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ROTIFER DENSITY, PERCENTAGE COMPOSITION AND THEIR SEASONAL VARIATIONS IN A PERENNIAL POND ECOSYSTEM OF TRIPURA IN RELATION TO PHYSICO-CHEMICAL FACTORS

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ABSTRACT
The present study was carried out on a perennial pond ecosystem of Tripura to observe the seasonal abundance and population dynamics of planktonic rotifers and its relationship with physico-chemical factors during a period from March 2013 to February 2015. The present observation revealed the presence of 18 species of planktonic rotifers belonging to 8 genera and 6 families. Quantitative analysis during study period revealed that Brachionidae is the dominant family with 8 species followed by Lecanidae with 4 species, Trichocercidae with 2 species, Colurellidae with 2 species while Asplanchnidae and Euchlanidae, have 1 species each, thus contributing 42%, 19%, 13%, 11%, 8% and 7% respectively to the rotifer fauna of the studied pond under observation. Percentage composition of each species of the total rotifer population was also noted. Rotifer population followed a definite rhythm of seasonal succession showing highest density (368 ind/l) in the winter and lowest (52 ind/l) in the summer in both the study periods. Notable physico-chemical parameters of the studied pond were also observed and their degree of influence over the seasonal abundance of planktonic rotifers was noted. The simple correlation coefficient shows that water temperature has negative and significant correlation ($r = -0.9571$, $P<0.01$) with the abundance of total planktonic rotifers. However, stepwise multiple regression analysis depicted that water temperature ($P<0.01$), dissolved organic matter ($P<0.01$), bicarbonate alkalinity ($P<0.01$), dissolved oxygen ($P<0.05$) and phosphate phosphorus ($P<0.05$) have significant correlation with the abundance of total planktonic rotifers.

KEY WORDS: Rotifer density, Percentage composition**,** Seasonal variations, physico-chemical factors, Pond ecosystem, Tripura.

INTRODUCTION

Rotifers form an important link in the food chain of most fin fishes and shell fishes in the aquatic ecosystem (Lubzens *et al*., 1989). They constitute a considerable portion of the total zooplankton population, since they reproduce parthenogenetically and are capable of existing in dense concentrations (Herzig, 1987). Their ability to colonize diversified aquatic and semi-aquatic biotopes and inherent quality to build up substantial densities within short time intervals make them ideal for ecological considerations as well as valuable tool for population dynamic studies (Paggi, 1990, Mahar *et al*., 2000, Dangne *et al*., 2007). The trophic status and rotifer assemblage of freshwater lentic ecosystem is very much related (Jyoti & Sehgal, 1979). Mass availability of rotifer species not only indicates trophic enrichment in lentic ecosystem (Pandit & Yousuf, 2003) but also enhances production of fish larvae (Laal & Nasar, 1977). Since rotifers play an important role in the freshwater ecosystem, the limnological investigations on rotifers also gained importance (Sinha & Sinha, 1983, Castro *et al*., 2005). Ponds are rich in components of biodiversity like flora, fauna of natural, local and regional significance (Ghanai *et al*., 2010) and diversity of zooplanktonic organisms is quite high in fertile standing water like pond(Chakrabarti, 2013 &2014). Physico-chemical parameters which play key role in the maintenance of healthy environment of the lentic water bodies is also one of the most important determining factors on the seasonal occurrence and abundance of rotifer population (Dhanapathi,1974, Jana *et al*., 1980, Mikschi,1988, Kirk & Gilbert, 1990, Kaushik & Sharma,1994, Chakrabarti, 2011). Although specific environmental factors may exert greater impact on their abundance, some parameters might affect their growth and survival (Berzins & Pejler,1987, Stewart & George,1987). Rotifers are very good indicators of subtle alterations in water quality because they respond quickly to environmental changes (Boltovskoy & Mazzoni, 1988). Hence, studies to trace the importance of physico-chemical factors in determining the optimum production of rotifers become important in aquaculture view point (Pillay, 1993). In Tripura, no in-depth studies were made on rotifer assemblages in pond ecosystem till date. In the present study, an attempt was undertaken to observe the density and composition of planktonic rotifers as well as their seasonal variations and to find out the degree of relationship of physico-chemical factors with the seasonal abundance of rotifer fauna in a perennial pond ecosystem of Tripura.

