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DIVERSITY AND SEASONAL VARIATIONS OF ZOOPLANKTON IN SOMALAPURA WATER TANKS IN HOSAPETE CITY, KARNATAKA (INDIA)

Vijaya B[1], Harshavardhana[2], Chandrappa C N[3], S. Manjappa[1] and Suresh B[4]

[1]Depaertment of Chemistry, University BDT College of Engineering, Davangere – 577005, Karnataka, India.
[2]Department of Chemistry, S.J.M Arts, Science and Commerce College, Chandravalli, Chitradurga-577501, Karnataka, India
[3]Bangalore College of Engineering and Technology, Bangalore-560099, Karnataka, India
[4]Department of Civil Engineering, Bapuji Institute of Engineering & Technology, Davangere – 577 004, Karnataka, India

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ABSTRACT

This study focuses on assessment of zooplankton with special reference to seasonal variation and selected physic-chemical variables of Somalapura water tanks in Hosapete city, Karnataka state. A large quantity of manmade activities near the water tank. During the study period, 48 species of zooplankton - 14 species of Rotifera, 12 species of Cladocera, 6 species of Ostracoda and 4 species of Copepoda were observed. Among zooplankton, Rotifera was (645 no./Org) noticed as the dominant group in the entire the study period and the maximum count was identified in the summer period while less numbers were noticed during winter season. Zooplankton community is also significantly correlated with some physico-chemical variables. The analytical results during the study period indicate that the scattering and density of zooplankton species were encouraged by prevailing physical and chemical features of the aquatic ecological condition.

KEYWORDS: ***Somalapura, water tank, zooplankton, diversity, seasonal and domestic activity.***

INTRODUCTION

Water is one of the abundantly available substance in nature. It is an essential constituent of all the animals and vegetable matter and forms about 75% of the matter of earth's crust. Water is the mother liquid of all forms of life. It is the vital essence, miracle of nature and the great sustainer of life. The essentiality of water for living systems is quite evident as without water, there is no life (Omar WMW, 2010). Water pollution due to organic materials is one of the most significant issues in present days. Most of the freshwater bodies are under remarkable pressure from human communities and developmental actions in an around the water tanks. Increasing in the addition of nutrient into the water tanks from the surrounding has been deteriorating water quality of surface water ecosystems (Kamble, *et al.*, 2005).

Physico-chemical constraints of any surface water tanks though, provide a good indication about the chemistry and quality of water. These variables will not give the clear picture of the ecological condition of the surface water body due to lack of proper assimilation with ecological factors (Karr, *et al.*, 2000). Plankton are free moving, unicellular, microscopic and colonial autotrophic organisms that grow in aquatic environments whose movement is more or less dependent upon water movements (Cecilia Medupin, 2011 and Suresh, 2015). Plankton are also called as biotic communities, microscopic organism and minute species since these are living inside the water. The biotic community is the outcome of the integration and interaction of different physical, chemical and geo-morphological characteristics of any water body, biological appraisal is a useful alternative in assessing those systems (Stevenson and Pan, 1999). Plankton are considered as significant component of aquatic fauna and flora, play

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a key role in maintaining equilibrium between abiotic and biotic components of aquatic ecosystem (Arfi, et al., 2003). The surface water bodies are most significant for all livening organism including other human activities like drinking and agricultural practices. Research studies on the zooplankton counting aspects are of great significance in developing resources of a water tanks including all types of water body. A number of researchers have studied the zooplankton diversity of lentic and lotic water bodies (Kar and Kar (2013); Pullie and Khan (2003); Manjare, (2015); Miah, et al., (2013); Suresh, 2015).

