</i>	2				2	4				4	4						2	2				2	4	6
<i>Lecane sp.</i>					2	4	4			4	4	2					2	4	2			4	6	6
<i>Monostyle sp.</i>	2			2	4	8			4	8	0	1			4		2	2	6	6		2	4	12
<i>Polyarthra sp.</i>	4	2	2		2	4		2	4	4	6	8	4	2	4	2	4	4			2	4	8	10
Total	3	2	3		7	1	8	3	4	9	2	1	6	3	5	5	7	0	8	4	7	0	5	17
	2	4	6	40	6	0	8	6	6	0	4	8	0	4	2	2	8	6	4	4	4	6	4	4

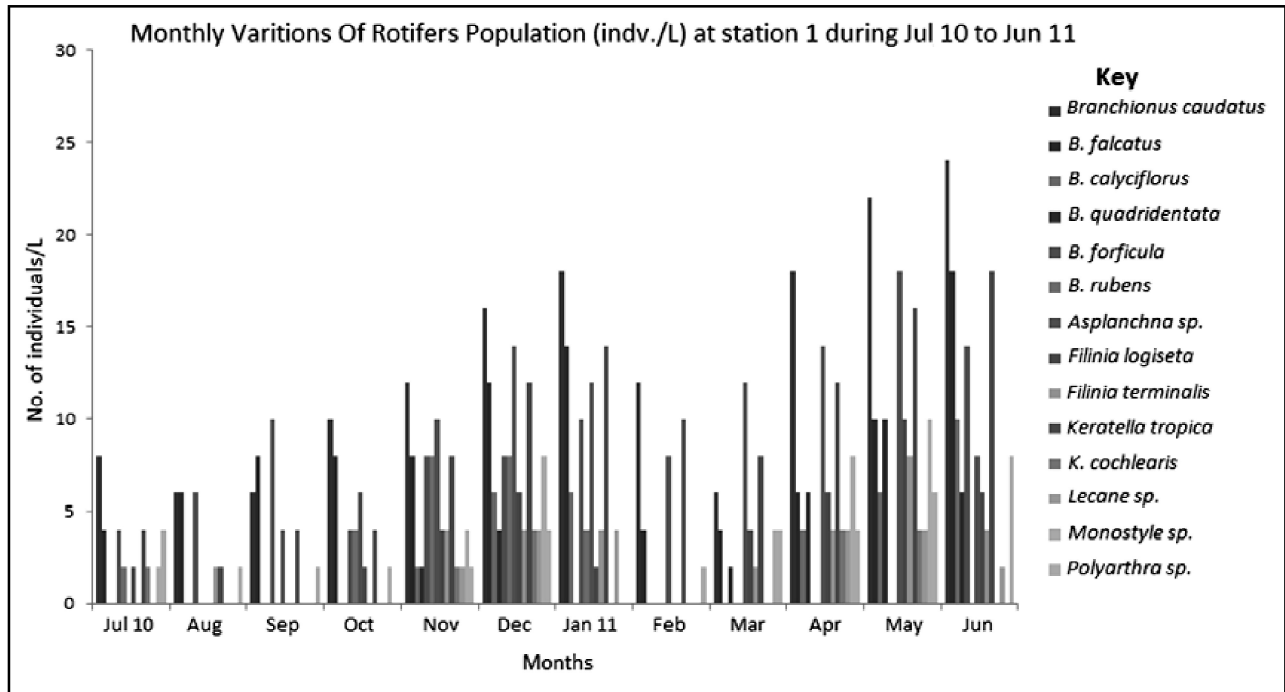


Fig.1.

Table 2.:Monthly Variations Of Rotifers Populations (indv./L) at Station 2( july 2010 to june 2011)

Orgarisms	Time Period In Hour																								
	Jul 10	Au g	S e p	Oct	Nov	Dec	Jan 11	Fe b	Ma rch	Apr il	Ma y	Jun	Jul	A ug	Se p	O ct	N o v	D e c	Jan 12	F e b	M a r	Ap r	Ma y	Jun	
ROTIFERA																									
<i>Branchionus caudatus</i>		2	4	6	6	10	8	4	8	14	22	18	8	4	10	4	6	8	12	8	10	14	16	20	
<i>B.falcatus</i>	14	4	6	6	10	10	12	16	20	24	28	14	6	4	2	4	4	0	14	8	2	16	4	30	
<i>B.calyciflorus</i>	6		4	8	8	12	14	10	6	8	14	16	10	4	2	2	4	8	12	4		8	0	18	
<i>B. quadridentata</i>	4	2	2	4		8	12		6	8	14	10	6	4	4		6	0	14	8		4	0	14	
<i>B. forficula</i>	22	10	6	6	10	12		10	14	18	26	38	22	12	4	1	1		16	0	2	24	3	28	
<i>B. angularis</i>	26	10	4	8	12	16	18	20	24	28	36	32	20	10	6	8	0	2	12	6	8	22	8	46	
<i>B. diversicomis</i>	8	4	6		4	4	8	2	4	10	10	12			6	6	8	0	10	4		4	8	14	
<i>Filinia longiseta</i>	4		2	4	8	4	2	2	6	8	8	12			4	4	0	4		2	6	8	0	14	
<i>Keratella cochlearis</i>	8	6	4	6	10	14	16	12	18	20	24	22	8	4	2	2	8	4	12	8	6	22	6	28	
<i>K. lenzi</i>	6		2		4	4	8			4	10				2	2	4	0				4	6	6	
<i>Lecane sp.</i>	4		2		6	8				8	10		2			2	2	4	2			2	4	10	
<i>Testudinella sp.</i>				2	4	4	6			4		4			2		4	6	8	2			4	4	
Total=	102	38	22	50	82	106	104	76	106	154	202	178	82	42	44	68	86	112	110	80	84	88	188	232	

