Original Article

Diversity Analysis of Rotifers from Temporary Spring Pools of Jallo Park, Lahore, Pakistan

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Abstract:

Temporary pools are relatively small water bodies with limited resources and are seasonally available. These freshwater bodies are rich source of microbial and planktonic life **Objective:** This survey was conducted to find out the presence of rotifers in temporary pools formed in Jallo Park established in 1978 and explore their density and diversity **Methods:** Sample collection was done from ten pools with the help of a planktonic mesh. The counting was performed with a Sedgwick- Rafter chamber. Diversity indices like Shannon Weaver index etc. were applied **Results:** In present study 27 rotifer species belonging to 14 genera were identified. The highest diversity and density was shown by *Brachionus* and *Lecane*. There was even distribution in each pool. Results of ANOVA showed statistically significant difference in population density and diversity **Conclusions:** This study has presented a guideline to find out rotifer diversity which could be present in any water reservoir like temporary pool.

Key Words: Sedgwick-Rafter chamber, Diversity indices, ANOVA

Introduction:

Zooplanktons play a role in energy flow as they are important food sources for aquatic organisms [1]. They are indicators of water quality in any water reservoir [2]. Changes in zooplankton communities of any water reservoir are due to the interactions of physical and biological processes [3]. Water quality of any water reservoir includes biological, chemical and physical characteristics [4]. Rotifers are small zooplanktons with elongated body, a ciliated corona and eat particulate matter, protozoans and algae [5]. They are called as rotaria or wheel animalcules and are small animals belonging to separate phylum [6]. They are small pseudocoelomates which are considered effective biological indicators because they are capable of rapid exploitation of suitable environments [7]. Their dispersal is affected by ecological barriers rather than geographical ones [8]. Temporary pools are small water bodies and provide an important habitat formed by upland forest streams [9]. Due to limited resources, fresh water pools provide limited habitats for microorganisms [10]. The present study aims to explore the status of rotifer population in temporary pools which were formed in Jallo Park, Lahore and to identify these organism upto species level.

Methods:

Study Area:

Jallo Park also called as Jallo Wildlife Park has latitude of 31° 34′ 21″ and longitude of 74° 28′ 38″ was established in 1978. It is a public recreational park and wild life site located in district Lahore, Punjab, Pakistan. It covers an area of more than 456 acres (185 Ha). The park is

furnished with forest research center, wildlife breeding center and a boating lake.

Sampling Identification and Counting of Rotifers:

10 temporary pools were selected to collect the rotifer samples. About 40 liters of water was taken from pool in a bucket with the help of a sieve mesh size 341 µm. The contents of the bucket were preserved in pre-cleaned 50 ml bottles 4% formalin [11 and 12]. Rotifers were observed and photographed with the help of LEICA HC 50/50 and 5.0 Megapixel Cannon camera. After staining with vital stain (1% neutral red) live organisms were observed to study internal features. Rotifers were identified upto species level by observing body shape and morphological features and their behavior [13, 14, and 15]. Rotifers were counted in a Sedgewick-Rafter chamber or cell 60-100 x magnification using an inverted Olympus microscope. It is calibrated to contain exactly 1.0 ml and is covered by a comparatively thick cover slip [16].

Sampling of water:

Water samples were collected from each pool. Before sampling the sample bottles were soaked in dilute solution (2-5 % HCl). Each bottle was washed with sample water in the field. Following physico-chemical parameters were measured with their respective meters: Water temperature, Dissolved Oxygen, pH, Electrical Conductivity, Oxygen Saturation, Turbidity, Salinity, Total Dissolved Solids (TDS).

Diversity Indices Analysis:

This analysis was performed using Shannon Weaver Index (H), Simpsons Index of Dominance (D), Simpsons Index of Diversity (SID), Simpsons Reciprocal Index (SRI), Species Richness (SR) and Species Evenness (E) from respective equations [17, 18, 19, 20 and 21].

Statistical Analysis:

Pearson correlation test was performed to evaluate the relationships between rotifer species with various observed environmental parameters which may be regulating their population. Analysis of Variance (ANOVA) was applied on data obtained from various pools. Both the tests were performed using software Minitab 13 for windows. Graphs were plotted in MS Excel.

