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Study of Seasonal Variation of Rotifers Populations in River Burhi Gandak (Muzaffarpur, Bihar)

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Abstract:
Rotifers are the most diversified group of Zooplanktons and play important role between the autotrophs and other heterotrophs. It forms an important links in food chain. Rotifers found abundantly in Burhi Gandak. A total of 14 and 12 species of rotifers were recorded in point I & II respectively. The first (108 U\L) and second (118 U\L) peak was recorded in December 2018 and May 2019 respectively. The dominant rotifer species was *B. Caudatus* (22 U\L) and (24 U\L) was recorded in May 2019 and June 2020. *Keratella tropica* was the second dominant speices. A total no. of 18 and 24 species was collected in first and second point during the study of diel variation. The data collected co-related to study the condition of river Burhi Gandak in the light of available literature.

Keywords: Rotifers, Diel variation, Zooplankton, Heterotrophs.

INTRODUCTION

Plankton plays integrators of variety of physico-chemical and biological conditions of water because of their role as grazer of algae & 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. Rotfers are consumer of microorganisms such as: Bacteria, algae, ciliates. Some species of Rotifers are detritivours, thus it plays an important role in the tropic 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). The aim of the present study was to explore the seasonal variation of rotifers of two point of river Burhi Gandak, in Muzaffarpur.

MATERIALS AND METHODS

The rotifers (Zooplankton) were collected from July 2018 to June 2019 from two points of river by filtering 50 liters 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. Now, the volume of same was made to 10 ml and it is thoroughly shaken. 1ml of material was taken from the sample and placed in a Sedgwick rafter Plankton Counting chamber. For counting lower power of the compound microscope was used. The planktons were identified up to species level. Wherever possible, with the help of Needham and Needham (1962), ward and whipple (1960) & Michael and Sharma (1973).

The quantities estimation of Zooplankton was made by the following formula
N = (A x 1000) C / L
Where
N = No. of Plankton / liter of water
A = Average no. of Plankton in 1 ml sub Sample
L = Volume of original sample in 1 liter
C = ml of Plankton concentrate

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

RESULT AND DISCUSSION

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

The maximum number (98 U / L) of total rotifers was recorded at 600 hours in Point I and at 300 hours (138 U / L) in Point II. Whereas minimum (20 U / L) and (12 U / L) at 1500 hours in both station during winter seasons. In summer, the highest number (120 U / L and 128 U / L) of total rotifers were recorded at 300 hours in Point I and 600 hours in Point II, while the lowest (18 U / L and 14 U / L) at 1500 hours in both points. In monsoon the maximum density of rotifers was recorded at 300 hours (64 U / L and 56 U / L) in Point I & II respectively. Whereas, the minimum density (8 U / L) and (6 U / L) at 1800 hours in point I & II respectively.

In Point I, during the winter *Brachionus caudatus*, *Brachionus falcatus* and *Keratella tropica* were several as most abundant species. The highest number (18 U / L) of *B. candatus* was recorded at 900 hours and the lowest (4 U / L) at 1800 hours. The maximum density (16 U / L) of B. falcatuswas noticed at 600 hours and minimum (6 U / L) at 1500 hours. *B. froficula* and *Keratella tropica* shows their maximum density (14 U / L and 14 U / L) at 600 hours and 900 hours while the minimum density (2 U / L and 4 U / L) at 1500 hours respectively.

In Point II, *B. fulcatus, B. quadridentata, B. calyciflorus* and *Keratella cochlearis* were recorded as the most abundant species during the study of winter dial variation. The highest density (18 U / L) of *B. falcatus*was recorded at 300 hours and lowest density (2 U / L) at 1800 hours. *Brachionus calyciflorus* was observed as the most dominant species during dial study. It shows their highest abundance (34 U / L) at 300 hours and the lowest (2 U / L) at 1800 hours. *Keratella cochlearis* was found only at point II. The maximum density (16 U / L) of this was observed at 900 hours and minimum (2 U / L) at 1500 hours.

In Point I, during summer *B. caudatus, B. falcatus* and *K. tropica* were the most dominent species. The maximum density (24 U / L) of *B. Candatus* was observed at 900 hours and the minimum (8 U / L) at 1500hours. *B. falcatus* and *K. trpica* shows their maximum density (16 U / L) and (18 U / L) at 900 hours and minimum (4 U / L) at 1500 hours.

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

B. qudridentata shows their highest (18 U / L) at 300 hours and lowest density (2 U / L) at 1500 hours. The maximum abundance (14 U / L) of *Filinia longiseta* was observed at 900 hours and minimum (2 U / L) at 2100 hours. *K. cochlearis* shows their highest and lowest density (14 U / L) and (4 U / L) at 900 hours and 1200 hours respectively.

