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REVIEW ARTICLE

CYCLICAL DISSIMILARITIES IN ZOOPLANKTON STRUCTURE OF SOME SELECTED LENTIC HABITATS IN AND AROUND HOSPET CITY, KARNATAKA (INDIA)

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ABSTRACT

This study focuses on seasonal dissimilarities of zooplankton structure of selected lentic habitats in and around the Hospet city, Karnataka state. Three lentic habitats were identified and sampling was done in the identified four location of the selected water tanks and assessed for its water quality status based on its physico-chemical parameters (temperature, pH, total dissolved solids, hardness, calcium, phosphate, nitrate and dissolved oxygen), during February 2015 to January 2016. A total of 16 species belonging to four groups of zooplankton like 4 protozoan, 4 rotifera, 3 cladocera and 3 copepodain the present study. The physico-chemical parameters of water were compared with standard values recommended by BIS and WHO. Significant correlation in water quality and zooplankton abundance were observed in different seasons. In the present study, the total zooplankton population was low in summer, moderate in pre monsoon, monsoon and high in post- monsoon. The zooplankton structure was more in the Daroji water tank to the lowest at Kampli tank water then Somalapura water tank. Zooplankton populations have shown positive correlation with all the physico-chemical parameters in pre-monsoon, except pH (-0.8686).

INTRODUCTION

Surface water is one of the abundantly available substance in nature comparatively ground water during different seasons.Surface water is main source for all the animals and vegetable matter including human beings and forms about 75% of the matter of earth's crust. Hydrological cycle is mainly involved between air and water. 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). Beginning with 1970s, in some of the countries were built the many reservoir for water supply hence the reservoirs are the main source for energy generation and also food chain. Currently some of the surface water tanks were suffer from eutrophication problems with an increase in macrophytes being one of the most severe problems (Rolda´ n 2003). Zooplankton species are play a role in cycling of carbon and elements in the biological cycling in the surface water bodies. Based on the environmental conditions zooplankton dynamics and the mechanisms driving their variability are highly susceptible during different seasonal variations, especially in low laying water, semi-enclosed barks with heavily populated coastal areas where increased anthropogenic nutrient input severely affects marine communities (Marcus, 2004 and Suresh *et al.,* 2009). In the food chain zooplanktons plays as role since zooplankton provides nutrients, proteins, fats, carbohydrates and mineral salts to fish which are depending upon the zooplankton species (Guy, 1992). Presence of zooplankton in the surface water is depending upon the availability of nutrients and climatic conditions along with physico-chemical parameters, season, water depth and vegetation cover (Neves *et al.,* 2013). Sinha and Islam (2002) and Park and Shin (2007) explained in their study, most of the species of phytoplankton and zooplankton organisms are cosmopolitan distribution. ecologically, zooplankton are one of the most important biotic components influencing all the functional aspects of an aquatic system, such as food chain, food webs, energy flow and cycling of nutrient which is present in the form of organic matter and also called as human.

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.