MATERIALS & METHODS

The present observation was carried out in a freshwater pond ecosystem located at Gobindapur area, Kailashahar Sub-

Division, Unakoti District of Tripura during March 2013 to February 2015. The pond is perennial and rectangular shaped; the surface area is of about 0.62 ha. The depth of water column of the studied pond varies from 1.0 to 2.5 m. The littoral zone of the pond harbours some species of macrophytes such as *Eichhornia crassipes*, *Lemna minor etc*. The planktonic rotifer fauna have been collected from the littoral zones of the studied pond through plankton net at weekly intervals by filtering 100 litre surface water and fixed immediately with 4% formalin. The planktonic rotifers were analysed quantitatively in the laboratory under the microscope through Sedgwick Rafter Plankton Counting Cell and results were expressed as individual per litre (ind/l). The rotifer fauna was identified following standard works of Pennak (1978) and Edmondson (1992). To get a clear idea regarding the influence of water quality variables over the planktonic rotifer fauna, some limnological variables (water temperature, pH, transparency) were determined in situ and the remaining parameters (such as dissolved oxygen, free carbon dioxide, bicarbonate, dissolved organic matter, silicate, chlorinity, salinity, phosphate phosphorus and nitrate nitrogen) have been analysed following the standard methods of APHA (1998). Statistical analyses such as correlation coefficient (r), Stepwise Multiple Regression were performed to find out the degree of relationship between the physico-chemical parameters and rotifer species density of the studied pond.

RESULTS & DISCUSSION

The list of planktonic rotifer species of the studied pond was presented in Table 1. Physico-chemical factors of the studied pond water were presented in Table 2. Stepwise multiple regression analysis was presented in Table 3. Percentage contribution of different families to the rotifer fauna of the studied pond were presented in Figure 1. Percentage composition of each planktonic rotifer species in studied pond were presented in Figure 2. Seasonal variations in the mean density values (ind/l) of the studied pond were presented in Figure 3.

TABLE 1: List of rotifer species in the studied pond

1.*Brachionus angularis*	7. *Keratella tropica*	13. *Trichocerca longiseta*
2. *Brachionus calyciflorus*	8. *Keratella cochlearis*	14. *Trichocerca cylindrica*
3. *Brachionus quadridentata*	9. *Lecane luna*	15. *Lapadella ovalis*
4. *Brachionus rubens*	10. *Lecane depressa*	16. *Lapadella patella*
5. *Brachionus forficula*	11. *Monostyla bulla*	17. *Asplanchna* sp.
6.*Brachionus falcatus*	12. *Monostyla lunaris*	18. *Euchlanis dilatata*

The present investigation revealed the presence of 18 species of rotifer belonging to rotifer belonging to 8 genera and 6 families. Quantitative analysis during study period revealed that Brachionidae is the dominant family with 8 species followed by Lecanidae with 4 species, Trichocercidae with 2 species, Colurellidae with 2 species while Asplanchnidae and Euchlanidae, have 1 species each, thus contributing 42%, 19%, 13%, 11%, 8% and 7%, respectively to the rotifer fauna of the studied pond under observation (Fig. 1)

