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Relative abundance of zooplankton observed in three freshwater temple ponds in Thirupparankundram near Madurai, Tamil Nadu

D. Manoharan[1], L. Isaiarasu [2], R. Suresh kumar [3] and V. Mariappan [2]

[1]TVS Lakshmi School, Madurai, India - 625020

[2]Post Graduate & Research Department of Zoology, Ayya Nadar Janaki Ammal College, Sivakasi, India–626124

[3]Post Graduate & Research Department of Zoology, Raja Doraisingam Government Arts College, Sivagangai, India – 630 561

Corresponding author email: bellimano@rediffmail.com

Abstract

Relative abundance of zooplankton was observed in three freshwater temple ponds at Thirupparankundram, Madurai. Tamil Nadu for a period of three years from the month of September, 2009 to August, 2012. A total of 17 zooplankton species were encountered in the three temple ponds which are located in the same geographical location but at different altitudes. This included rotifer (8), cladocera (4), copepoda (4) and ostracoda (1). The maximum number of 17 species was recorded in Saravana poigai, while, in Lakshmi theertham and Kasi theertham the maximum number of species recorded were only 16 and 11 respectively. The zooplankton were identified to be as *Brachionus calyciflorus, Brachionus angularis, Brachionus quadridentata, Brachionus diversicornis, Brachionus plicatilis, Brachionus pterodinoides, Brachionus urceolaris, Brachionus rubens, Alona rectangula rectangula, Moina brachiata, Moina micrura, Diaphanosoma excisum, Mesocyclops thermocyclopoides, Mesocyclops hyalinus, Mesocyclops edax, Mesocyclops aspericornis* and *Stenocypris major*. The analysis of variance of the zooplankton observed revealed that most of the variations observed are statistically significant and that these variations may be due to the altitudinal difference in the locations of the pond.

Key words: Relative abundance, Zooplankton, Temple pond, Thirupparankundram.

Introduction

Zooplanktonic components of aquatic ecosystems help in regulating algal and microbial productivity through grazing and the transfer of primary productivity to fish and human consumers (Dejen *et al.,* 2004). Zooplankton communities are highly sensitive to environmental variations. As a result, changes in their abundance, species diversity, or community composition can provide important indications of environmental change or disturbance. They often respond quickly to a wide variety of environmental change or disturbances including nutrient loading because most species have short generation time (Dodson, 1992). The present study has made an attempt to record the changes in the relative abundance of zooplankton in three tropical temple ponds in Thirupparankundram near Madurai. Specifically, this work involved the collection and preservation of zooplankton from the surface waters of the ponds, enuemeration of the different categories of zooplankton using rafter cell, calculation of the relative abundance of the zooplankton and working out the significance of variations in the occurrence of zooplankton.

Study Area

Thirupparankundram, is a town located about six kilometers south-east of Madurai. It is a historical holy place known for the famous temple of Lord Subramanya situated at the base of the hillock and has a heavy inflow of pilgrims regularly for worship from all over the state and tourists from other states of India and abroad. There are three ponds associated with this temple, one on the top of the hillock namely Kasi theertham, the second one Lakshmi theertham within the temple and the third one Saravana poigai outside the temple. Geographically, these ponds are associated with a hillock located at 9°54'N; 78°7'E from the base at 131MSL measuring a total height of 1056 feet. All the three ponds receive rain water which drains out from hillock and this is the only source of water for these ponds. The ponds are used for bathing, washing and some recreational activities by the pilgrims. Interestingly, these three ponds which are at the same geographical location and fed by rain water during the monsoon showers differ in their size, altitude and human impact provifding a unique opportunity to make an ecological observation.

Materials and Methods

Sampling of water was done twice for every month and analyzed mostly on the day of sampling. Samples were collected between 6 am and 8 am on all days with the view of ensuring uniformity and enormity. Zooplankton samples collected were washed into a sampling jar with one litre water, filtered again through a 40 µm Nitex and preserved again in the laboratory in 4% formaldehyde solution. The preserved zooplankton samples were kept stored in refrigerator at low temperature until analysis (Altaff, 2004). The enumeration of the zooplankton encountered was done carefully with the help of Sedgwick-Rafter cell and noted down in the Plankton Counting Data Sheet. This was repeated for 3 times and the total number of respective zooplankton species was taken by averaging all the counts rounded off the nearest whole number. Abundance of zooplankton was estimated by considering at least 200 individuals per sample (ind.m^{-3}) as per Rossa *et al.* (2001).