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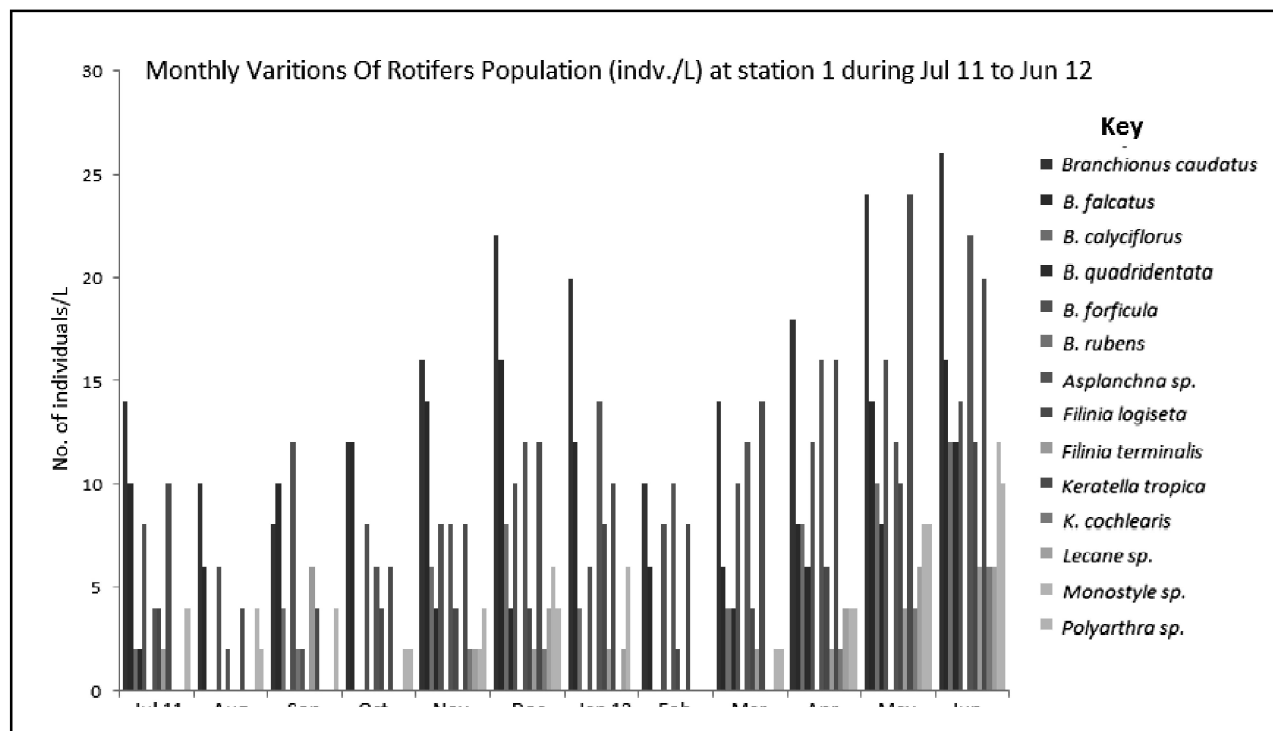


Fig.2.