Results:

Air temperature varied from 22 ◦c to 26.6 ◦c in ten pools. Water temperature range was 21◦c to 24.3◦c. Dissolved oxygen was highest about 10.43 mg/dl in pool 8 and 9.2 mg/dl lowest value recorded in pool 4. Mean values of pH ranged from 6.2 to 7.5. Oxygen saturation was lowest 103 $(mgL)^{-1}$ in pool 2 Salinity was almost same in all ten pools 0.1 or 0.2. The lowest value of electrical conductivity was 12.6 µs/cm found in the water sample of pool 8 and highest recorded value was 26.3 µs/cm in pool 6. Range of total dissolved solids was 0.15 mg/L to 0.235 mg/L. The high value of turbidity was found in pool 1 (4.20 FTU) and least turbidity was in pool 10 (1.28 FTU) (Table 1). In present study, 27 rotifer species belonging to 14 genera were identified from all temporary pools (Pool 1- Pool 10). The highest density and diversity was shown by *Lecane* and *Brachionus* (Table 2, Figure 1). Analysis of variance (ANOVA) showed that there is statistically significant difference ($f=24.24$, $p=0.000$) in the population density of rotifers (Table 3). Shannon-Weaver Index ranged from 2.38 to 3.15 showing high diversity of rotifer species. Simpson's Index of Dominance ranged from 0.05 to 0.20 supporting the results of Shannon-Weaver Index. Simpson's Index of Diversity ranged from 0.08 to 0.95 showed high diversity of rotifers. Species evenness was near one from pool 1 to pool 10. Species richness was moderate (Figure 2).

Temporary Pools (Pool 1 – Pool 10)										
Parameters	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Air Temperature (◦c)	22	22.9	26	26.6	24	23	24	26	26	26
Water Temperature (◦c)	21.2	21	24.3	23.6	22.4	21.7	22.9	24.2	24.2	24.2
Dissolved Oxygen (mg/dl)	9.6	9.5	9.9	9.2	10.4	9.5	9.7	10.43	9.5	9.5
pH	6.5	7.2	7.3	6.6	7.5	7.2	7.2	7.3	6.2	6.4
Electrical Conductivity (µs/cm)	21.1	12.7	22.4	23.4	23.3	26.3	24.7	12.6	22.9	22.6
Total Dissolved Solids (mg/L)	0.15	0.185	0.184	0.194	0.235	0.214	0.15	0.152	0.184	0.234
Salinity (ppm)	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2
Oxygen Saturation $(mgL)^{-1}$	105	103	106	204	217	104	204	207	203	105
Turbidity (FTU)	4.20	2.17	2.25	1.69	2.26	1.64	2.23	2.22	1.90	1.28

Table 1: Average values of physico-chemical parameters (Pool 1 to pool 10)

Relative % of rotifer genera in water samples (Pool 1- Pool 10)										
Genera	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**
Brachionus	8.09	19.05	21.54	49.69	3.71	20.47	9.52	12.9	23.4	18.53
Cephalodella	11.12	0	0	8.47	0	4.08	4.76	5.91	5.66	5.17
Colurella	0	0	3.27	2.83	0	4.68	4.76	4.3	3.55	0
Dicranophorus	8.09	0	4.56	4.52	4.77	2.92	3.16	4.3	0	0
Euchlanis	0	0	3.92	3.38	0	2.33	5.54	0	0.17	0
Keratella	7.06	13.34	3.27	7.28	7.62	10.52	4.76	7.53	9.93	11.11
Lecane	16.15	34.25	24.84	23.7	40.97	29.24	26.97	25.79	19.87	30.35
Lepadella	0	3.8	9.15	6.22	8.57	0.57	5.54	4.3	7.08	0.73
Notholca	9.09	0	1.31	4.52	4.77	2.92	0	1.65	4.25	2.22
Polyarthra	0	9.51	5.88	1.13	8.57	6.43	3.97	4.3	0	4.44
Philodina	19.18	6.65	7.84	9.03	6.65	9.94	19.83	11.82	12.76	14.82
Rotaria	0	8.57	5.23	4.52	7.62	2.92	2.38	7.53	3.55	3.15
Synchaeta	9.09	0	7.84	7.33	0	1.75	0	2.14	3.55	0
Trichocerca	13.12	5.71	1.96	4.5	8.57	1.75	10.3	8.06	7.08	4.44
Mean	6.931	7.206	7.186	9.794	7.273	7.180	7.249	7.181	7.241	6.783