Results and Discussion

Table 1. Relative abundance of zooplankton observed in Kasi theertham pond during the three years of the study period in 2009-10, 2010-11 and 2011-12.

S.No	Name of the zooplankton observed during the year	2009-2010		2010-2011		2011-2012	
		Total	RA (%)	Total	RA (%)	Total	RA (%)
1	*Brachionus calyciflorus*	29	4	45	5.79	35	4.49
2	*Brachionus angularis*	25	3.45	21	2.7	21	2.69
3	*Brachionus quadridentata*	27	3.72	23	2.96	24	3.08
4	*Brachionus diversicornis*	22	3.03	32	4.12	29	3.72
5	*Brachionus plicatilis*	16	2.21	31	3.99	24	3.08
6	*Alona rectangula rectangula*	136	18.76	138	17.76	127	16.28
7	*Moina brachiata*	72	9.93	74	9.52	86	11.03
8	*Moina micrura*	77	10.62	87	11.2	98	12.56
9	*Mesocyclops thermocyclopoides*	156	21.52	146	18.79	156	20
10	*Mesocyclops aspericornis*	149	20.55	163	20.98	157	20.13
11	*Stenocypris major*	16	2.21	17	2.19	23	2.95
Total		725	100	777	100	780	100

Table 2. Relative abundance of zooplankton observed in Lakshmi theertham pond during the three years of the study period in 2009-10, 2010-11 and 2011-12.

S.No	Name of the zooplankton observed during the year	2009-2010		2010-2011		2011-2012	
		Total	RA (%)	Total	RA (%)	Total	RA (%)
1	*Brachionus calyciflorus*	51	3.5	52	3.82	54	3.78
2	*Brachionus angularis*	46	3.16	35	2.57	43	3.01
3	*Brachionus quadridentata*	47	3.23	33	2.42	45	3.15
4	*Brachionus diversicornis*	36	2.47	37	2.72	51	3.57
5	*Brachionus plicatilis*	28	1.92	28	2.06	39	2.73
6	*Brachionus urceolaris*	43	2.95	42	3.09	48	3.36
7	*Brachionus rubens*	32	2.2	33	2.42	39	2.73
8	*Brachionus pterodinoides*	41	2.81	50	3.67	44	3.08
9	*Alona rectangula rectangula*	161	11.05	163	11.98	153	10.71
10	*Moina brachiata*	160	10.98	165	12.12	150	10.5
11	*Moina micrura*	214	14.69	170	12.49	171	11.97
12	*Mesocyclops edax*	158	10.84	133	9.77	159	11.13
13	*Mesocyclops thermocyclopoides*	140	9.61	119	8.74	139	9.73
14	*Mesocyclops hyalinus*	116	7.96	138	10.14	122	8.54
15	*Mesocyclops aspericornis*	163	11.19	148	10.87	158	11.06
16	*Stenocypris major*	21	1.44	15	1.1	14	0.98
Total		1457	100	1361	100	1429	100

Table 3. Relative abundance of zooplankton observed in Saravana poigai pond during the three years of the study period in 2009-10, 2010-11 and 2011-12.

S.No	Name of the zooplankton observed during the year	2009-2010		2010-2011		2011-2012	
		Total	RA (%)	Total	RA (%)	Total	RA (%)
1	*Brachionus calyciflorus*	69	5.06	100	7.72	114	8.13
2	*Brachionus angularis*	78	5.72	98	7.56	101	7.2
3	*Brachionus quadridentata*	86	6.31	73	5.63	75	5.35
4	*Brachionus diversicornis*	67	4.92	77	5.94	69	4.92
5	*Brachionus plicatilis*	56	4.11	70	5.4	68	4.85
6	*Brachionus urceolaris*	74	5.43	57	4.4	42	3
7	*Brachionus rubens*	58	4.26	52	4.01	55	3.92
8	*Brachionus pterodinoides*	62	4.55	63	4.86	48	3.42
9	*Alona rectangula rectangula*	65	4.77	60	4.63	67	4.78
10	*Moina brachiata*	83	6.09	75	5.79	82	5.85
11	*Moina micrura*	82	6.02	53	4.09	78	5.56
12	*Diaphanosoma excisum*	62	4.55	53	4.09	76	5.42
13	*Mesocyclops edax*	130	9.54	118	9.1	167	11.91
14	*Mesocyclops thermocyclopoides*	132	9.68	120	9.26	134	9.56
15	*Mesocyclops hyalinus*	124	9.1	96	7.41	113	8.06
16	*Mesocyclops aspericornis*	124	9.1	119	9.18	105	7.49
17	*Stenocypris major*	11	0.81	12	0.93	8	0.57
Total		1363	100	1296	100	1402	100

Each value given in the total is the sum of the averages of six observations made during every month of the respective study period and rounded off to the nearest whole number.