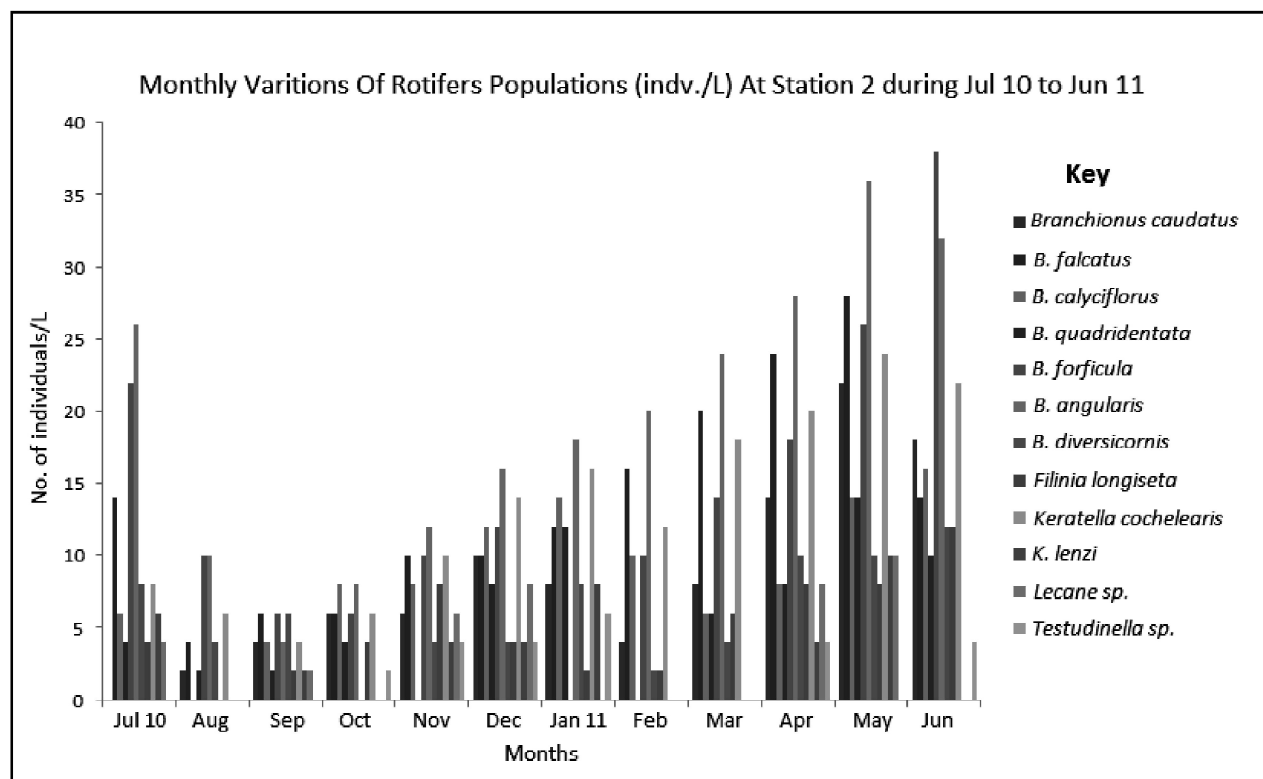


Fig.4.

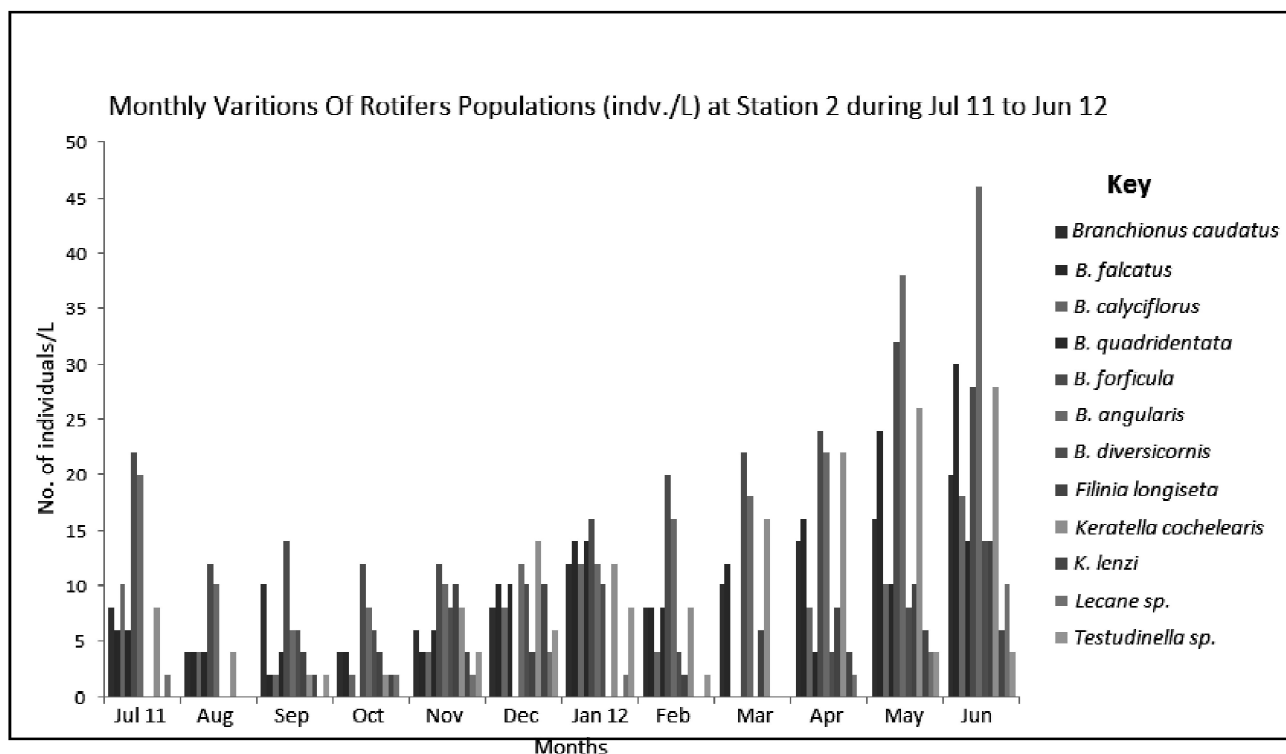


Fig.4.