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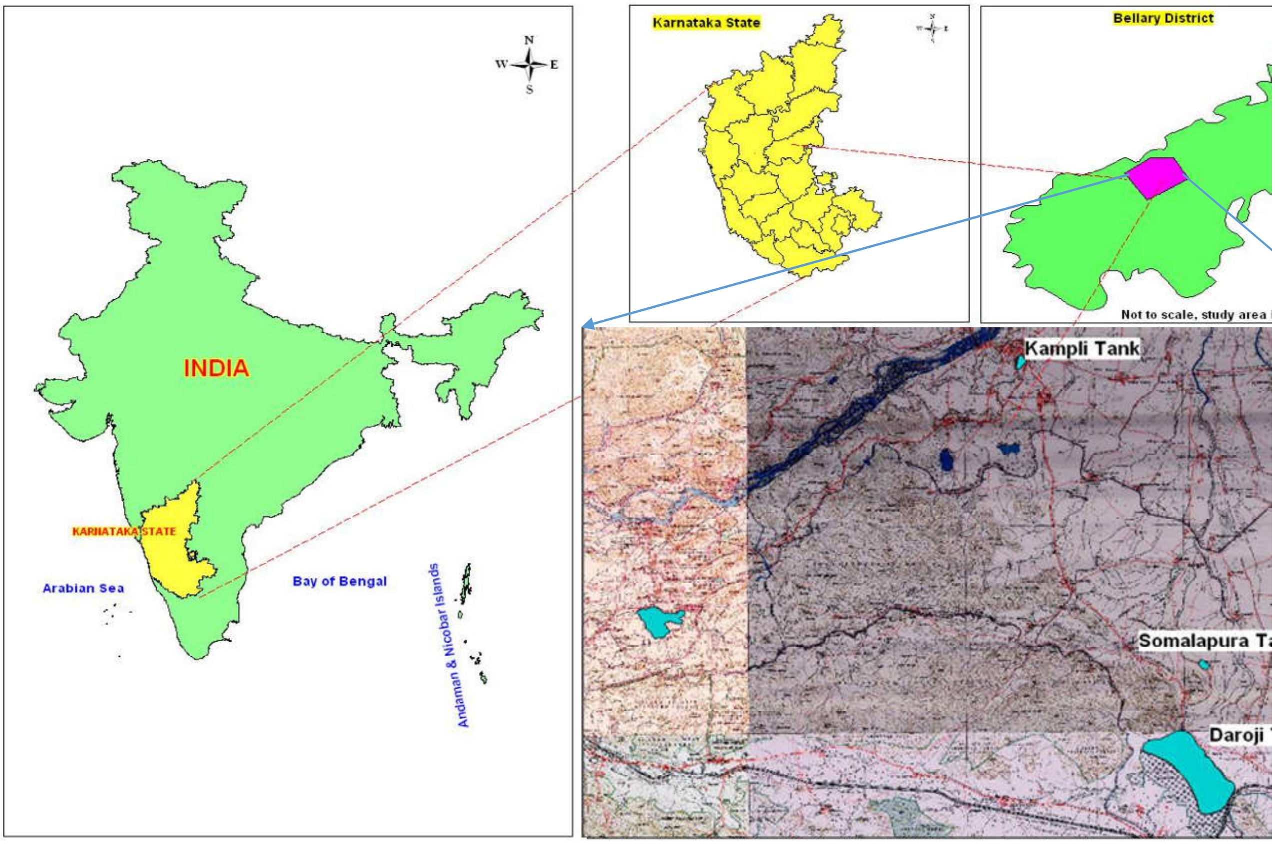

Figure 1. Location Map of the study area

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 (Rajashekar *et al.,* 2009). The main objectives of the study are: collection of zooplankton samples using plankton netand using plastic can for physico-chemical parameters at three different water tank in the Hospet city of Karnataka state. The present paper reports influence of physico-chemical parameters on abundance of zooplankton populations in selected water tanks. As per literature, no work have so far neither been done in enumerating zooplankton in the selected water tanks in and around the Hospet city. The present attempt made an endeavor to appraise the water quality parameters and to assess pollution status of the selected water tanks using zooplankton.

MATERIALS AND METHODS

Topography of the study area

Hospet is a town head quarter situated 66 Kms away from Ballary 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 Hospet 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 2005 and a minimum of 361.9 mm in the year 2003. The normal rainfall of the study area is 656.70 mm.

Kampli tank

It is a natural, perennial fresh water tank situated in the Hospet city and located 35 km away from Hospet. The water tank lies at $15^{0}.30^{1}$ N latitude and $76^{0}.6^{1}$ E longitude. The area of the tankis 20 acres and depth is about 8 feet. The colour of the tank is pale greenish. The tank is rectangular in shape. The Kampli 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.

Daroji tank

It is artificial perennial tank. This tank lies at $15^{0}.24^{1}$ N latitude and $76^{0}.7^{1}$E longitude. The area of the tank is 92 acres and depth is about 18 feet. Daroji tank is situated 20 kms away from Hospet town to northern region. The tank is rectangular in shape and it receives water from rainfall. The water is used for irrigation and pisciculture purposes. The colour of the tank is pale reddish. Anthropogenic activities are practiced in the vicinity of the tank. The water is used to grow paddy, sugarcane jutes and vegetables. The catchment area received an average rainfall of 656.70 mm (Irrigation Department, 2004-05).

Somalapura tank

It is a natural perennial tank situated 18 Kms away from Hospet to western side. This tank is located at $15^0.31^{'}$ N latitude and $76^0.8^{|}$E longitude. The area of the tank is 12 acres and depth is 6 feet. The colour of the water is pale greenish. The shape of the tank is circular. Main source of water to this tank is rainfall and seepage from hilly region. Water is used for drinking and irrigation. Paddy, sugarcane, cotton and vegetables are grown on the adjacent side of this tank. The average rainfall of this region is 656.70 mm (Irrigation Department, 2004-05).

Methods

The water samples for physico-chemical as well as phytoplankton analysis were collected at monthly interval for a year from February 2015 to January 2016 from three collection points taking randomly at the water tanks. 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 parameters (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). Zooplankton samples were collected from three water tanks of Gulbarga district between 6 A.M. and 9 A.M. The collection was made during the period of February 2015 to January 2016. 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 (Rajashekar *et al.,* (2009).