Table 2: Relative percentage of rotifer genera (Pool 1 to pool 10)

Analysis of variance					
Source	**DF**	**SS**	**MS**	**F**	**P**
Pools	9	2937.6	326.4	24.24	0.000
Error	20	13.5	13.5		
Total	29				

DF= Degree of freedom; SS= Sum of square; MS= Mean of square; F= f-distribution; P= Probability

Table 3: Analysis of variance (ANOVA)

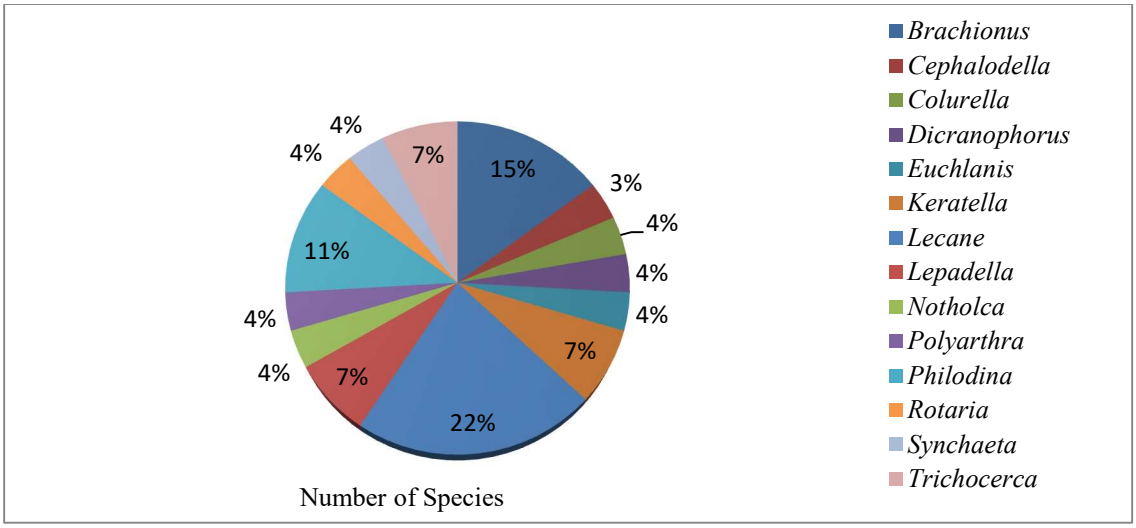

Figure 1: Total number of species from each rotifer genus (Pool 1 to pool 10)