Table 3: Diel variations in Rotifers Population (indv./L) at station 1 during winter(07-01-2011 to 08-01-2011)

Organisms	Time Period In Hour							
	900	1200	1500	1800	2100	2400	300	600
ROTIFERA								
<i>Branchionuscaudatus</i>	18	10	8	4	6	8	10	12
<i>B.falcatus</i>	14	10	6	8	10	8	10	14
<i>B.calyciflorus</i>	6						2	10
<i>B. quadridentata</i>						2	2	
<i>B.forficula</i>	10	6	2	4	4	6	8	14
<i>B.rubens</i>	4			4	2	2		
<i>Asplanchnasp.</i>	10	2		2	2	4		10
<i>Filiniaterminalis</i>	4	2				8	10	16
<i>Keratellatropica</i>	14	6	4	6	4	10	14	8
<i>Polyarthra sp.</i>							4	6
<i>Lecane sp.</i>	4	2			4	12	10	8
	84	38	20	28	32	60	70	98

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Table4: Diel variations o Rotifers (indv/L) at station 2 during winter 09.01.2011 to 10.01.2011

Organism	Time Period In Hours							
	900	1200	1500	1800	2100	2400	300	600
ROTIFERA								
<i>Branchionuscaudatus</i>	8	2	2		4	4	6	6
<i>B.falcatus</i>	12	4		2	8	10	18	16
<i>B.calyciflorous</i>	14	4	2	6	12	18	22	32
<i>B.quadridentata</i>	14	4	6	2	16	24	34	22
<i>B.diversicornis</i>	8				2	4	4	4
<i>B.rubens</i>	4			4		6	6	8
<i>B.plicatilis</i>	6	2				4	4	4
<i>Filiniaterminalis</i>					2			2
<i>F. longiseta</i>	2			4		6	8	8
<i>Keratellacochlearis</i>	16	4	2		8	10	14	10
<i>Keratellacochlearis Lenzi</i>	8				4	6	8	6
<i>Polyarthra sp.</i>	10				2	4	10	4
<i>Lecane sp.</i>					4	6		
<i>Testudinella sp.</i>	6				2	2	4	4
Total:-	106	24	12	14	68	104	138	126

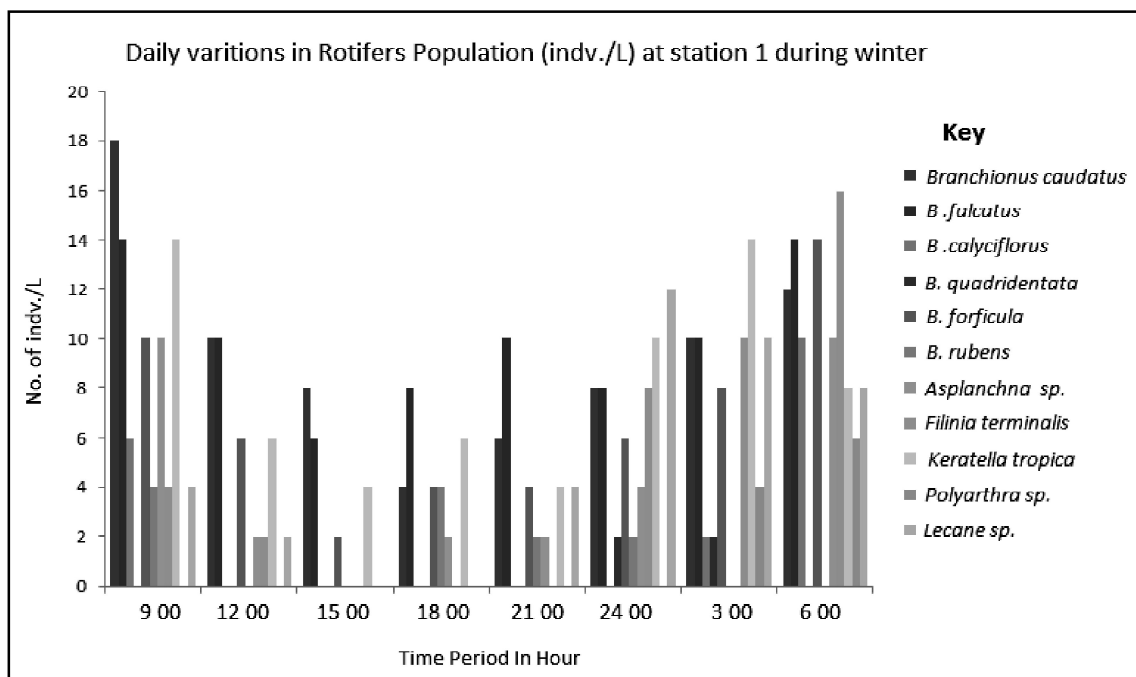


Fig.5.