RESULTS AND DISCUSSION

Water quality data of the selected Kampli, Daroji and Somalapura water tanks were showed in the Table 1. The surface water temperatures recorded during the study period was between the ranges from 25.01 ^{0}Cat Kampli lentic habitat during Winter Season to 28.90^{0}C during monsoon at Darojilentic habitat. The maximum temperature was observed during monsoon the study period while the minimum was found during winter season. Vijaykumar (1991), 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 Hospet cityduringthe study period was in between 7.24 at Somalapuralentic habitat during the summer season to 8.02during monsoon at Doroji lentic habitat. In the present study Darojilentic habitat showing the maximum value of pH and were slightly higher towards alkalinerange, it is extremely acidic during monsoon season. In this present investigation dissolved oxygen concentration of the selected lentic habitats in and around the Hospet city was varied from 8.60 mg/l during winter at Somalapura lentic habitat to 6.10 mg/l during monsoon at Kampli lentic habitat. 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 Hospet 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 (Reddy Radha Krishna *et al.,* 2012 and Dhanalakshmi, et al. 2013).3

Table 1. Mean Value of seasonal variation in Physico-chemical Parameters of three water tanks in and around the Hospet city

Parameters	Location in and around the Hospet City Summer Season		
	Kampali Tank	Daroji Tank	Somalapura Tank
Temperature (^{O}C)	26.81	26.90	26.20
pH	7.89	7.92	7.24
TDS (ppm)	145.6	148.5	139.2
DO (ppm)	7.1	7.3	7.8
Hardness (ppm)	124.0	138.0	118.0
Calcium (ppm)	62.00	73.00	69.00
Parameters	Location in and around the Hospet City Winter Season		
	Kampali Tank	Daroji Tank	Somalapura Tank
Temperature (^{O}C)	25.01	26.90	25.20
pH	7.56	7.32	7.96
TDS (ppm)	165.6	171.5	151.2
DO (ppm)	8.1	8.3	8.6
Hardness (ppm)	122.0	129.0	109.0
Calcium (ppm)	56.0	61.0	58.0
Parameters	Location in and around the Hospet City Monsoon Season		
	Kampali Tank	Daroji Tank	Somalapura Tank
Temperature (^{O}C)	27.08	28.90	27.20
pH	8.01	8.02	7.96
TDS (ppm)	198.6	156.5	161.2
DO (ppm)	6.1	6.3	6.8
Hardness (ppm)	142.0	138.0	159.0
Calcium (ppm)	52.0	49.0	51.0

Total dissolved solids (TDS) was varied 198.6 ppm at Kamplilentic habitat during monsoon season to 139.2 ppm during summer season at Somalapuralentic habitat. The highest value was recorded during monsoon and the lowest was observed during summer season period. Raised ionicconcentration due to nutrient deposition and organic pollution attributed highest electrical conductivity (Beenamma Joseph *et al.,* 2011). 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 rainwater carried organic load resulting reduction of dissolved oxygen content in water sample (Hulyal andKaliwal, 2011; Ramulu and Benarjee, 2013) and on the other hand. (Dhanalakshmi *et al.,* 2013) particularly during monsoon. Calcium values ranging from 49.0 to 73.0 ppm. All the samples are in permissible limit. Calcium and magnesium contribute temporary hardness to the water and it imparts unpleasant odor. As per BIS max permissible limit for water calcium is up to 75 ppm. The values of hardness ranged from 122.0 ppm to 159.0 ppm at Kampli and somalapura lentic habitat respectively. The values are not much higher when compared with permissible limit. As per BIS maximum permissible limit of hardness was up to 300 ppm. Total hardens in the present within the permissible limit of BIS.

Zooplankton structure

The mean (data collected at 3 different lentic habitats for 1 year, i.e., 12 months) of 36 samples of rotifer, cladoceran, copepod and protozoans zooplankton groups recorded from the Kampli, Doroji and Somalapura lentic habitats in Hospet Taluk are shown in the Table.1and Figure 1. The mean abundance of rotifers recorded was 125 Org/L.More seasonal variation of abundance of rotifers (SD=9.39) were noticed. However, maximum abundance of rotifers (66 Org/L) were noticed in the Somalapura lentic habitat and minimum (22 Org/L) in the Kampli lentic habitat. However, the abundance of rotifers show correlation with the water quality parameters (Table 3 to 5). This may be due to their special characteristic, i.e., less specialized feeding and frequent parthenogenetic reproduction which isfavoured in unstable and eutrophic environments. The results obtained in this study are similar to the study of Rocha and Sendacz Matsumura- Tundisi (1995) who made limnological studies of two lentic water body and reported that the dissimilarity of rotifer were more in winter season and less abundant during rainy season. Present study also reveals the same trend of dissimilarities.