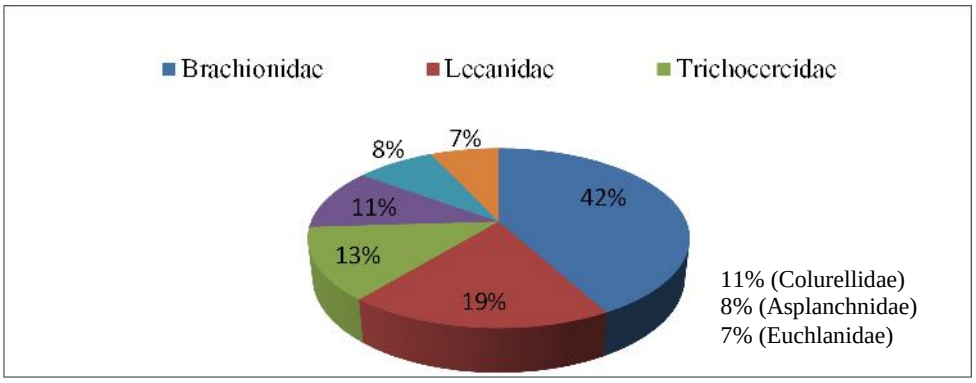

FIGURE 1. Percentage contribution of different families to the rotifer fauna of the studied pond

The percentage composition of the *Brachionus angularis, Brachionus calyciflorus, Brachionus quadridentata, Brachionus rubens, Brachionus forficula ,Brachionus falcatus , Keratella tropica* and *Keratella cochlearis* were 6%, 3%, 8%, 2%, 4%, 7%, 9% and 3% respectively. The percentage composition of *Lecane luna, Lecane depressa, Monostyla bulla* and *Monostyla lunaris* were 5%, 3%, 7% and 4% respectively. The percentage composition of *Trichocerca longiseta* and *Trichocerca cylindrica* were 9% and 4% while the percentage composition of *Lapadella ovalis* and *Lapadella patella* were 8% and 3%. The percentage composition of *Asplanchna* sp. was 8% while the percentage composition of *Euchlanis dilatata* was 7% (Fig.2).

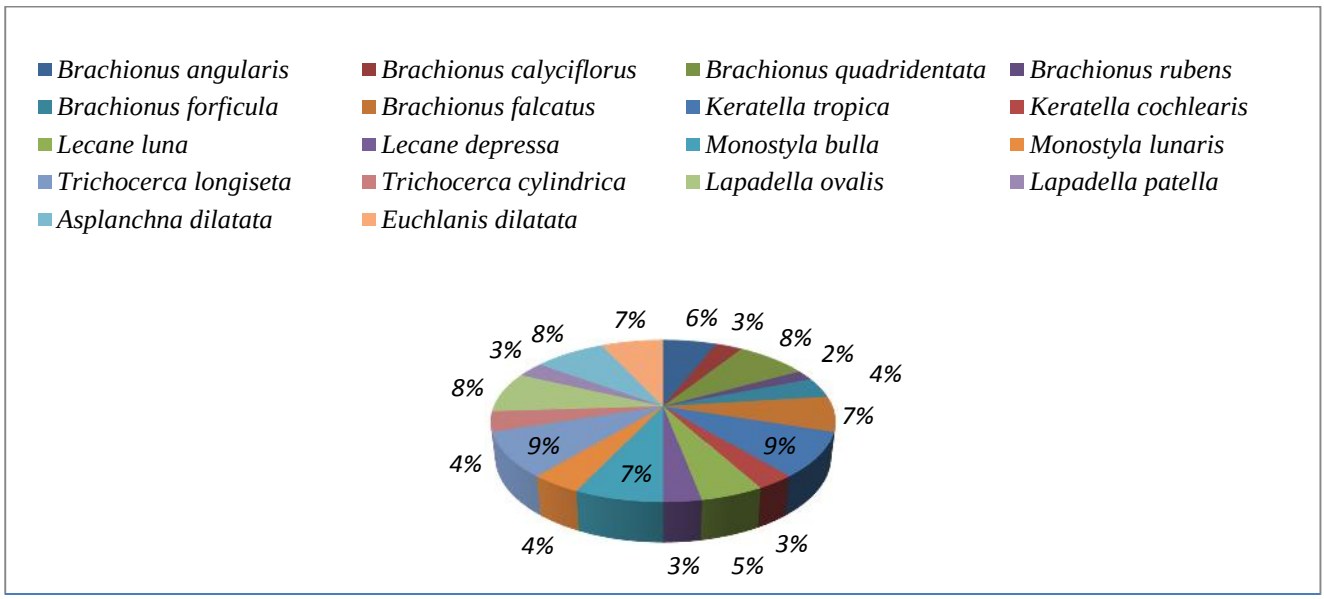

FIGURE 2. Percentage composition of each species of the total rotifer population in the studied pond

