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Priyanka G. Dube., Shailendra D. Shelar and
Satish S. Mokashe



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RESEARCH ARTICLE

CORRELATION BETWEEN *BRACHIONUS CALYCIFORUS* AND *BRACHIONUS FALCATUS* WITH PHYSICO-CHEMICAL PARAMETERS OF UPPER DUDHANA DAM

Priyanka G. Dube^{1*}, Shailendra D. Shelar² and Satish S. Mokashe¹

¹Dr.Babasaheb Ambedkar Marathwada University, Aurangabad-431004, (M.S.) India

²L.B.S.Senior College, Partur, Tq.Partur, Dist.Jalna (M.S.) India

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ABSTRACT

The occurrence and abundance of zooplankton depends on its productivity, which in turn is influenced by physico-chemical parameters and the level of nutrients in the water. The zooplankton community constitutes an important component of aquatic ecosystem and important role in the trophodynamics cycling and aquaculture productivity. Rotifera is the dominant group amongst the zooplankton of which *Brachionus* is most dominant genera belongs to class monogonanta. Present study deals with the abundance and correlation of two fresh water *Brachionid* species i.e. *Brachionus calyciforus* and *Brachionus falcatus* with respect to physico-chemical parameters of Upper Dudhana dam, which is located in Jalna district (M.S.) India. The water samples were collected for a period of one year and analyzed for determination of (Water Temperature, pH, Transparency, Total Alkalinity, Chloride, TDS, Total Hardness, Ca, Mg, DO and BOD) during the period of sampling from Feb.2014 to Jan.2015. Result showed that the density of *Brachionus calyciforus* was maximum (54.5 org/L) in June and minimum or absence of this species in the month of October. Similarly *Brachionus falcatus* showed maximum density (15.75 org/L) in April and minimum or absence of the species in the month of January. *B. calyciforus* showed positive high significant correlation with Chloride and *B.falcatus* with TDS at 1% level. It concluded that abundance of these species is strictly correlated with physico-chemical parameters of water.

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INTRODUCTION

Rotifers are generally present, in great numbers and with high species richness, in tropical habitats: from flooded areas to large rivers, lakes and reservoirs [1]. Rotifers form an important link in the food chain with phytoplankton and other aquatic animals and also occupy an intermediate position in the aquatic food web [2]. These organisms are exposed to a variety of changes in the physical, chemical and biological characteristics of the environment in which they live. Since rotifers play an important role in the ecosystem, the ecological investigations on them gain importance [3].

Different environmental factors that determine the characteristics of water have great importance upon the growth and the abundance of rotifers [4]. The term water quality is defined as those physical, chemical, and biological characteristics by which the users evaluate the acceptability of water [5]. The distribution of zooplankton community depends on a complex of factors such as, change of climatic conditions, physical and chemical parameters and vegetation cover [6]. The management of any aquatic ecosystem is a means of

conservation of fresh water habitat with an aim to maintain the water quality or to rehabilitate the physico-chemical and biological settling of water [7]. The present study focused on the inter-relationships between the distribution and correlation of two Brachionid species and physico-chemical characteristics of Upper Dudhana dam located in district Jalna.

Upper Dudhana dam is situated near village Somthana of taluka Badnapur in district Jalna (M.S.) on the river Dudhana. The dam is located at 19°55'11.8"N longitude to 75°41'39.9"E latitude. This is an earth fill dam and has a height of about 18m and 2.46 km in length, wherein the width is approximately 2 km.

MATERIAL AND METHODS

Zooplankton and water samples were collected at fortnightly interval from the study sites of dam during February 2014 to January 2015. Samples were collected by filtering 100 lit. water using plankton net (40µ mesh size) and concentrating the same to 50 ml and transferred to plastic container and

*Corresponding author: **Priyanka G. Dube**

Dr.Babasaheb Ambedkar Marathwada University, Aurangabad-431004, (M.S.) India

preserved with 4% formalin. Then samples were brought to the laboratory for further analysis.

Concurrently, water samples were taken for measuring selected physico-chemical variables. At the time of sampling, we measured the surface water temperature by using thermometer. pH was measured by pH probe (HANNA). Transparency was measured with the help of *Secchi* disc. Dissolved oxygen (DO), BOD, total alkalinity, chloride, hardness and salinity were determined by titrimetric method of [8] and [9].