The mean abundance of cladocerans recorded was 101 Org/L (Table.2). Seasonally the variation of dissimilarities of cladocerans (SD=6.19) were noticed during study period. However, maximum abundance of cladocerans (53 Org/L) were noticed in the Doroji lentic habitat and minimum (18 Org/L) in Kampli lentic habitat. The cladocerans showed significant positive correlation only with pH and negative correlation with hardness and calcium. In the present investigation, the regression analysis revealed that 53% of the variation in the abundance of cladocerans was due to pH in all the three lentic habitats. Yousuf and Quadri (1985) reported the seasonal fluctuation of zooplankton in lake Manasbal, Kashmir, State of India and reported that the abundance of Cladocerans were more during rainy season, and lowest during summer seasons. Present study reveals same trend of zooplankton abundance during summer. Author, Kiran et al. (2007) have supported the present study and studied the diversity and seasonal fluctuations of zooplankton in a fish pond of Bhadra, Shankaraghatta, Karnataka. The copepods constitute dominant planktonic group of both freshwater and marine habitats. It includes three groups viz., Mesocyclop, Heliodiaptomus, cyclops and Diaptomus. It is interesting and noteworthy to record that Diaptomus zooplankton groups were completely absent in two lentic habitat during summer season in Kampli and Somalapura lentic habitats. In the present study it is observed that the pH value of surface water varies between 7.04 and 8.02. Many surface water supports extensive algal blooms particularly when pH exceeds 8.0.

Algae use carbon dioxide in their photosynthetic activity, and its removal is responsible for such a high pH as reported by Purandara et al. (2003). Thus, this algae makes very little provision for the abundance of sensitive zooplankton groups and it is probably toxic to Cyclops, Hence, in this study only Cyclops-copepods were noticed. The copepods described here include only the abundance of Cyclopoid-copepods. The mean abundance of copepods recorded was52 Org/L (Table 3 to 5).Seasonally (SD=6.0) of abundance of copepods were noticed. Maximum abundance of copepods (27 Org l-1) were noticed in the month of April 2009 and minimum (15 Org l-1) in August 2009. The abundance of Cyclopoid – copepods showed significant positive correlation with pH and they also showed significant negative correlation with turbidity, phosphate and nitrate. The regression analysis revealed that 55% of the cyclopoids were positively controlled by pH. Moreover, other water quality parameters such as nitrate, turbidity and phosphate also affected, but negatively, in deciding the abundance of Cyclopoids. Thus, it is notworthy that, when concentration of nitrate, phosphate and turbidity was more, the abundance of Cyclopoid were less (Table 3, 5). On the basis of the results presented in Table 2, it can be easily elucidate that the changes have occurred in the total zooplankton composition in all the three lentic habitats. A total of 17zooplankton individuals were identified in the present study. Of these, the most abundant taxon was Protozoan (4), which was distantly followed by rotifer (4), cladocera (5) and finally copepod (4). The relative abundance of the major taxa of zooplankton are presented in Table 2 alongside that of species. Among rotifer group maximum (21) species were identified during winter season, while in the cladocera species (29), copepod (7) and protozoan (16)were recorded.The zooplankton composition and abundance mean values are shown in Table 1. Zooplankton recorded was represented by four groups'protozoa, rotifera, cladocera and copepoda. *Protozoa* was represented by *Amoeba, Vorticella, Paramecium* and *Diffugia.* Rotifera includes *Brachionus, Filinia, Asplanchna* and *Keratella.* Cladocerarepresentedby *Daphnia, Moina, Chydorus, Cypris*and*Calanus.* Copepodsinclude *Mesocyclop, Heliodiaptomus, Cyclops*and *Diaptomus*. The present investigation provides the evidences for the changes in the structure of zooplankton (Table 1). The total zooplankton composition has significantly changed in all three selected lentic habitat in the Hospet taluk (Table 2). During the study period the tanks were recorded total 31 species. The condition of kampli and Somalapura lentic habitats are found similar (Table 2). Eutrophication leads to the changes instructure [20]. A similar trend was also reported by [23] while studying Grosnicareservoir (Serbia, Yugoslavia). According toHarshey *et al.,* (1987), Sampaio *et al.,* 2002) living organism population respond to pollution or to eutrophication in three main expectations. First one is nutrients alters but community structure (species composition and relative abundance) does not. Second one is species remain the same but relative abundances alter and biomass may alter and third one is species composition and relative abundance alter and biomass may alter. Water tank Daroji lentic habitat gradually losing its catchment area by increasing urbanization and due to pollution loading changes in the composition of zooplankton. Rotifers areprominent group among the zooplankton of alentic habitat irrespective of its trophic status. This may be due to theless specialized feeding, parthenogenetic reproduction and high fecundity (Sampaio *et al.,* 2002).