Rotifer population followed a definite rhythm of seasonal succession showing highest density (368 ind/l) in the winter (November to February) and lowest (52 ind/l) in the summer (March to May) in both the study periods

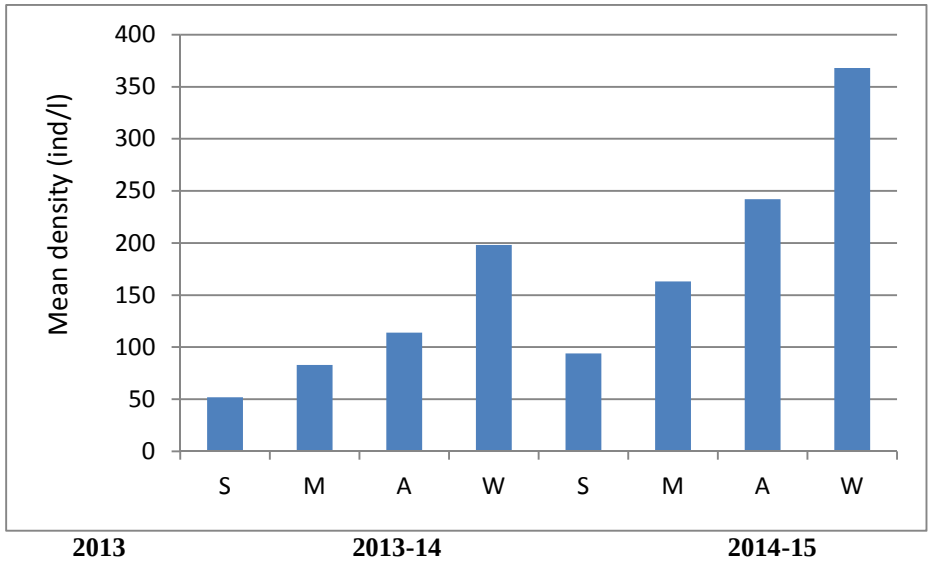

FIGURE 3. Seasonal variations in the mean density values (ind/l) of Rotifers of the studied pond water from March 2013 to February 2015.

Lower concentration of dissolved organic matter as well as low availability of live food biota during summer season was also another probable reason for the poor density of the planktonic rotifers in the said period (Hofmann, 1977, Mikschi, 1989, Mahar *et al*., 2000 Castro *et al*., 2005). Highest density of the planktonic rotifers during winter season may be due to favourable conditions like food in addition to physico-chemical factors like temperature, pH, dissolved oxygen *etc*., as reported earlier by several noteworthy researchers (King, 1967, Backer, 1979, Edmondson, 1992, Nasar, 1997, Patra & Datta, 2004, Paulose & Maheshwari, 2008, Sivakami *et al*., 2013). The present observation shows that the planktonic rotifers are comparatively more abundant under the macrophytes than those of the exposed littoral areas of the studied water bodies. Several researchers (Nayar & Nair, 1969, Sharma 1983, Sarma, 1988) opined that the occurrence as well as abundance planktonic rotifers are dependent upon the degree of availability of the food algae and the metabolic products of the macrophytes. So, the availability of the planktonic rotifer fauna in higher numerical abundance around the macrophytes than those of the exposed littoral zones

indicates that the periphery of macrophytes forms a suitable ecological niche condition. Stewart & George (1987) and Boltovskoy & Mazzoni (1988) also opined that the lower abundance of rotifers in the vegetation free area was due to sunlight factor.