Table5: Diel variations of Rotifers (indv./L) in Station 1 During Summer 05.06.11 to 06.06.11

Organisms	900	1200	1500	1800	2100	2400	300	600
ROTIFERA	900	1200	1500	1800	2100	2400	300	600
<i>Branchionus caudatus</i>	24	8	8	10	14	14	16	20
<i>B.falcatatus</i>	16	6	4	8	10	12	12	8
<i>B.calyciflorous</i>	10	2	-	-	4	4	8	8
<i>B.quadridentata</i>	6	-	-	2	2	4	4	4
<i>B.forficula</i>	14	4	2	-	2	2	8	10
<i>B.rubens</i>	-	-	-	-	4	6	8	8
<i>Asplanchna</i>	8	-	-	-	6	6	10	14
<i>Filinia terminalis</i>	4	-	-	-	-	8	14	10
<i>Filinia longiseta</i>	6	-	-	-	-	6	10	4
<i>Keratella tropica</i>	18	-	4	-	4	10	14	14
<i>Polyarthra sp.</i>	-	-	-	2	4	4	8	4
<i>Lecane sp.</i>	2	-	-	4	6	8	8	10
TOTAL -	108	20	18	26	56	84	120	114

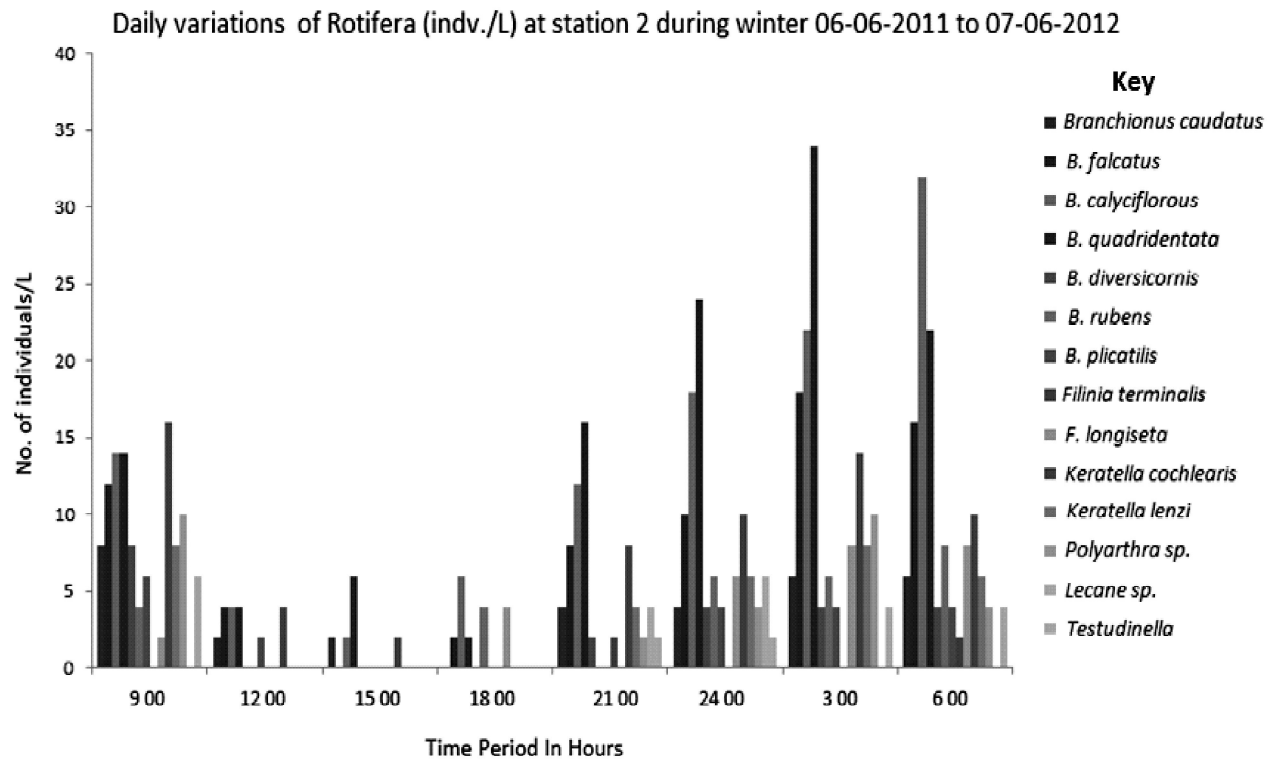


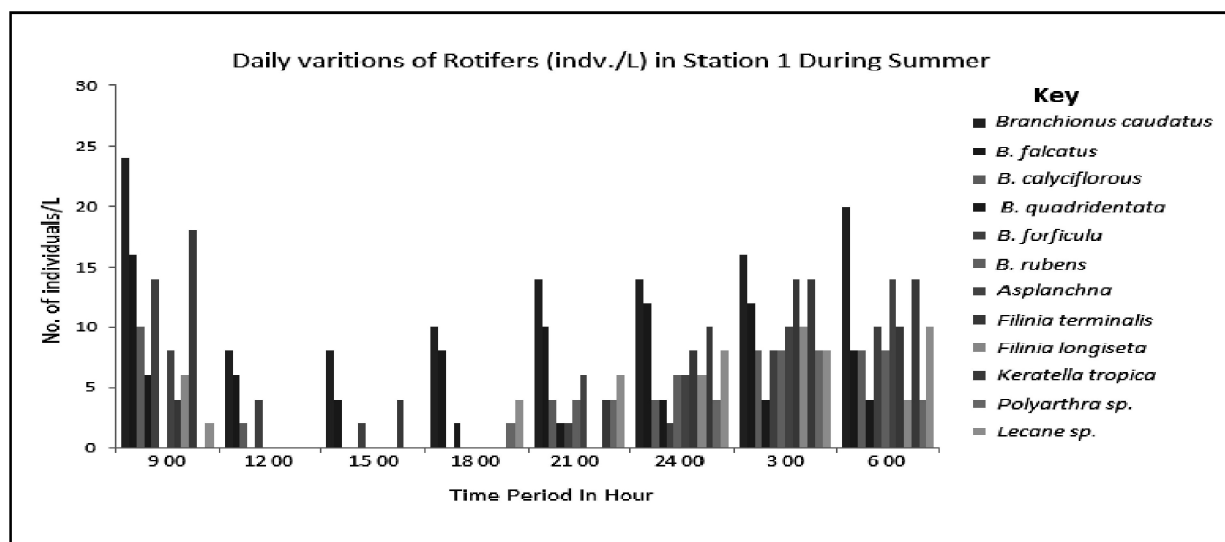
Fig.6.