Among the zooplankton rotifers respond more quickly to the environmental changes and used as a change in water quality (Gannon and Stemberger, 1978). Rotiferadiversity is effected in all threeselected lentic habitats. Daroji water tank reveals that the drastic change in the rotifera composition due to the disappearance of 10 species (Table 1). Sladecek (1983) reported that the Triclocerca similes, T. ruttus, T. cylindricaland T. longiseta are present in oligotrophic conditions. Due to the continues inflow of nutrients from the surroundings, the lake reached eutrophication state and sensitive species are disappeared from the lake. While in Somalapura lentic habitat all Triclocerca species were absent except the T. cylindrical. This lake was bigger lake but in course of time increase the development activities surrounding the lake it has become smaller and its water volume is come down. Therefore may species have been disappeared form the lake and similar results are investigated in Kampli lentic habitat.

Table 2. Seasonal variation in abundance of zooplankton (no/L) in selected three lentic habitat

Organisms	Monsoon			Winter			Summer		
Protozoan	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura
Amoeba	2	3	1	3	5	2	1	1	1
Vorticella	3	2	3	5	4	4	2	1	0
Paramecium	4	5	2	4	4	3	1	2	2
D-Diffugia	3	4	2	3	3	2	0	1	1
Total	12	14	8	15	16	11	4	5	4
SD	0.816	1.291	0.816	0.957	0.816	0.957	0.816	0.500	0.816
Percentage	25.00	27.45	20.51	23.08	21.92	20.75	21.05	20.00	22.22
Rotifera	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura
Brachionus	3	3	2	5	5	5	2	1	1
Filinia	2	4	3	4	4	6	1	2	2
Asplanchna	4	4	4	5	4	4	2	2	2
Keratella	6	5	5	4	8	3	2	3	2
SD	1.708	0.816	1.291	0.577	1.893	1.291	0.500	0.816	0.500
Total	15	16	14	18	21	18	7	8	7
Percentage	31.25	31.37	35.90	27.69	28.77	33.96	36.84	32.00	38.89
Cladocera	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura
Daphina	3	4	3	4	5	5	1	2	1
Moina	3	3	2	6	6	4	2	1	0
Chydorus	2	3	3	5	7	3	1	1	2
Cypris	3	3	2	4	5	4	1	2	1
Calanus	2	4	3	7	6	4	1	1	1
SD	0.548	0.548	0.548	1.304	0.837	0.707	0.447	0.548	0.707
Total	13	17	13	26	29	20	6	7	5
Percentage	27.08	33.33	33.33	40.00	39.73	37.74	31.58	28.00	27.78
Copepoda	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura	Kampli	Doroji	Somalapura
Mesocyclop	1	1	1	2	2	1	1	1	1
Heliodiaptomus	2	0	0	1	1	0	0	2	0
Cyclops	3	2	1	2	2	2	1	1	1
Diaptomus	2	1	2	1	2	1	0	1	0
SD	0.816	0.816	0.816	0.577	0.500	0.816	0.577	0.500	0.577
Total	8	4	4	6	7	4	2	5	2
Percentage	16.67	7.84	10.26	9.23	9.59	7.55	10.53	20.00	11.11
Grand Total	48	51	39	65	73	53	19	25	18

Table 3. Zooplankton Diversity of selected lentic habitat in and around the Hospet city during the study period

Locations in and around the Hospet City			
Protozoan	Rotifera	Cladocera	Copepopoda
Amoeba	*Brachionus*	*Cladocera*	*Mesocyclop*
Vorticella	*Filinia*	*Daphina*	*Heliodiaptomus*
Paramecium	*Asplanchna*	*Moina*	*Cyclops*
D-Diffugia	*Keratella*	*Chydorus*	*Diaptomus*
		Cypris	

Table 3. Correlation sigificance between selectd physico-chemical paremetrs and Zooplankton during Summer

