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DIVERSITY AND SEASONAL VARIATIONS OF ZOOPLANKTON COMMUNITY IN KUNIGAL TANK, TUMKUR DISTRICT, KARNATAKA

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This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The limnological study is a pre-requisite in any aquatic system to evaluate its potentialities, to understand the realities between various water levels and food networks. Smaller water bodies like ponds, tanks are the important components of the landscape, are seriously threatened by climate change, eutrophication, and other anthropogenic activities Recently, Aquaculture is fast growing in many parts of India and in the world. Zooplanktons are the important component of the biotic habitat that influence the functional aspects and plays a key role in the food chain, nutrient recycling, and energy flow in the aquatic ecosystem. Zooplanktons are controlled by many factors, such as physico-chemical parameters, trophic status, pollution impact, and all kinds of interactions between biological communities. Members of the zooplankton's community are important for their role in energy transfer in trophic dynamics and water ecosystems. They provide food to fish in freshwater ponds and play a key role in lakes for fish production. Zooplankton diversity is one of the most important ecological parameters in water quality assessment. They are very sensitive to environmental changes and are therefore considered to be the potential indicators of water quality. The present investigation aims to study the zooplankton diversity for a period of two years from February 2014 to January 2016 in Kunigal tank to assess the species composition and seasonal variations of this faunal group. Diversity indices such as Shannon-Weiner Index and Simpson Index were calculated. On monthly basis, the water samples were collected from five sampling sites between 7 am to 9 am. 50 liters of water sample were collected, filtered through 60µm mesh size plankton net. The concentrated water sample was fixed and preserved in 4% formalin, one ml concentrated sample was transferred into Sedge-wick Rafter cell and counted under Olympus binocular microscope. Sample preserved in Lugol's solution was centrifuged, sample from pellet was observed under digital microscope and planktons were photographed. The results revealed the occurrence of 25 species of zooplanktons belonging to

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four groups - Rotifera, Cladocera, Copepoda and Ostracoda. Rotifera is represented by 10 species belonging to 6 genera, Cladocera- 8 species belonging to 6 genera, Copepoda -5 species belonging to 5 genera and Ostracoda - 2 species belonging to 2 genera. Rotifera is dominant followed by Cladocera, Copepoda and Ostracoda species. The percentage composition of zooplankton species was found as Rotifera > Cladocera > Copepoda > Ostracoda. Shannon-Weiner Index value of zooplanktons ranged between 2.0 - 3.0 and Simpson Index values between 0 and 1. Temperature was the main factor in the appearance and abundance of Rotifer species. Water temperature, dissolved oxygen, turbidity play an important role in controlling the diversity and density of Cladocerans. High population density of Copepoda during summer may be due to favourable temperature and availability of food. Maximum population density of Ostracoda during summer season may be due to water quality. Shannon-Weiner Index and Simpson Index values indicated the good diversity with less water pollution of the tank. This help in planning of successful fisheries management and to improve the productivity of the tank.

Keywords: *Physico-chemical parameters; zooplanktons; diversity; rotifera; Diversity indices; shannon-weiner index.*

1. INTRODUCTION

Biodiversity interprets the organisms of a variety of species in each habitat, which should be considered at all levels and has a range of genetic species, genera, and families, as well as the physical conditions under which they live [1]. The ecology of a lake can be studied through proper identification of freshwater species found in that lentic habitat. They constitute an integral part of the aquatic food web and contribute significantly to the biological productivity of the aquatic ecosystem [2]. Zooplankton plays a fundamental role in the flow of energy and nutrient cycling in the aquatic ecosystem. Its rapid growth rate can provide meaningful and quantifiable indication of ecological change in short and long-time scales [3]. The study of the composition, abundance and seasonal variations of zooplankton may be helpful in planning successful fisheries management [4]. They form an important link in the transformation of energy into the aquatic food web, as they are inherently active, have high density, high biodiversity, and tolerance to stress [5]. Zooplanktons belong to four major taxonomic groups, namely Rotifera, Cladocera, Copepoda and Ostracoda. Rotifers are the most important invertebrates with soft bodies and form the important part of the zooplankton community that lives in the aquatic ecosystem. They are usually used to determine the significance of the trophic status of a water body. Cladocerans are popularly referred as water flea, which live in the deep water and constitute the major food for fish. Thus, they occupy a key position in the transformation of energy in the food chain [6]. Copepods are tiny, free swimming plankton forms that are found abundantly in fresh and marine water habitats. Copepods prefer a more stable environment and are considered as pollution-sensitive group because they disappear when water is polluted [7]. Ostracoda is one of the main zooplankton groups and is often referred as seed shrimp. They occupy an intermediate position in the aquatic food web, transferring energy from producers to consumers [8]. The present investigation aims to study the zooplankton diversity for a period of two years from February 2014 to January 2016 in Kunigal tank to assess the species composition and seasonal variations.