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**Table-6: Diel variations of Rotifers (indy/L) in station 2 during summer in 09.06.11 to 10.06.11**

Organisms	Time Period in Hours								
	900	1200	1500	1800	2100	2400	300	600	900
ROTIFERA									
<i>Brachionus caudatus</i>	18	2	-	2	4	6	8	14	22
<i>B. falcatus</i>	14	4	2	4	6	10	10	12	14
<i>B. calyciflorous</i>	16	6	-	-	8	10	12	14	18
<i>B. quadridentata</i>	14	6	2	4	8	12	18	14	12
<i>B. diversicornis</i>	12	2	-	2	4	6	8	10	12
<i>B. rubens</i>	-	-	-	-	4	8	8	10	-
<i>B. plicatilis</i>	8	2	-	-	-	4	10	8	4
<i>Filinia longiseta</i>	12	4	4	-	2	10	12	8	6
<i>Filinia terminalis</i>	-	-	-	-	4	-	4	6	-
<i>Keratella procarva</i>	-	-	6	6	4	2	-	-	-
<i>K. cochlearis</i>	14	4	-	-	6	10	10	12	16
<i>K. lenzi</i>	-	-	-	-	2	6	4	-	-
<i>Polyarthrasp.</i>	8	-	-	-	-	2	8	6	6
<i>Lacane sp.</i>	-	-	-	2	2	4	-	-	-
<i>Testudinella sp.</i>	4	-	-	2	4	-	8	10	6
TOTAL:-	120	30	14	22	58	90	120	126	116



**Fig.7.**

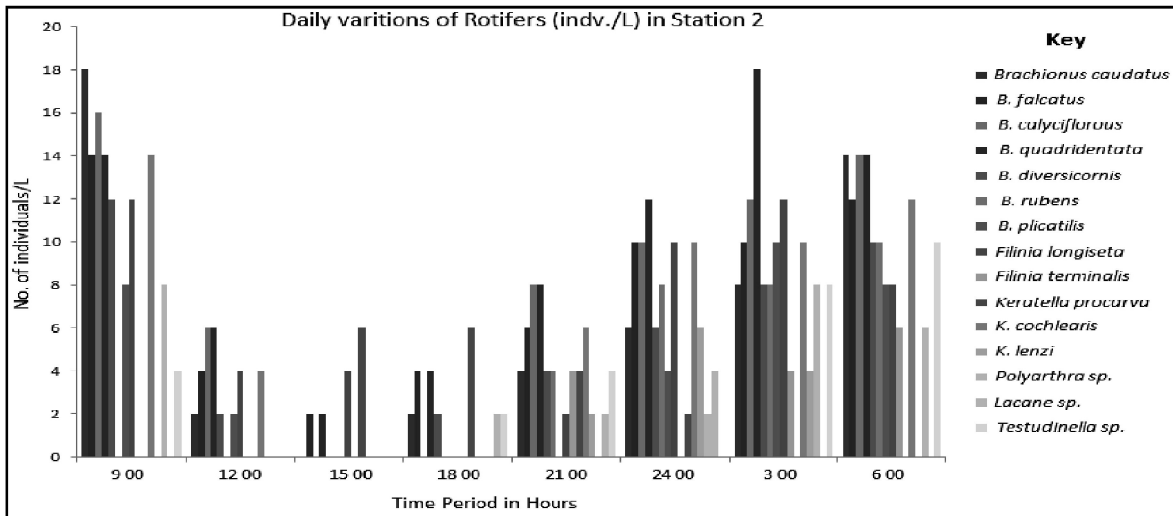


Fig.8.