In India 80 % of the surface water is vulnerable to pollution as more than 95 % of the sewage in the country is not treated. Lotic water bodies like rivers and streams play a very significant role in maintaining the bio-diversity and over all ecological balance in nature. However, the water quality of fluvial systems is deteriorating due increase in the amount of raw sewage entering the rivers. The increase of pollution is caused by population growth and increasing urbanization. Related to this is the industrialization that also causing huge environmental problems (Zargar and Ghosh, 2006). Karnataka state is endowed with 6.31 lakhs hectare of freshwater resources consisting of 4.15 lakhs hectare which includes ponds and tanks and 2.16 lakh hectare reservoirs. In addition, the state has 6000 kms of river stretch and 3000 kms length of canal. Water pollution is the introduction into fresh/ground/ocean waters of chemical, physical or biological material that degrades the quality of the water and affects the organisms living in it (Pandey, *et al.,* 2009).

The main objectives of the study are: collection of water samples using plankton net at three different water tank in the Hosapete city of Karnataka state. Since, no work have so far neither been done in enumerating zooplankton nor in analyzing water quality in Kamapli water tank in Hosapete city. The present attempt made an endeavor to appraise the water quality varaiables and to assess pollution status of the Somalapura water tanks using Palmer's scale.

MATERIALS AND METHODS

Topography of the study area

Hospet is a town head quarter situated 66 Kms away from Bellary district in the Central part of Karnataka state, India. Hospet-Shimoga Highway (SH-25) passes through the study area. Almost all the villages of the area are connected by unmetalled and metalled roads and regular bus facility exits from Hosapete to different villages. The study area falls in the survey of India topo map numbers 57 B/6 on 1:50000 scale. The area is bounded by 14.74° to 14.88° N latitude and 75.88° to 76° E longitude. The location map of the study area is represented in Fig. 1. Topography of the study area is generally undulating to rolling topography with frequent mound like structures. Soils of the area are affected by erosion. Isolated hills and hill ranges are also seen. The geology (rock) of the study area consists of metamorphic rocks like gray wacke, argillite and granodiorite and tonalitic gneisss. The study area received a maximum rainfall of 742 mm in the year 2015 and a minimum of 361.9 mm in the year 2003. The normal rainfall of the study area is 656.70 mm.

Somalapura tank: It is a natural, perennial fresh water body situated in the Hosapete city and located 35 km away from Hosapete. The water body lies at 150.301 N latitude and 760.61 E longitude. The area of the water body is 20 acres and depth is about 8 feet. The colour of the water body is pale greenish. The water body is rectangular in shape. The Somalapura tank received water from rainfall, city sewage and agricultural run-off. The water is used to grow the crops like paddy, sugarcane, banana and some vegetable crops. Besides this, water is also used for washing of vehicles, cattle washing and other domestic activities.

METHODS

The water samples for physico- chemical as well as zooplankton analysis were collected at monthly interval for a year from March 2019 to February 2020 from three collection points taking randomly at Somalapura water tank. The data thus generated were summed up as average data on the basis of seasons viz. summer (April to July), monsoon (August to October) and winter (November to March). Grab surface water samples were collected in all the selected water tanks and were analyzed for the physico-chemical variables (temperature, pH, total dissolved solids (TDS), and dissolved oxygen (DO)) in situ using and pH meter and conductivity meter. DO was estimated as per the standard method means Wrinkles methods (APHA 2012). The zooplankton sampling was carried out by filtering 50 L of water through a planktonic net and was placed in 20 ml plastic vials to which 4% formalin was added for preservation. The preserved zooplankton samples were scanned under compound microscope in the laboratory at magnifications of 75x to 300x and were further identified using the taxonomic keys Tenenbaum, *et al.* (2004).

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RESULT AND DISCUSSION

Water quality data of the selected Somalapura water tank were showed in the Table 1. The surface water temperatures recorded during the study period was between the range from 25.20(± 1.21)^{0}C at Somalapura tank during Winter Season to 28.90 (±1.38)^{0}C during monsoon. The maximum temperature was observed during monsoon the study period while the minimum was found during winter season. Yadav *et al.* (2013), Niroula *et al*. (2010) observations at urban ponds are agreement with the current results. The pH value of the selected water tank in and around the Hosapete city during the study period was in between 7.24 (± 0.29) at Somalapura water tank during the summer season to 8.02 (± 0.52) during monsoon at Somalapura water tank. In the present study Somalapura water tank showing the maximum value of pH and were slightly higher towards alkaline range, it is extremely acidic during monsoon season.