The identification of rotifers was done by using taxonomic keys as, [2], [10], [11] and [12]. Rotifers were counted by using 'Lackey's Drop count method'.

The density of rotifers were expressed as organisms per liter using formula,

$$N = n \cdot v / V$$

Where,

N= Total number of org/lit.

n = number of organism counted in 1 ml of sample.

v = volume of concentrated sample in ml.

V = Volume of total water filtered in lit.

OBSERVATION AND RESULTS

The present study revealed the correlation between two Brachionid species viz. *B. calyciforus* and *B. falcatus* with physico-chemical parameters of the Upper Dudhana dam water. During the study variation were noticed between the water parameters which are depicted in Table.1.

Table 1 Monthly record of physico-chemical parameters of Upper Dudhana Dam from Feb.2014 to Jan.2015

Para- meters MONTHS	WT °C	pH	WTr cm	TA mg/l	Cl mg/l	TDS mg/l	TH mg/l	Ca mg/l	Mg mg/l	DO mg/l	BOD mg/l
Feb	25.0	7.5	10.37	440	57.21	200	71.5	29.65	25.61	3.76	2.38
Mar	25.75	8.0	7.92	400	51.54	800	123.6	32.27	22.28	2.9	1.2
Apr	29.5	8.5	10.17	346	87.04	1500	125.6	24.0	24.78	2.9	1.04
May	26.5	8.5	8.17	391	95.99	900	157.0	31.33	30.65	2.9	1.24
Jun	25.0	7.75	11.25	285	125.88	700	135.93	30.99	25.6	2.56	0.36
Jul	26.25	8.25	10.12	378.33	177.02	600	177.3	39.40	33.64	2.49	0.19
Aug	25.5	8.0	7.25	303.33	211.58	800	211.33	46.75	40.15	1.89	1.89
Sept	27.0	7.75	9.0	216.5	19.88	400	69.0	17.19	12.63	3.3	1.64
Oct	27.0	7.95	10.5	271.5	23.14	140	89.6	22.68	16.32	2.5	1.9
Nov	23.75	7.9	8.75	325.0	27.19	165.5	114.6	23.88	22.13	2.36	0.56
Dec	20.25	8.25	7.5	304.5	26.69	153	115.6	27.09	21.59	2.79	2.09
Jan	20.25	8.2	6.5	289.5	28.11	151	114.0	25.61	21.56	3.06	1.33

Abbreviations: WT-Water Temperature, pH-potential Hydrogenii, WTr-Water Transparency, TA-Total Alkalinity, Cl-Chloride, TDS-Total Dissolved Solids, TH-Total Hardness, Ca-Calcium, Mg-Magnesium, DO-Dissolved Oxygen, BOD-Biological Oxygen Demand.

The availability of *B. calyciforus* and *B. falcatus* were recorded (Table.2a) and abundance (Table.2b) also in figure.1. The Pearson's correlation coefficient of these species with water parameters is placed in Table.3.

Temperature is one of the essential and changeable environmental factors, since it influences the growth and distribution of flora and fauna. In the present study temperature ranged between 20.25°C and 29.5°C.

The highest temperature was recorded in the month of April (29.5°C) whereas lowest in December and January (20.25°C).

The values of pH were highest in April and May (8.5) and lowest in February (7.5). Transparency was observed to be minimum (6.5cm) in January and maximum (11.25cm) in the month of June. Total alkalinity is ranged from 216.5 mg/l to 440 mg/l in the month September and February respectively. The Chloride showed maximum value 211.58 mg/l in August and minimum value 19.88 mg/l in September. TDS ranged between 140 mg/l and 1500 mg/l during the study period.

The hardness of water is not a pollution parameter but indicates water quality. Waters are often categorized according to degrees of hardness as, 0–75 mg/l = soft, 75–150 mg/l = moderately hard, 150–300 mg/l = hard, above 300 mg/l = very hard. In the present investigation, total hardness level varied from 69.0 mg/l to 211.33 mg/l.