Table 7: Daily variation of rotifers population (indv./L) at station 1 during Monsoon (23.09.11 to 24.09.11)

ROTIFERA	900	1200	1500	1800	2100	2400	300	600
<i>Brachionus caudatus</i>	8	2	4	4	-	2	6	4
<i>B. falcatus</i>	10	-	-	-	6	6	16	10
<i>B. calyciflorus</i>	4	-	-	-	2	2	4	8
<i>B. forficula</i>	12	4	4	2	2	2	8	4
<i>B. rubens</i>	2	-	-	-	2	-	-	-
<i>Asplanchna sp.</i>	8	-	-	-	4	4	4	6
<i>Filiniaterminalis</i>	6	4	4	-	-	2	8	8
<i>Keratella tropica</i>	4	-	2	2	4	4	10	4
<i>Polyarthra sp.</i>	4	-	-	-	2	2	8	4
TOTAL-	58	10	14	8	22	24	64	48

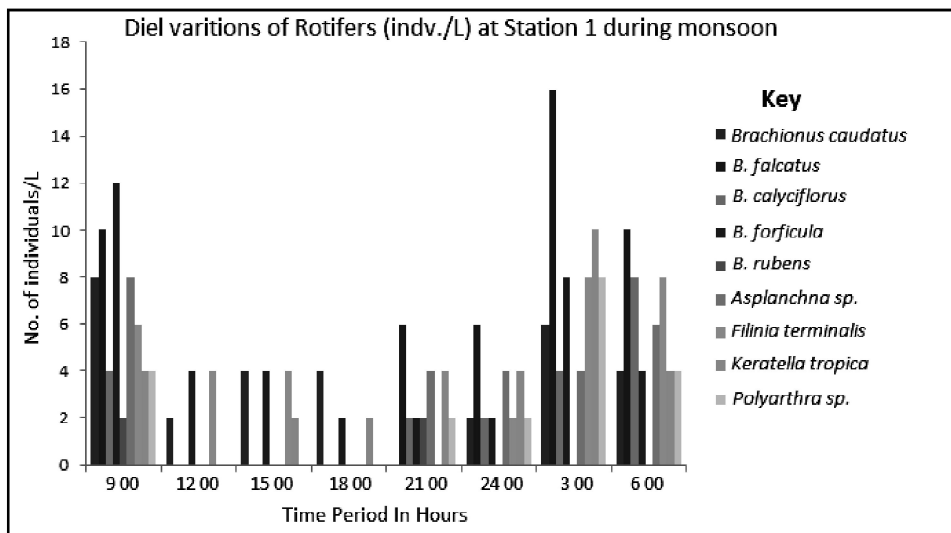


Fig.9.

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Table8: Diel variations of Rotifers population (indv./L) at Station 2 during Monsoon (25.09.11 to 26.09.11)

Organisms	Time period in Hours							
	900	1200	1500	1800	2100	2400	300	600
ROTIFERA								
<i>Brachionus caudatus</i>	10	4	4	2	4	4	6	8
<i>B. falcatus</i>	10	2	-	-	4	6	12	8
<i>B. calyciflorus</i>	2	-	-	-	2	2	4	4
<i>B. quadridentata</i>	4	-	-	-	-	2	4	-
<i>B. diversicornis</i>	6	2	-	-	2	4	8	8
<i>B. plicatilis</i>	2	-	-	-	-	-	2	4
<i>F. longiseta</i>	4	-	-	-	-	2	8	6
<i>Keratella cochlearis</i>	2	-	-	4	-	-	4	8
<i>K. lenzi</i>	2	-	-	-	2	4	-	-
<i>Polyarthra sp.</i>	6	4	2	-	-	-	4	8
<i>Testudinella sp.</i>	2	-	-	2	-	-	-	2
Total =	50	12	6	8	14	24	52	56