	Amoeba	Vorticella	Paramecium	D-Diffugia	Brachionus	Filinia	Asplanchna	Keratella	Daphina	Moina	Chydorus	Cypris	Calanus	Mesocyclop	Heliodiaptomus	Cyclops	Diaptomus	Temp	pH	TDS	DO	Hardness	Calcium
Amoeba	1.00																						
Vorticella	0.60	1.00																					
Paramecium	0.76	0.48	1.00																				
D-Diffugia	0.71	0.52	0.97	1.00																			
Brachionus	0.77	0.91	0.63	0.59	1.00																		
Filinia	0.53	0.63	0.55	0.57	0.78	1.00																	
Asplanchna	0.61	0.86	0.75	0.83	0.80	0.69	1.00																
Keratella	0.77	0.50	0.67	0.73	0.49	0.28	0.62	1.00															
Daphina	0.77	0.79	0.74	0.76	0.88	0.89	0.83	0.65	1.00														
Moina	0.84	0.92	0.64	0.62	0.95	0.63	0.80	0.61	0.83	1.00													
Chydorus	0.90	0.69	0.59	0.61	0.78	0.59	0.69	0.72	0.76	0.85	1.00												
Cypris	0.87	0.81	0.75	0.72	0.92	0.77	0.78	0.70	0.95	0.91	0.83	1.00											
Calanus	0.81	0.84	0.68	0.70	0.88	0.72	0.85	0.55	0.83	0.93	0.90	0.86	1.00										
Mesocyclop	0.78	0.66	0.43	0.40	0.68	0.33	0.53	0.51	0.51	0.83	0.88	0.70	0.84	1.00									
Heliodiaptomus	0.14	0.09	0.22	0.15	0.00	-0.25	0.04	0.34	0.03	0.14	0.00	0.24	-0.02	0.22	1.00								
Cyclops	0.56	0.56	0.80	0.74	0.64	0.38	0.68	0.59	0.61	0.60	0.37	0.68	0.45	0.27	0.41	1.00							
Diaptomus	0.46	0.54	0.48	0.62	0.39	0.30	0.64	0.87	0.61	0.47	0.50	0.60	0.42	0.28	0.43	0.53	1.00						
Temp (^{O}C)	0.06	-0.41	0.23	0.29	-0.39	-0.29	-0.13	0.35	-0.11	-0.29	-0.17	-0.21	-0.26	-0.36	-0.03	0.01	0.20	1.00					
pH	-0.37	0.06	0.01	0.07	-0.12	0.02	0.10	-0.08	0.05	-0.16	-0.52	-0.13	-0.27	-0.60	0.07	0.17	0.21	0.36	1.00				
TDS (ppm)	0.43	0.52	0.58	0.61	0.40	0.05	0.61	0.75	0.41	0.48	0.33	0.51	0.32	0.28	0.59	0.83	0.78	0.12	0.19	1.00			
DO (ppm)	0.30	0.34	-0.11	-0.18	0.50	0.53	0.07	-0.14	0.34	0.40	0.49	0.42	0.44	0.53	-0.17	-0.15	-0.19	-0.77	-0.59	-0.37	1.00		
Hardness (ppm)	-0.14	-0.09	0.04	0.22	-0.38	-0.33	0.13	0.44	-0.09	-0.21	-0.10	-0.18	-0.16	-0.21	0.24	-0.05	0.61	0.64	0.42	0.40	-0.73	1.00	
Calcium (ppm)	-0.29	-0.54	-0.58	-0.70	-0.43	-0.37	-0.77	-0.49	-0.51	-0.42	-0.28	-0.35	-0.44	-0.03	0.23	-0.56	-0.51	-0.31	-0.45	-0.55	0.44	-0.39	1.00

Table 4. Correlation sigificance between selectd physico-chemical paremetrs and Zooplankton during Winter

	Amoeba	Vorticella	Paramecium	D-Diffugia	Brachionus	Filinia	Asplanchna	Keratella	Daphina	Moina	Chydorus	Cypris	Calanus	Mesocyclop	Heliodiaptomus	Cyclops	Diaptomus	Temp	pH	TDS	DO	Hardness	Calcium
Amoeba	1.00																						
Vorticella	0.60	1.00																					
Paramecium	0.76	0.48	1.00																				
D-Diffugia	0.71	0.52	0.97	1.00																			
Brachionus	0.77	0.91	0.63	0.59	1.00																		
Filinia	0.53	0.63	0.55	0.57	0.78	1.00																	
Asplanchna	0.61	0.86	0.75	0.83	0.80	0.69	1.00																
Keratella	0.77	0.50	0.67	0.73	0.49	0.28	0.62	1.00															
Daphina	0.77	0.79	0.74	0.76	0.88	0.89	0.83	0.65	1.00														
Moina	0.84	0.92	0.64	0.62	0.95	0.63	0.80	0.61	0.83	1.00													