Table 4. Analysis of the variations through (One way ANOVA) for the relationship between zooplankton observed in the three tropical ponds during different seasons from September 2009 to August 2012

Location & Study period	***Source of Variation***	***Sum of square SS***	***df***	***Mean square MS***	***F-value***	***P-value***	***F-critical value***
Kasi theertham September'09-August'10	Between Groups	678.81	11	61.71	**1.83#**	0.06	1.87
	Within Groups	4052.18	120	33.77			
Kasi theertham September'10-August'11	Between Groups	818.02	11	74.37	**2.24**	0.02	1.87
	Within Groups	3989.27	120	33.24			
Kasi theertham September'11-August'12	Between Groups	812.73	11	73.88	**2.37**	0.01	1.87
	Within Groups	3740.18	120	31.17			
Lakshmi theertham Septermber'09 - August'10	Between Groups	1293.81	11	117.62	**2.80**	< 0.05	1.84
	Within Groups	7562.69	180	42.01			
Lakshmi theertham Septermber'10 - August'11	Between Groups	1638.43	11	148.95	**4.21**	< 0.05	1.84
	Within Groups	6371.06	180	35.39			
Lakshmi theertham Septermber'11 - August'12	Between Groups	1327.93	11	120.72	**3.68**	< 0.05	1.84
	Within Groups	5903.44	180	32.80			
Saravana poigai September'09-August'10	Between Groups	629.00	11	57.18	**3.13**	< 0.05	1.84
	Within Groups	3507.29	192	18.27			
Saravana poigai September'10-August'11	Between Groups	730.24	11	66.39	**5.05**	< 0.05	1.84
	Within Groups	2524.35	192	13.15			
Saravana poigai September'11-August'12	Between Groups	1101.75	11	100.16	**4.65**	< 0.05	1.84
	Within Groups	4138.94	192	21.56			

 # - Insignificant

A total of 17 zooplankton species were encountered in the three temple ponds, Kasi theertham, Lakshmi theertham and Saravana poigai during the study period between September 2009 and August 2012. This included rotifer (8), cladocera (4), copepoda (4) and

ostracoda (1). The relative abundance of the zooplankton species estimated in the present study for the entire duration of three years noticed during the study is given separately in Table 1-3. In Kasi theertham, the maximum abundance (21.52%) noticed was that of *Mesocyclops thermocyclopoides*, followed by *Mesocyclops aspericornis* (20.98%) while the minimum abundance was shown by *Brachionus plicatilis* (2.21%) and *Stenocypris major* (2.19%) respectively. In Lakshmi theertham, maximum abundance noticed (14.69%) was that of *Moina micrura* followed by *Moina brachiata* (12.12%) while the minimum abundance was shown by *Stenocypris major* (0.98%) and *Brachionus plicatilis* (1.92%) respectively. In Saravana poigai, maximum abundance noticed (11.91%) was that of *Mesocyclops edax*, followed by *Mesocyclops thermocyclopoides* (9.56%) while the minimum abundance was shown by *Stenocypris major* (0.57%).

In this regard, Amshadevi *et al.* (2013) reported that in a temple pond in Virudhunagar near Madurai, a total of 17 species of zooplankton belonging to 4 major groups such as rotifer (10), Cladocera(3), copepoda(3) and ostracoda(1). Balakrishna *et al*. (2013) reported that during February 2011 – January 2012 there were 21 species identified in Dharmasagar Lake, Warangal District. These species belonged to 4 major groups with the distribution as 10 species of rotifers, 4 species of copepods, 5 species of cladoceran and 2 species of ostracodes. Karuthapandi *et al*. (2013) studied for a period of two years in Safilguda tank and it revealed that the occurrence of 17 species of various zooplankton groups comprises 13 species of rotifers (6 families), 3 species of cladocera (two families) and 1 species of copepoda (one family). Tyor *et al.* (2014) observed a total number of 42 species (23 species of rotifers, 15 species of branchiopods, 3 species of copepods and 1 species of ostrachopods) of zooplankton belonging to 19 genera, 12 families, 7 orders and 4 classes in Sultanpur National Park, Gurgaon.