TABLE 2: Physico-chemical factors of the studied pond

Physico-chemical factors	Range	Mean
Water Temperature(^{0}C)	11.0-32.0	24.37
Transparency(cm)	6.0-22.0	14.26
pH	6.2-8.0	7.24
Bicarbonate alkalinity(ppm)	56.0-124.0	82.71
Dissolved oxygen(ppm)	4.2-10.6	6.47
Free carbon dioxide(ppm)	2.0-4.0	2.31
Dissolved organic matter (ppm)	8.0-17.2	12.58
Silicate(ppm)	4.0-11.4	7.01
Chlorinity(ppm)	12.0-26	17.13
Salinity(ppt)	0.01-0.03	0.02
Phosphate phosphorus(ppm)	0.4-0.6	0.52
Nitrate nitrogen(ppm)	0.4-0.7	0.53

The physico-chemical parameters, mainly the water temperature exert significant impact on the relative abundance of rotifers (Jyoti & Sehgal, 1979, Jana *et al*., 1980). In the present observation, maximum density of the planktonic rotifers is encountered at a temperature range of 22-26^{0}C. Dhanapathi (1974) reported that pH is not a single influential factor on the occurrence as well as abundance of rotifers. However, in the present investigation maximum density of planktonic rotifers has been noticed in the pH range of 6.4-7.2. Oxygen seemed to be an important limiting factor in the occurrence as well as abundance of the rotifer species. In the present observation, *Monostyla* sp. was available only in low oxygen concentration. However, most of the species were recorded in wide range of oxygen concentration (5.2-6.8ppm). Bicarbonate alkalinity also plays a limiting factor for the distribution of some rotifer species in many water bodies (Hofmann, 1977, Laal & Nasar, 1977). The present observation depicts maximum abundance of the total rotifers at 80-120ppm. The dissolved organic matter (DOM) has been found to be important for the growth of live food biota (Goldman & Horne, 1983, Jhingran, 1993). The phytoplanktonic algae which serve as food to the rotifers is known to be strongly correlated with phosphate content of water (Shortreed *et al*., 1984). In the present observation, the maximum density of planktonic rotifers was noted in the range of 0.4-0.5 ppm phosphate phosphorus concentration. The simple correlation coefficient shows that water temperature has negative and significant correlation **(**r = -9571, P<0.01) with the abundance of total planktonic rotifers. However, stepwise multiple regression analysis depicted that water temperature (P<0.01), dissolved organic matter (P<0.01), bicarbonate alkalinity (P<0.01), dissolved oxygen (P<0.05) and phosphate phosphorus (P<0.05) have significant correlation with the abundance of total planktonic rotifers. The coefficient of multiple determination indicated that 51% influence on the abundance of planktonic rotifer fauna has been exerted by water temperature, pH, dissolved oxygen, bicarbonate alkalinity, transparency, dissolved organic matter and phosphate phosphorus, though pH and transparency did not depict any significant correlation (Table 3).

TABLE 3: Stepwise multiple regression analysis

Variables in regression	Reg. Coeff	S. F	F	Beta Coeff.
Water Temperature	-45.033	4.124	109.055	-0.837**
pH	0.023	0.029	0.738	0.143
Dissolved Oxygen	-13.735	5.719	6.866	-0.204*
Bicarbonate Alkalinity	0.053	0.018	9.274	0.753**
Transparency	3.131	2.849	1.357	0.875
Dissolved organic matter	78.439	8.178	24.927	0.367**
Phosphate phosphorus	-21.037	8.466	6.190	-0.179*

Asterisks indicate values are significant at P<0.01(**) and P<0.05 (*)
Multiple Correlation Coefficient(R) =0.71503
Coefficient of Multiple Determination (R^2) =0.51127

CONCLUSION

Thus, the present study infers that the abundance of planktonic rotifers may vary with seasons due to the dynamic nature of the aquatic ecosystem and might be also due to optimal condition in the physico-chemical factors of the freshwater lentic ecosystem.

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