In Point I during monsoon *B. candatus* shows their maximum density (8 U / L) at 900 hours and minimum (2 U / L) at 2400 hours. *B. falcatus* was most abundant during night hours. Its highest peak

(16 U/L) was recorded at 300 hours and the lowest (6 U/L) at 2100 hours. The maximum density (12 U/L) of *B. falcatus* was recorded at 900 hours and minimum (2 U/L) at 1800 hours and 2100 hours , 2400 hours respectively *K. tropica* shows their maximum no (100 U/L) at 300 hours and lowest (12 U/L) at 1500 hours and 1800 hours.

B. candatus was the most dominant species in point II during monsoon. Its maximum and minimum density was (100 U/L) and (2 U/L) at 900 hours and 1800 hours respectively. *B. falcatus* shows their highest peak (4 U/L) at 300 hours and lowest (2 U/L) at 2100 hours. They were not recorded during 1500 hours and 1800 hours.

Table 1: Monthly Variations of Rotifers Population (in dv/L) at Point I (From Jul 2018 to June 2019)

Month / Organism	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Rotifera												
B. caudatus	8	6	6	10	12	16	18	12	6	18	22	24
B. falcatus	4	6	8	8	8	12	14	4	4	6	10	18
B. Calyciflorus					2	6	6			4	6	10
B. quadridentata					2	4			2	6	10	6
B. forficula	4	6	10	4	8	8	10					14
B. rubens	2			4	8	8	4					
Asplanchana sp.			4	6	10	14	12	8	12	14	18	8
Filinia logistea	2			2	4	6	2		4	6	10	6
Filinia terminalis		2		4	4	4		2	8	4	2	
Keratella tropica	4	2	4	8	12	14	10	8	12	16	18	10
K. cochlearis	2				2	4				4	4	
Lecan Sp.					2	4	4			4	4	2
Monostyle Sp.	2			2	4	8			4	8	10	
Polyarthra Sp.	4	2	2	2	4		2	4	6	8	4	2
Total	32	24	34	50	82	108	82	38	58	98	118	100

Table 2: Monthly Variations of Rotifers Population (in V/ L) at Point II (From Jul 2018 to June 2019)

Month / Organism	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Rotifera												
B. caudatus		2	4	6	6	10	8	4	8	14	22	18
B. falcatus	14	4	6	6	10	10	12	16	20	24	28	14
B. calyciflorus	6		4	8	8	12	14	10	6	8	14	16
B. quadridentata	4	2	2	4		8	12		6	8	14	10
B. forficula	22	10	6	6	10	12		10	14	18	26	38
B. angularis	26	10	4	8	12	16	18	20	24	28	36	32
B. diversicomis	8	4	6		4	4	8	2	4	10	10	12
Filinia logistea	4		2	4	8	4	2	2	6	8	8	12
Keratella cochlearis	8	6	4	6	10	14	16	12	18	20	24	22
K. lenei	6		2		4	6	8			4	10	
Lecane Sp.	4		2		6	8				8	10	
Testudinella Sp.				2	4	4	6			4		4
Total	102	38	42	50	82	108	104	76	106	154	202	178

Table 3: Diel Variations in Rotifers Population (in dv / L) at Point I during winter (07-01-2018 to 08-01-2018)

	Time Periods in Hours							
Organism	**900**	**1200**	**1500**	**1800**	**2100**	**2400**	**300**	**600**
Rotifera								
B. caudatus	18	10	8	4	6	8	10	12
B. fulcatus	14	10	6	8	10	8	10	14
B. Calyciflorus	6						2	10
B. quadridentata						2	2	
B. forficula	10	6	2	4	4	6	8	14
B. rubens	4			4	2	2		
Asplanchna sp.	10	2		2	2	4		10
Fillinia terminalis	4	2				8	10	16
Keratella tropica	14	6	4	6	4	10	14	8
Polyarthra sp.							4	6
Lecane sp.	4	2			4	12	10	8
Total	84	38	20	28	32	60	70	98

Table 4: Diel Variations of Rotifers (indv / L) at Point II during winter (09-01-2018 to 10-01-2018)

	Time Periods in Hours							
Organism	**900**	**1200**	**1500**	**1800**	**2100**	**2400**	**300**	**600**
Rotifera								
Brachinuscaudatus	8	2	2		4	4	6	6
B. falcatus	12	4		2	8	10	18	16
B. Calyciflorus	14	4	2	6	12	18	22	32
B. quadridentata	14	4	6	2	16	24	34	22
B. diversicornis	8				2	4	4	4
B. rubens	4			4		6	6	8
B. plicatilis	6	2				4	4	4
Filiniaterminalis					2			2
F. longiseta	2			4		6	8	8
Keratellacochlearis	16	4	2		8	10	14	10
Keratellacochlearislenzi	8				4	6	8	6
Polyarthra sp.	10				2	4	10	4
Lecane sp.					4	6		
Testudinella sp.	6				2	2	4	4
Total	106	24	12	14	68	104	138	126

Table 5: Diel Variations of Rotifers (in dv / L) at Point II during winter (09-01-2018 to 10-01-2018)