Further, in the present study, the zooplankton were identified as *Brachionus calyciflorus, Brachionus angularis, Brachionus quadridentata, Brachionus diversicornis, Brachionus plicatilis, Brachionus pterodinoides, Brachionus urceolaris, Brachionus rubens, Alona rectangula rectangula, Moina brachiata, Moina micrura, Diaphanosoma excisum, Mesocyclops thermocyclopoides, Mesocyclops hyalinus, Mesocyclops edax, Mesocyclops aspericornis* and *Stenocypris major*. This maximum number of 17 species was recorded in Saravana poigai the largest of the three ponds that is located at the base of the hillock while, in Lakshmi theertham and Kasi theertham the maximum number of species recorded were only 16 and 11 respectively. Of the 17 species, *Brachionus calyciflorus, Brachionus angularis, Brachionus quadridentata, Brachionus diversicornis, Brachionus plicatilis, Alona*

rectangula rectangula, Moina brachiata, Moina micrura Mesocyclops thermocyclopoides, *Mesocyclops aspericornis,* and *Stenocypris major* were observed in all the temple ponds.

The analysis of variance (one way ANOVA) of the zooplankton observed in the three temple ponds studied for three consecutive years of the study period (Table 4) revealed that the most of the variations observed are statistically significant. In Kasi theertham, the highest F-value of 2.37 was obtained during the third year of the study. But in the first year it was observed to be insignificant with the F-value of 1.83. The F-values for the next two consecutive years were noticed to be significant with the F-value of 2.24 and 2.37 respectively. The sequential increase in F-value every year during the study period may be taken as an indication of increased variations in the occurrence of zooplankton in the pond. In Lakshmi theertham, the F-values obtained are statistically significant for all the three years. It was 2.80 during the first year of study period. In the second year, the F-value was observed to be 4.21 and in the third year it was 3.68. In Saravana poigai, also the values were statistically significant for all the three year of the study period. In the first year, the F-value was 3.13 which were 5.05 and 4.65 in the second year and third year respectively. This increase in the significance of the F values may be taken as the indication of the establishment of zooplankton diversity in these ponds. If so, the decline obtained for the third year of the study period may be taken as an indication of some disturbance in the system resulting fluctuation in the zooplankton populations.

There could be several reasons for the variations in the relative abundance of the zooplankton in the freshwater systems. The distribution of cladocera may be due to the interaction of biotic and abiotic components of water (Wetzel, 1975). High rotifer population indicates pollution from organic matter due to direct entry of untreated domestic sewage from the catchment area (Arora, 1967). Chandrashekhar (1996) observed in Saroornagar Lake, Hydrabad that the diversity of rotifers may be influenced due to different water quality and chemical factors. In summer and monsoon, the factors like water temperature, dissolved oxygen play an important role in controlling the diversity and density of rotifers. According to Datta (1995) abundance of cladocerans can be attributed to thick deposits of organic matter in an aquatic ecosystem which might also be due to the abundance of diatoms and blue green algae. Kedar *et al.* (2008) found that the zooplankton diversity of Rishi Lake was represented by 61 species consisting of 29 species (47.54%) of rotifers, 14 species (22.95%) of protozoa, 6 species (09.83%) of copepoda, 7 species (11.47%) of cladocera and 5 species (8.19%) of ostracoda.

The overall percentage composition of the zooplankton species that occurred during the entire study period of three years in the three temple ponds revealed that in Kasi theertham, the copepoda were the most abundant of the four zooplankton groups comprising 47% of the total number of organisms, followed by the cladocera and rotifera at 45% and 7% respectively. In Lakshmi theertham, the cladocera was the most abundant of the four zooplankton groups comprising 42% of the total number of organisms, followed by the copepoda and rotifera at 29% and 28% respectively. In Saravana poigai, the rotifera were the most abundant of the four zooplankton groups comprising 49% of the total number of organisms, followed by the copepoda and cladocera at 28% and 22% respectively. The ostracoda was the least abundant species with about 1% in all the three ponds. These variations in the percentage of individuals may be due to the altitudinal difference in the locations of the pond that make these ponds to differ in receiving allothonous input of nutrients either from the runoff of from human impact.

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