In this present investigation dissolved oxygen concentration of the selected water tanks in and around the Hosapete city was varied from 8.60 (± 2.89) mg/l during winter to 6.10 (± 1.68) mg/l during monsoon at Somalapura water tank. From the present study the results area revealed that and was noticed that the monsoon rain play key role in seasonal dynamics of studied physicochemical properties of the water samples. The runoff water during the rainy season carried large amount of organic matter in the form of community and home waste to the selected water tanks in and around the Hosapete city. As the runoff water were rich in clay, silt and colloidal organic matter which also attributed for excessive plankton growth and thus increase turbidity during monsoon season (Radhika et al. 2004, Pathak and Limaye, 2012 and Dhanalakshmi et al. 2013). Total dissolved solids (TDS) was varied 198.6 (± 3.84) at Somalapura water tank during monsoon season to 139.2 (± 2.36) mg/l during summer season. The highest value was recorded during monsoon and the lowest was observed during summer season period. Raised ionic concentration due to nutrient deposition and organic pollution attributed highest electrical conductivity (Fokmare and Musaddique, 2001). In the present study TDS was higher during High during monsoon since TDS and EC are most correlated. Water temperature could raise the rate of microbial decomposition of the rain water carried organic load resulting reduction of dissolved oxygen content in water sample (Hulyal and Kaliwal, 2011; Ramulu and Benarjee, 2013) and on the other hand. (Dhanalakshmi, et al., 2013) particularly during monsoon.

STATISTICAL ANALYSIS

The statistical analysis of Pearson's correlation coefficient is presented in the Table 2. The surface water temperature was significantly positively correlated with total dissolved solids and temperature. On the other hand, surface water temperature showed strict negative relation pH in water tanks in all the selected water tanks also. The pH showed significant negative correlation with temperature and dissolved oxygen during the entire study period and all the selected water tanks in and around the Hosapete city. Dissolved oxygen has positive correlation with temperature and showed negative correlation with pH. Due to the accelerated microbial decomposing activity the requirement of oxygen was increased (Mwebaza-Nadwula, *et al.,* 2005) resulting lower value of DO during monsoon season. Runoff from the surrounding human settlement consisting domestic sewage rich in organic matters was the main cause of nutrient enrichment of the selected water tanks in and around the Hosapete city (Verma *et al.*, 2012).

ZOOPLANKTON STUDY

A total of 14 genera of zooplankton individuals were collected in the present study. Of these, the most abundant taxon was Rotifera (5 or 35.71%), which was distantly followed by Cladosera (3 or 24.420%), Copepoda (3 or 21.42%) and finally Ostracoda (2 or 14.28%). The relative abundance of the major taxa of phytoplankton are presented in Table 4 alongside that of species (Table 3). Somalapura – 1 (K1) showed a maximum species compared to other two (Somalapura-II and III) location suring the study period. At Somalapura-II and III also the Rotifera (72% and 57%) were dominant followed by Cladosera (30% and 25%), Copepoda (20% and 25%) and Ostrocoda (10% and 12.5%). In the current study, at Somalapura water tank, the occurrence of *Brachionus sp., Conochilus sp., Plationus sp., Daphnia sp., Alonella sp., Moina sp., Cyclops sp., Heliodiapt omus sp., Cyprinotus sp.,* was indicating pollutants of organic and biological origin. The current study agreed with the observation of Gadag et al. (2005). The pollution level was observed to increase in the Somalapura water tank in Hosapete city onwards as it was confirmed by using Shannon-Weaver index (Table 3). The abundance of *Daphnia sp., Alonella sp., Moina sp., Cyclops sp., Heliodiapt omus sp.,* were maximum at Somalapura water tank this indicating the highest degree of organic pollution. Unpolluted Somalapura (K3) is slightly characterized by abundance of Rotifera species followed by cladocera and Copepoda, as it was supported by earlier workers (More and Nandan, 2000; Nandan and Aher, 2005; Tas and Gonulal, 2007).