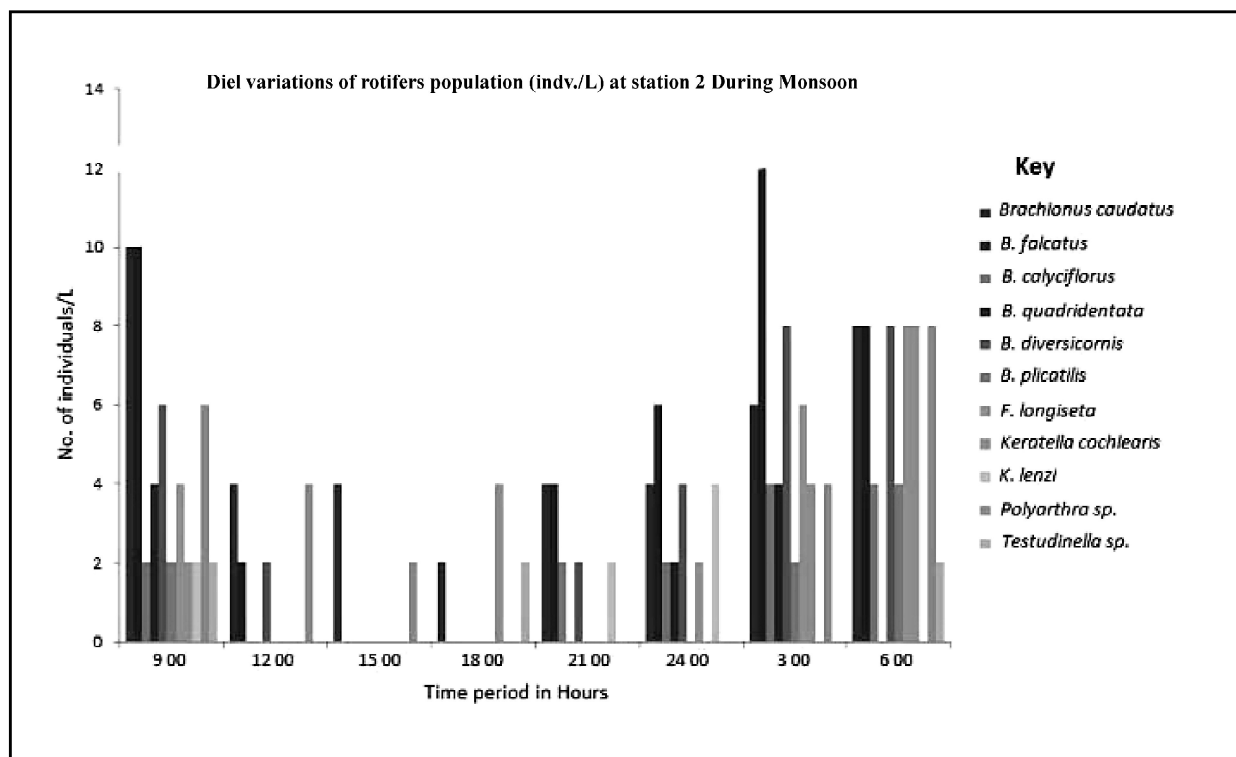


Fig.10.

In station I, during summer *B. caudatus*, *B. falcatus* and *K. tropica* were the most dominant species. The maximum density (24u/L) of *B. caudatus* was observed at 0900 hrs and the minimum (8u/L) at 1500 hrs. *B. falcatus* and *K. tropica* shows their maximum density (16u/L) and (18u/L) at 900 hrs and minimum (4u/L) and (4u/L) at 1500 hrs.

*B. Falcatus*, *B. qudarydentata*, *Filinia longiseta* and *Keratella cochlearis* were recorded as most abundant rotifers in station II during the investigation of summer diel variations. The maximum density (14u/L) of *B. falcatus* was recorded at 0900 hrs and the minimum (20u/L) at 1500 hrs. *B. calyciflorus* was not observed at 1500hrs and 1800 hrs and its maximum and minimum density (16u/L) and (6u/L) were recorded at 900 hrs and 1200 hrs respectively.

*B. quadridentata* shows their highest (18u/L) at 0300 hrs & the lowest density (2u/L) at 1500 hrs. The maximum abundance (14u/L) of *Filinia longiseta* was absorbed at 0900 hrs & minimum (2u/L) at 2100 hrs. *K. cochlearis* shows their highest & lowest density (14u/L) & (4u/L) at 0900 hrs & 1200 hrs respectively.

In station 1 during monsoon *B. caudatus* shows their maximum density (8u/L) at 0900 hrs & minimum (2u/L) at 2400 hrs. *B. falcatus* was most abundant during night hrs. Its highest peak (16u/L) was recorded at 0300 hrs & the lowest (6u/L) at 2100 hrs. The maximum density (12u/L) of *B. falcatus* was recorded at 0900 hrs & the minimum (2u/L) at 1800 hrs & 2100 hrs, 2400 hrs respectively. *K. tropica* shows their maximum no.(10u/L) at 0300 hrs & lowest (12u/L) at 1500 hrs & 1800 hrs.

*B. caudatus* was the most dominant sps in station 2 during monsoon. Its maximum & minimum density was (110u/L) & (2u/L) at 0900 hrs & 1800 hrs respectively. *B. falcatus* shows their highest peak (4u/L) at 0300 hrs & the lowest (2u/L) at 2100 hrs. They were not recorded during 1500 hrs & 1800 hrs.

#### **DISCUSSION:**

Zooplankton play important role between the autotrophs and other heterotrophs and form an important link in the food web of the fresh water ecosystem. Zooplankton is good indicator of change in water quality because it is strongly affected by environmental condition and respond quickly to change in environmental quality

(Shivakami et al 2007). Six sps of Brachionus were found in station I and seven in station II is regarded as pollution indicator sps. A/c to Sharma (1986) *B. angularis*, *B. calyciflorus* and *B. rubens* accompanied with BGA and large number of cladocerans indicates highly polluted state of water. The present study differs from observation of Sharma.

*B. angularis* was absent and *B. rubens* were scantily present. Only *B. calyciflorus* were present in significant no. The distribution of *keratella* sps. was different in two stations under study were only *Keratella tropica* was found in station 1. The second station showed the presence of four sps. of this genus. Though at one time maximum of 3sps of *keratella* was collected. This sps is also regarded indicator of pollution on the basis its higher presence in polluted station 2 can be explained. The study of diel cycle show that rotifers dominating the zooplankton population showing migration on towards surface culminating in its maximum at 0900 hrs on both the station. Such observation was reported by Dutta et al (1982). *B. caudatus* was dominant sps in both the stations throughout the year round. The sps belonging to this genus have been found to be positively correlated with *Filinia terminalis*, *F. longiseta* and *Keretella tropica*. The *K. tropica* show a well mark diurnal migration, aggregating the surface during night hours and sink at day time.

The seasonal variation of rotifers, Nasar (1997) and Patra and Dutta (2004) reported that fluctuation is controlled by abiotic and biotic factor. In the present investigation the maximum rotifers were found in winter season and the diel variation was maximum at night hrs. The higher quantity of rotifers in winter season may be due to favorable condition of abiotic factor like temperature, PH and abiotic factors. Such observation was also reported by Shivakami et al. (2011). Which supported the present study.

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