The high value of total hardness was because of high values of Ca and Mg hardness. Ca hardness ranged from 17.19mg/l to 46.75 mg/l. Mg hardness showed maximum 40.15 mg/l and minimum value 12.63mg/l. Dissolved oxygen (DO) is an important aquatic parameter whose measurement is vital in the context of culture of any aquatic animal as oxygen plays a crucial role in its life processes. DO ranged from 1.89mg/l to 3.76mg/l. High concentration of DO was recorded during February and low in August. This may be due to low solubility at high temperature and high degradation of organic substances. Estimation of biological oxygen demand (BOD) is an important measure to the oxygen required for the degradation of organic matter. The BOD value ranged from 0.19 mg/l to 2.38 mg/l. The highest value of BOD was recorded in February whereas lowest value in the month of July.

The present study showed that the presence of *B. calyciforus* in all the months of study period except October and *B. falcatus* was absent in the months of June, August, September, December and January whereas present in remaining months. It is tabulated in Table.2a. According to this the maximum density of *B. calyciforus* was recorded in June (54.5 org/L) and minimum in February (0.25 org/L). The density of *B. falcatus* was maximum in April (15.75org/L) and minimum in July (0.25org/L) which showed in Table.2b. The same results are depicted in figure 1.

Table 2 Showing availability and density of *B. calyciflorus* and *B. falcatus* in Upper Dudhana Dam.

Table2 a

Months	Availability of species	
	<i>B.calyciflorus</i>	<i>B.falcatus</i>
Feb	+	+
Mar	+	+
Apr	+	+
May	+	+
Jun	+	-
Jul	+	+
Aug	+	-
Sept	+	-
Oct	-	+
Nov	+	+
Dec	+	-
Jan	+	-

Table.2b

Months	No.of Organism/L	
	<i>B.calyciflorus</i>	<i>B.falcatus</i>
Feb	0.25	0.5
Mar	0.75	0.5
Apr	35	15.75
May	14	0.75
Jun	54.5	0
Jul	37	0.25
Aug	21	0
Sept	13.5	0
Oct	0	0.5
Nov	15	5.25
Dec	4.75	0
Jan	4	0
Total=	119.75	23.5

(+) Presence of species, (-) Absence of species

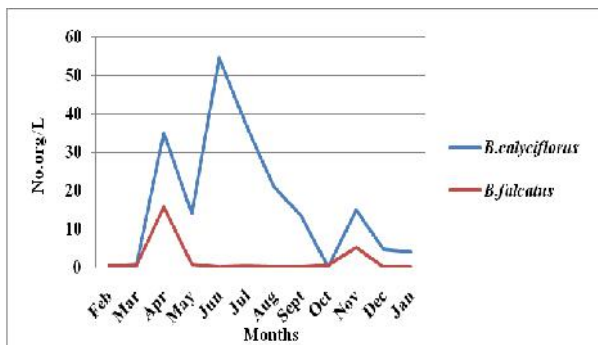


Figure.1 Showing density (No.org/L) of Brachionid species from Upper Dudhana Dam.

Table 3 Pearson’s correlation coefficient between water parameters and *Brachionid species* from Upper Dudhana Dam during study period

Parameters	WT	pH	WTr	TA	Cl	TDS	TH	Ca	Mg	DO	BOD	<i>B.cal</i>	<i>B.fal</i>
WT	1												
pH	0.069	1											
WTr	0.583**	-0.334	1										
TA	0.128	0.115	0.090	1									
Cl	0.293	0.169	0.105	0.211	1								
TDS	0.669**	0.509	0.156	0.250	0.510	1							
TH	0.069	0.469	-0.504	0.168	0.876*	0.474	1						
Ca	0.085	0.110	-0.168	0.401	0.884*	0.283	0.865*	1					
Mg	0.084	0.274	-0.124	0.453	0.906	0.420	0.894*	0.931*	1				
DO	-0.027	-0.251	0.120	0.276	-0.549	-0.155	-0.737*	-0.521	-0.486	1			
BOD	-0.172	-0.252	-0.277	-0.029	-0.317	-0.327	-0.369	-0.117	-0.186	0.366	1		
<i>B.cal</i>	0.338	0.136	0.496	-0.120	0.627**	0.543	0.469	0.278	0.389	-0.372	-0.719*	1	
<i>B.fal</i>	0.471	0.418	0.244	0.113	-0.039	0.619**	-0.030	-0.271	-0.031	-0.226	-0.226	0.296	1

** = significant ‘r’ value at 1% (p < 0.01), * = significant ‘r’ value at 5% (p < 0.05), (- indicate negative correlation).