	Time Periods in Hours							
Organism	**900**	**1200**	**1500**	**1800**	**2100**	**2400**	**300**	**600**
Rotifera								
B. caudatus	24	8	8	10	14	14	16	20
B. falcatus	16	6	4	8	10	12	12	8
B. Colyciflorous	10	2			4	4	8	8
B. quadridentata	6			2	2	4	4	4
B. forficula	14	4	2	-	2	2	8	10
B. rubens					4	6	8	8
Asplanchna	8				6	6	10	14
Filinia terminalis	4					8	14	10
Filinia longisata	6					6	10	4

Keratella tropica	18		4		4	10	14	14
Polyarthra sp.				2	4	4	8	4
Lecane sp.	2			4	6	8	8	10
Total	108	20	18	26	56	84	120	114

Table 6: Diel Variations of Rotifers (in dv / L) at Point II during summer in (09-06-2018 to 10-06-2018)

	Time Periods in Hours								
Organism	**900**	**1200**	**1500**	**1800**	**2100**	**2400**	**300**	**600**	**900**
Rotifera									
B. caudatus	18	2		2	4	6	8	14	22
B. falcatus	14	4	2	4	6	10	10	12	14
B. Colyciflorous	16	6			8	10	12	14	18
B. quadridentata	14	6	2	4	8	12	18	14	12
B. diversicornis	12	2		2	4	6	8	10	12
B. rubens					4	8	8	10	
Filinia terminalis	8	2				4	10	8	4
B.plicatilus									
F. longiseta	12	4	4		2	10	12	8	6
Keratella tropica	14	4			6	10	10	12	16
K. lenzi			6	6	4	2			
Polyarthra sp.	8					2	8	6	6
Testudinella	4			2	4		8	10	6
Total	120	30	14	22	58	90	120	128	116

Table 7: Diel Variations of Rotifers Populations (in dv / L) at Point I during monsoon (20-09-2018 to 21-09-2018)

	Time Periods in Hours							
Organism	**900**	**1200**	**1500**	**1800**	**2100**	**2400**	**300**	**600**
Rotifera								
B. caudatus	8	2	4	4		2	6	4
B. falcatus	10				6	6	16	10
B. Colyciflorous	4				2	2	4	8
B. forficula	12	4	4	2	2	2	8	4
B. rubens	2				2			
Asplanchna sp	8				4	4	4	6
Filinia terminalis	6	4	4			2	8	8
Keratella tropica	4		2	2	4	4	10	4
Polyarthra sp	4				2	2	8	4
Total	58	10	14	8	22	24	64	48

Table 8: Diel Variations of Rotifers Population (in dv / L) at Point II during monsoon in (20-09-2018 to 21-09-2018)

	Time Periods in Hours							
Organism	**300**	**600**	**900**	**1200**	**1500**	**1800**	**2100**	**2400**
Rotifera								
B. caudatus	6	8	10	4	4	2	4	4
B. falcatus	12	8	10	2			4	6
B. Colyciflorous	4	4	2				2	2
B. quadridentata	4		4					2

B. diversicornis	8	8	6	2			2	4
B. plicatilis	2	4	2					
F. longiseta	8	6	4					2
Keratella cochlearis	4	8	2			4		
K. lenzi			2				2	4
Polyarthra sp.	4	8	6	4	2			
Testudinella sp.		2	2			2		
Total	52	56	50	12	6	8	14	24

DISCUSSION

Zooplankton plays important role between the autotrophs and heterotrophs and form an important link in the food web of fresh water ecosystem. It is good indicator of change in water quality because it is strongly affected by environmental condition and responds quickly to change in environmental quality (Shivakami et. al. 2007). Six species of Brachionus were found in Point I and seven in Point II is regarded as pollution indicater species. A/C to Sharma (1986) *B. angularis, B. Calyciflorus and B. rubensac* comparied with BGA and large number of cladocerans indicates highly polluted state of water. The present study differs from observations of Sharma (1986).

B. angularis was absent and *B. rubens* were scantly present in significant number. The distribution of *keratella* species was different in different in two points under study were only *Keratella tropica* was found in point I. The second point showed the presence of four species of this genus. Though at one time maximum of 3 species of *keratella* was collected. This species is also regarded as indicator of pollution on the basis of its higher presence in polluted point II can be explained.

The study of diel cycle shows that rotifers dominating the Zooplankton population showing migration on towards surface culminating in its maximum at 900 hours on both the points. Such observation was reported by Dutta et. al. (1982) and Faiyaz & Mukesh (2018). *B. candatus* was dominant species in both the points throughout the year round. The species belonging to this genus have been found to be positively correlated with *Filinia terminalis, F. longiseta* and *Keretella tropica*. The *K. tropica* shows 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 hours. The higher quality of rotifers in winter season may be due to favorable condition of artistic factor like temperature pH and abiotic factors. Such observation was also reported by Shivakami et. al. (2011) and Faiyaz & Mukesh (2018). These supported the present study.

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