Continue……………

Chydorus	0.90	0.69	0.59	0.61	0.78	0.59	0.69	0.72	0.76	0.85	1.00												
Cypris	0.87	0.81	0.75	0.72	0.92	0.77	0.78	0.70	0.95	0.91	0.83	1.00											
Calanus	0.81	0.84	0.68	0.70	0.88	0.72	0.85	0.55	0.83	0.93	0.90	0.86	1.00										
Mesocyclop	0.78	0.66	0.43	0.40	0.68	0.33	0.53	0.51	0.51	0.83	0.88	0.70	0.84	1.00									
Heliodiaptomus	0.14	0.09	0.22	0.15	0.00	-0.25	0.04	0.34	0.03	0.14	0.00	0.24	-0.02	0.22	1.00								
Cyclops	0.56	0.56	0.80	0.74	0.64	0.38	0.68	0.59	0.61	0.60	0.37	0.68	0.45	0.27	0.41	1.00							
Diaptomus	0.46	0.54	0.48	0.62	0.39	0.30	0.64	0.87	0.61	0.47	0.50	0.60	0.42	0.28	0.43	0.53	1.00						
Temp (^{O}C)	0.06	-0.41	0.23	0.29	-0.39	-0.29	-0.13	0.35	-0.11	-0.29	-0.17	-0.21	-0.26	-0.36	-0.03	0.01	0.20	1.00					
pH	-0.37	0.06	0.01	0.07	-0.12	0.02	0.10	-0.08	0.05	-0.16	-0.52	-0.13	-0.27	-0.60	0.07	0.17	0.21	0.36	1.00				
TDS (ppm)	0.43	0.52	0.58	0.61	0.40	0.05	0.61	0.75	0.41	0.48	0.33	0.51	0.32	0.28	0.59	0.83	0.78	0.12	0.19	1.00			
DO (ppm)	0.30	0.34	-0.11	-0.18	0.50	0.53	0.07	-0.14	0.34	0.40	0.49	0.42	0.44	0.53	-0.17	-0.15	-0.19	-0.77	-0.59	-0.37	1.00		
Hardness (ppm)	-0.14	-0.09	0.04	0.22	-0.38	-0.33	0.13	0.44	-0.09	-0.21	-0.10	-0.18	-0.16	-0.21	0.24	-0.05	0.61	0.64	0.42	0.40	-0.73	1.00	
Calcium (ppm)	-0.29	-0.54	-0.58	-0.70	-0.43	-0.37	-0.77	-0.49	-0.51	-0.42	-0.28	-0.35	-0.44	-0.03	0.23	-0.56	-0.51	-0.31	-0.45	-0.55	0.44	-0.39	1.00

Table 5. Correlation sigificance between selectd physico-chemical paremetrs and Zooplankton during Monsoon

	Amoeba	Vorticella	Paramecium	D-Diffugia	Brachionus	Filinia	Asplanchna	Keratella	Daphina	Moina	Chydorus	Cypris	Calanus	Mesocyclop	Heliodiaptomus	Cyclops	Diaptomus	Temp	pH	TDS	DO	Hardness	Calcium
Amoeba	1.00																						
Vorticella	0.60	1.00																					
Paramecium	0.76	0.48	1.00																				
D-Diffugia	0.71	0.52	0.97	1.00																			
Brachionus	0.77	0.91	0.63	0.59	1.00																		
Filinia	0.53	0.63	0.55	0.57	0.78	1.00																	
Asplanchna	0.61	0.86	0.75	0.83	0.80	0.69	1.00																
Keratella	0.77	0.50	0.67	0.73	0.49	0.28	0.62	1.00															
Daphina	0.77	0.79	0.74	0.76	0.88	0.89	0.83	0.65	1.00														
Moina	0.84	0.92	0.64	0.62	0.95	0.63	0.80	0.61	0.83	1.00													
Chydorus	0.90	0.69	0.59	0.61	0.78	0.59	0.69	0.72	0.76	0.85	1.00												
Cypris	0.87	0.81	0.75	0.72	0.92	0.77	0.78	0.70	0.95	0.91	0.83	1.00											
Calanus	0.81	0.84	0.68	0.70	0.88	0.72	0.85	0.55	0.83	0.93	0.90	0.86	1.00										
Mesocyclop	0.78	0.66	0.43	0.40	0.68	0.33	0.53	0.51	0.51	0.83	0.88	0.70	0.84	1.00									
Heliodiaptomus	0.14	0.09	0.22	0.15	0.00	-0.25	0.04	0.34	0.03	0.14	0.00	0.24	-0.02	0.22	1.00								
Cyclops	0.56	0.56	0.80	0.74	0.64	0.38	0.68	0.59	0.61	0.60	0.37	0.68	0.45	0.27	0.41	1.00							
Diaptomus	0.46	0.54	0.48	0.62	0.39	0.30	0.64	0.87	0.61	0.47	0.50	0.60	0.42	0.28	0.43	0.53	1.00						
Temp (^{O}C)	0.06	-0.41	0.23	0.29	-0.39	-0.29	-0.13	0.35	-0.11	-0.29	-0.17	-0.21	-0.26	-0.36	-0.03	0.01	0.20	1.00					
pH	-0.37	0.06	0.01	0.07	-0.12	0.02	0.10	-0.08	0.05	-0.16	-0.52	-0.13	-0.27	-0.60	0.07	0.17	0.21	0.36	1.00				
TDS (ppm)	0.43	0.52	0.58	0.61	0.40	0.05	0.61	0.75	0.41	0.48	0.33	0.51	0.32	0.28	0.59	0.83	0.78	0.12	0.19	1.00			
DO (ppm)	0.30	0.34	-0.11	-0.18	0.50	0.53	0.07	-0.14	0.34	0.40	0.49	0.42	0.44	0.53	-0.17	-0.15	-0.19	-0.77	-0.59	-0.37	1.00		
Hardness (ppm)	-0.14	-0.09	0.04	0.22	-0.38	-0.33	0.13	0.44	-0.09	-0.21	-0.10	-0.18	-0.16	-0.21	0.24	-0.05	0.61	0.64	0.42	0.40	-0.73	1.00	
Calcium (ppm)	-0.29	-0.54	-0.58	-0.70	-0.43	-0.37	-0.77	-0.49	-0.51	-0.42	-0.28	-0.35	-0.44	-0.03	0.23	-0.56	-0.51	-0.31	-0.45	-0.55	0.44	-0.39	1.00