Water temperature showed positive significant correlation with at 1% level with water transparency (r=0.583) and TDS (r=0.669). Total hardness positively significant at 5% level with chloride (r=0.876), calcium (0.865), magnesium (r=0.894) whereas negatively significant with DO (r=-0.737). Calcium positively significant with at 5% level with chloride (r=0.884), total hardness (r=0.865), magnesium (r=0.894) and negatively significant with DO (r=-0.737). Magnesium at 5% level positively significant with chloride (r=0.906), total hardness (r=0.894), calcium (r=0.931). DO negatively significant at 5% level with total hardness (r=-0.737). *Brachionus calyciflorus* positively significant with chloride (r=0.627) at 1% level and negatively significant with BOD (r=-0.719) at 5% level. *Brachionus falcatus* positively significant with TDS (r=0.619) at 1% level.

DISCUSSION

B. calyciflorus was positively correlated with temperature (0.338), pH (0.136), transparency (0.496), chloride (0.627), TDS (0.543), total hardness (0.469), Ca (0.278) and Mg (0.389), whereas negatively correlated with total alkalinity (-0.120), DO (-0.372) and BOD (-0.719). In the present study temperature ranged from 20.25°C to 29.5°C, which is reported to be suitable for the development of planktonic organism [13]. *B. calyciflorus* was positively correlated with pH [14]. Transparency is a physical parameter in aquatic ecosystem and thus directly affects productivity [15]. It was observed to be lowest (6.5cm) in January, so the density count of *B. calyciflorus* was also lowest and showed positive correlation. Total alkalinity is ranged from 216.5 mg/l to 440 mg/l. There was sudden rain in the month of February, so probably due to this reason alkalinity value was recorded high in February. This observation is supported by [16]. In the present investigation from March to August slowly increases the value of chloride and there was rain in September so reduction in the level of chloride content, hence *B. calyciflorus* showed significant positive correlation with chloride. [17] Opined that slow increase in the value of chloride was because of drying up of water body. *B. calyciflorus* was positively correlated with TDS showed positive correlation and total hardness of water has been found to be positively correlated with *B. calyciflorus*.

Magnesium hardness of the water is highly related with calcium hardness, both influencing water hardness, so *B. calyciforus* positively correlated with Ca and Mg hardness [18]. *B. calyciforus* showed negative correlation with DO (-0.372) and DO was ranged from 1.89mg/l to 3.76mg/l. High concentration of DO was recorded during February and low in August. This may be due to low solubility at high temperature and high degradation of organic substances. [19] And [20] drew similar results. Highest value of BOD was recorded during February when density of *B. calyciforus* was low (0.25 Org/L) whereas lowest value of BOD showed high density (37Org/L) and showed significant negative correlation with BOD (-0.719). This result is supported by [20].

B. falcatus is positively correlated with temperature, pH, transparency, total alkalinity, TDS and DO whereas negatively correlated with chloride, total hardness, Ca, Mg and BOD. *B. falcatus* showed positive correlation with temperature (0.471), pH (0.418), transparency (0.244), total alkalinity (0.113), TDS (0.619) and negative correlation with chloride (-0.039), total hardness (-0.030), Ca (-0.271), Mg (-0.031) DO (-0.226) and BOD (-0.226). As the *B. falcatus* showed positive correlation with temperature, similar observation showed by [13]. The values of pH were highest in April and May (8.5) and lowest in February (7.5) probably due to lack of rain. Similar result obtained by [14].

In the present investigation *B. falcatus* was positively correlated with transparency. [21] drew the result that productivity is directly proportional to the transparency. So lowest value of transparency showed absence of *B. falcatus* in the month of January. *B. falcatus* was positively correlated with total alkalinity, it showed controversy with the result of [16]. *B. falcatus* showed significant positive correlation with TDS. Total hardness of water has been found to be negatively correlated with *B. falcatus*. As the result drew by [18] in the present study *B. falcatus* is negatively correlated with Ca and Mg. *B. falcatus* showed negative correlation with DO [22] and [20]. *B. falcatus* also showed negative correlation (-0.226) with BOD. Similar observation made by [20].

CONCLUSION

It was obvious that correlations exhibited between *B. calyciforus* and *B. falcatus* with water parameters is not uniform possibly because of sudden rain in odd season or drying up of the water body.

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Conflict of Interest

Authors declare that we have no conflict of interest.

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