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Distribution of zooplankton depends partly upon the aquatic environment, their requirements and their range of tolerance. The organisms with many requirements and a limited range of tolerance are very narrowly distributed and usually rare (Amphorn Sakset and Wanninee Chankaew, 2013). The distribution of zooplankton may explain disparities in Frequency in the present study. Among the zooplanktons, 14 (100%) occurred in Tank-I (K1) (See Table 4). The various zooplankton taxa presented different presence performances: most species in the Rotifera class showed presence in all the selected locations of Somalapura water tank the trends with the Tank 1 - K1 (14), Tank II – K2 (10) andf Tank III – K2 (8). A study of dominance among the zooplankton taxa shows that the Rotifera, followed by the Cladocera, Copepoda and Ostrocoda were dominant during the study period in the Somalapura water tank of the Hosapete city. However we believe that the habitat suffers frequent variability, and according to Tiwari et al., (2006), conditions are not ideal for any one competing species and the competitive advantage swings from one species to another before the latter has had the opportunity to replace the former.

The seasonal variation of species diversity index in 4 studied sectors is given in Table 3. The index is based on the principle that in clean water, the species diversity is high while, in polluted water the diversity becomes low. The Shannon-Weaver diversity index proposed as diversity index greater than (>4) is clean water; between 3-4 is mildly polluted water; between 2-3 is moderately polluted water and less than 2(<2) is heavily polluted water. The index computed in the present analysis showed that zooplankton species diversity ranged from 2.188 in Tank I (K1) location water representing moderately polluted water (medium the Shannon- Weaver index medium level of pollution), 2.924 in Tank III (K3) water indicating mildly polluted water and 4.285 in Tank III (K3) water indication slightly polluted water in Somalapura lake.

CONCLUSION

In the present investigation, based on physico-chemical parameters and zooplankton load was higher at Tank – I (K1) and Tank – II (K2). Hence, Shannon-Weaver index values observed to be lower (Table 3) in Tank – I (K1) and Tank – II (K2) water tank. The index was maximum at Tank – III (K3) location, since the water is slightly due to absence of human anthropogenic activities near this location. Comparatively, Tank-II (K2) location showing is mildly polluted when compared to Tank-I (K1) and Tank –II (K2) location because of there is no human activity near and around these locations.

It is summarized from the results that Somalapura water tank in the Hosapete city, which are the most productive water tanks. The results show that the improvement of diversity index from Somalapura water tank, was due to the decline in pollution level. The findings of this investigation clearly revealed that in respect to domestic waste and human activity the pollution, zooplankton perhaps were more tolerant to pollution. The study emphasizes the necessity of using zooplankton as effective and appropriate method of biomonitoring for evaluation of lentic water quality.

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No conflict for interest

Table 1. Mean Value of seasonal variation in Physico-chemical Parameters of Somalapura water