Distribution of plankton 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 (Mridula *et al.,* 2002). The distribution of zooplankton may explain disparities in Frequency in the present study. Among the zooplankton 13 species and 391 Org/L, further, 132 Org/L (33.76%) occurred in Kampli tank, 149 Org/L (38.10%) occurred in Daroji tank and 110 Org/L (28.23%) in Somalapura water tank (See Table 2). The various zooplankton taxa presented different presence performances: most species in the cladoceraclass showed presence in all the selected lentic habitat (38.46%), the trends with the protozoan, copepodes and rotifers were shown the same trends in all the lentic habitats and during the present study. A study of dominance among the zooplankton species shows that the cladocera, followed by the all other three are same trends but variation in the dominancy in the selected lentic habitat in and around the Hospet city. However we believe that the habitat suffers frequent variability, and according to Suresh *et al.,* (2009), indicated in their study, the zooplankton opulation dynamics might have been influenced by sand mining and other human activities in some selected stations of Tungabhadra River. Zooplankton depletion will adversely affect normal food web pattern of the river water and intern this leads destruction of environmental conditions of the river.

Statistical Analysis

The statistical analysis of Pearson's correlation coefficient is presented in the Tables 3 to 5. The surface water temperature was highly significantly positively correlated with only hardness other parameters are shown 0.61 in summer season and 0.64 in winter and monsoon seasons. On the other hand, most of the zooplankton species are showing positive correlation between the selected physico-chemical permeants in all the selected lentic habitats in and around the Hospet city. Due to the accelerated microbial decomposing activity the requirement of oxygen was increased (Anitha*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 Hospet city (Verma*et al.*, 2012).

Conclusion

In the present study, a total of 13 zooplankton were recorded, represented by four groups namely, protozoa, rotifera, cladocera and copepoda. *Protozoa* was represented by *Amoeba, Vorticella, Paramecium* and*Diffugia.* Rotifera includes *Brachionus, Filinia, Asplanchna* and *Keratella.* Cladocera represented by *Daphnia, Moina, Chydorus, Cypris* and *Calanus.* Copepodsinclude*Mesocyclop, Heliodiaptomus, Cyclops*and *Diaptomus*. Zooplankton populations have shown the surface water temperature was highly significantly positively correlated with only hardness other parameters are shown 0.61 in summer season and 0.64 in winter and monsoon seasons. It is summarized from the results that selected lentic habitat in and around the Hospet city, which are the most productive water tanks of Hospet city. Out of that Daroji lentic water tank shown high zooplankton species compared to other two lentic habitat viz., Kampli and Somalapura. The findings of this investigation clearly revealed that in respect to domestic waste and human activity the pollution, zooplankton perchance were more tolerant to pollution. The study emphasizes the necessity of using plankton as effective and appropriate method of biomonitoring for evaluation of river water quality.

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