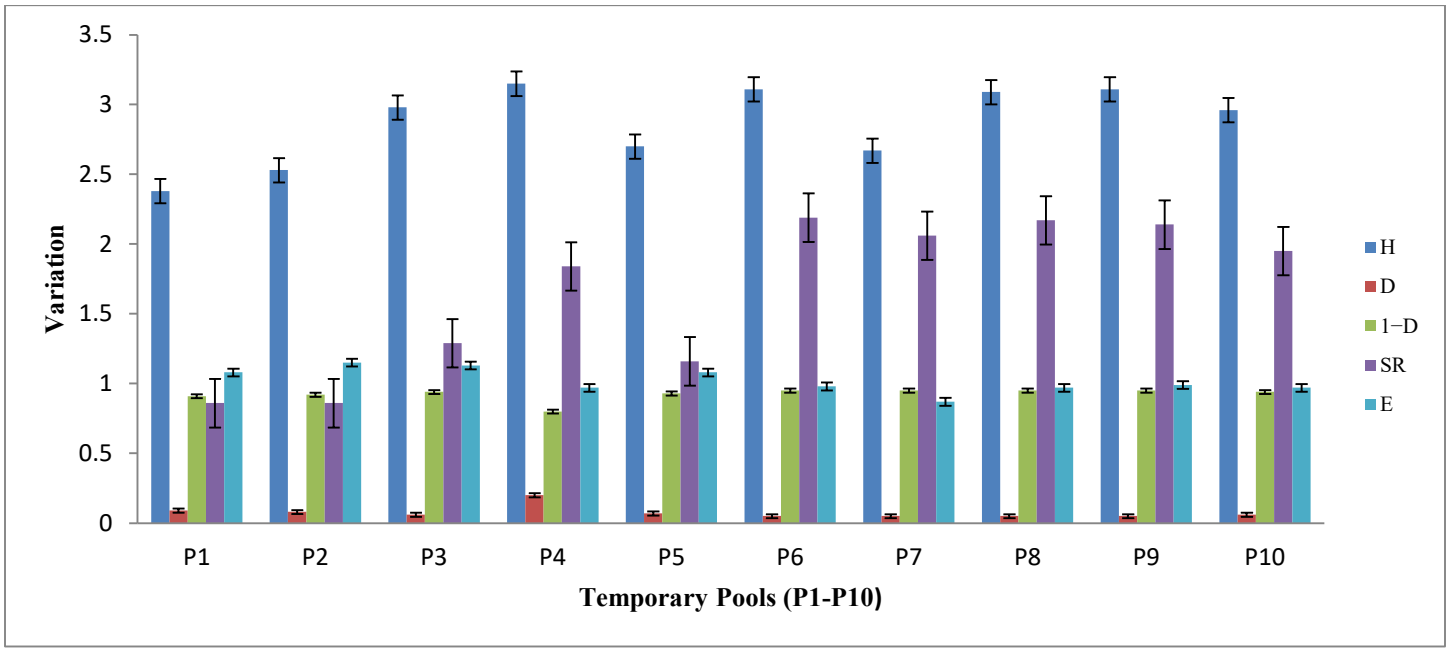

Figure 2: Variation of diversity indices in temporary pools
(H= Shannon-weaver Index, D= Simpson's index of dominance, 1–D= Simpsons index of diversity, SR= Species richness, E= Species Evenness)

Discussion:

This is first survey on rotifer population of temporary pools. A moderate to low density and diversity was observed in all ten temporary pools because of various reasons. This result was supported by the values obtained from diversity indices including Shannon Weaver Index (H), Simpsons Index of Dominance (D), Simpsons Index of Diversity (SID), and Simpson's Reciprocal Index (SRI). Air and water temperatures were moderate. The ranges of pH were neutral (6.2- 6.5). Rotifers prefer pH in the range of 6.5 to 8.5 [22]. The water was turbid. Suspended particles and floating plant materials were abundant in pool water. This matter contributed to increased turbidity. There was no replacement of water. Turbidity influenced other biotic factors controlling rotifer densities [23, 24]. Salinity had a great effect on availability of rotifers. Rotifer population decreased as salinity was reduced. Greater the salinity, lower will be the saturation point [25]. Zooplankton abundance was affected by oxygen concentration. Oxygen saturation is an important factor to check the aquatic organism [26]. Total dissolved solids are influenced by atmospheric temperature and rainfall. Total dissolved solids ranged 0.15 mg/dl to 0.23 mg/dl. A similar finding was reported in a previous research work [27]. Most of the species found in the pools were cosmopolitan in distribution. The highest density and diversity was shown by *Lecane* and *Brachionus*. A similar observation was made where *Brachionus*, *Lecane*, *Keratella* were dominant genera [28]. Although species evenness was 1 in all pools which showed even distribution of rotifers in all pools.

Conclusions:

Rotifers are important zooplanktons which are a part many food chains and food webs in any water reservoir. In present study, overall a low diversity and density of rotifers was found in all pools. The reason for this was a limited resources and no replacement of water due to occasional raining. This study gives insight of type of rotifer population in Pakistan. These organisms could be studied more as bio-indicator of water reservoirs.

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