Parameters	IS Standards	Summer Season		
		Tank – I (K1)	Tank – II (K2)	Tank – III (K3)
Temperature (^{O}C)		26.81 ± 0.05	26.90 ± 0.05	26.20 ± 0.11
pH	6.5 – 8.5	7.89 ± 0.02	7.92 ± 0.02	7.24 ± 0.03
TDS (ppm)	1000	145.6 ±5.84	148.5±0.69	139.2±1.36
DO (ppm) minimum	5.0	7.1±0.09	7.3±0.02	7.8±0.03
		Winter Season		
Temperature (^{O}C)		25.01 ± 0.05	26.90 ± 0.05	25.20 ± 0.11
pH	6.5 – 8.5	7.56 ± 0.02	7.32 ± 0.02	7.96 ± 0.03
TDS (ppm)	1000	165.6 ±5.84	171.5±0.69	151.2±1.36
DO (ppm) minimum	5.0	8.1±0.09	8.3±0.02	8.6±0.03
		Monsoon Season		
Temperature (^{O}C)		27.08 ± 0.05	28.90 ± 0.05	27.20 ± 0.11
pH	6.5 – 8.5	8.01 ± 0.02	8.02 ± 0.02	7.96 ± 0.03
TDS (ppm)	1000	198.6 ±5.84	156.5±0.69	161.2±1.36
DO (ppm) minimum	5.0	6.1±0.09	6.3±0.02	6.8±0.03

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Table 2 Correlation sigificance between selectd physico-chemical variables

	Tank – I (K1)				Tank – II (K2)				Tank – III (K3)			
	pH	**DO**	**Temp.,**	**TDS**	**pH**	**DO**	**Temp.,**	**TDS**	**pH**	**DO**	**Temp.,**	**TDS**
pH	1.00				1.00				1.00			
DO	-0.08	1.00			-0.09	1.00			-0.06	1.00		
Temp.,	-0.48	0.69	1.00		-0.56	0.70	1.00		-0.51	0.71	1.00	
TDS	0.86	-0.72	0.61	1.00	0.79	-0.68	0.70	1.00	0.82	-0.58	0.59	1.00

Note: in bold correlation is significant at the level (2 tailed)

Table 3 Phytoplankton Diversity of selected water tanks in and around the Hosapete city

Locations in and around the Hospet City			
	Kampali Tank - I	**Kampali Tank – II**	**Kampali Tank - III**
Zooplankton diversity	**Rotifera** Brachionus sp. Conochilus sp. Polyarthra sp Filinia sp. Plationus sp.. **Cladosera** Daphnia sp Alonella sp Diaphanos oma sp. Moina sp. **Copepoda** Cyclops sp. Nauplius sp. Heliodiapt omus sp **Ostracoda** Cypris sp Cyprinotus sp	**Rotifera** Brachionus sp. Conochilus sp. Filinia sp. Plationus sp. **Cladosera** Daphnia sp Alonella sp Moina sp. **Copepoda** Cyclops sp. Heliodiapt omus sp **Ostracoda** Cyprinotus sp.	**Rotifera** Conochilus sp. Polyarthra sp Plationus sp.. **Cladosera** Alonella sp Diaphanos oma sp. **Copepoda** Nauplius sp. Heliodiapt omus sp **Ostracoda** Cypris sp

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DO (ppm) minimum	5.0	7.1±0.09	7.3±0.02	7.8±0.03
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		Monsoon Season		
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pH	1.00				1.00				1.00			
DO	-0.08	1.00			-0.09	1.00			-0.06	1.00		
Temp.,	-0.48	0.69	1.00		-0.56	0.70	1.00		-0.51	0.71	1.00	
TDS	0.86	-0.72	0.61	1.00	0.79	-0.68	0.70	1.00	0.82	-0.58	0.59	1.00

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Table 4 Percentage presence of Phytoplankton Diversity in and around the Hosapete city

Frequency %	Total count	Rotifera	Cladosera	Copepoda	Ostracoda
Tank – I (K1)	14 (100.0%)	5 (35.71%)	4(28.057%)	3 (21.43%)	2(14.28%)
Tank – II (K2)	10 (72.0%)	4 (40.0%)	3 (30.0%)	2 (20.0 %)	1 (10.0 %)
Tank – III (K3)	08 (57.0%)	3 (37.5%)	2 (25.0%)	2(25.0%)	1 (12.5%)
	14	5 (35.71%)	3(21.42%)	3(21.42%)	2(14.28%)

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