1.1 Study Area

Kunigal tank is one of the biggest tanks in Tumkur District situated in between Kunigal town and Kottagere village. It is situated between 13° 02′ N 77° 02′ E (Latitude of 130 01′ 30" Longitude of 770 01′ 30") at an elevation of 778.45 meters above the mean sea level. It is rain fed and perennial in nature. The location map and satellite view of study area is shown in Fig. 1 and 2.

The tank was mainly constructed for the purpose of irrigation. The sources of water for Kunigal tank are rain fall, Nagini and Hemavathi rivers. The tank is situated with an area of 1030 acres and the catchment area is found to be 339.14 sq. km. It is being utilized enormously for irrigation and fish culture.

2. MATERIALS AND METHODS

On monthly basis, the water samples were collected from five sampling sites between 7 am to 9 am for a period of two years from February 2014 to January 2016. 50 liters of water sample were collected from each sampling site and filtered through 60µm mesh size plankton net. 50 ml of the concentrated water sample was collected from the bottle attached at the end of plankton net. The concentrated water sample was fixed and preserved in 4% formalin. For the quantitative analysis of planktons, one ml of the concentrated sample from each sampling site was transferred into Sedge-wick Rafter cell and counted under Olympus binocular microscope at 10X magnification. Taxonomic identification of planktons was based on morphological and taxonomic key

characters described by [9-13]. The sample preserved in Lugol's solution was centrifuged for 30 minutes at 3000 rpm, a drop of sample from pellet was taken on a clean slide and observed under digital microscope (LM-52-1711, Lynx, software- Scope image 9.0.at 100X magnification and photographs were taken [14].

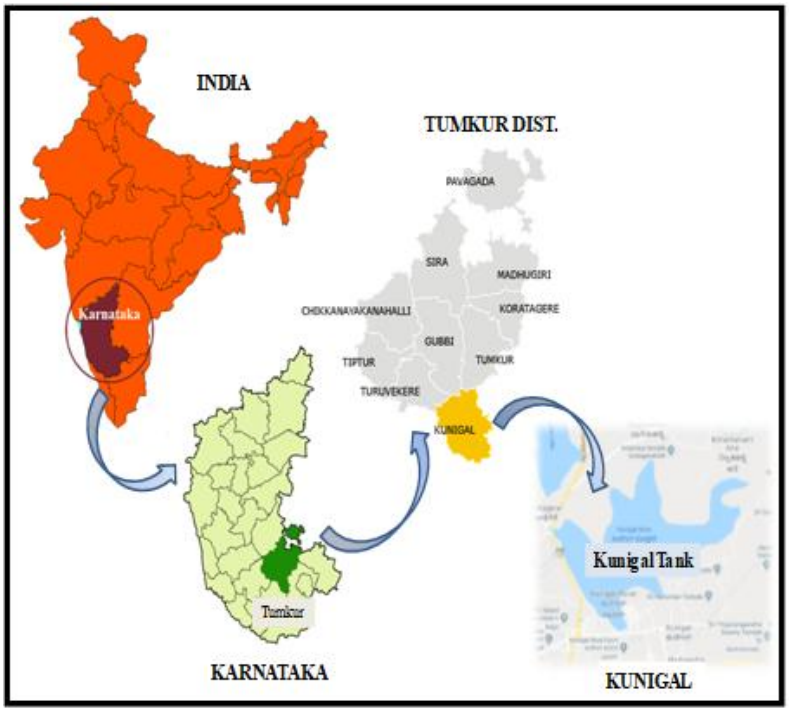


Fig. 1. Map showing Kunigal tank through Kunigal, Tumkur, Karnataka and India

Fig. 2. Satellite view of Kunigal Tank

The abundance of zooplanktons was carried out by using the following formula as given in [15].

$$No.of\ Organisms/m^3 = \frac{C\ x\ V1}{V2\ xV3}$$

Where,

C= No. of organisms counted.
V1= Volume of concentrated sample (50 ml).
V2= Volume of sample counted (1 ml).
V3= Volume of grab sample ($0.1m^3$).

Finally, to obtain org/l, the No. of organisms per m^3 was divided by 1000.

2.1 Statistical Analysis

The data obtained during the study period has been subjected to Statistical analysis. Diversity indices such as Shannon-Weiner Index and Simpson Index were used to explain the species diversity in zooplankton community [16 and 17] and calculated using PAST package software.

3. RESULTS

The diversity of zooplanktons from five sites of Kunigal tank were studied for two years from February 2014 to January 2016 and the results of seasonal group wise population density, percentage composition is presented in Table. No. 1,2 and 3 and Fig. No.3 to10. The diversity indices for each group of zooplankton are calculated and presented in Table. No. 4 to7. Some representative species of zooplanktons are depicted in Plate. 1 & 2.

3.1 Diversity of Zooplankton

In the present study, zooplanktons have been identified under four groups- Rotifera, Cladocera, Copepoda and Ostracoda. Among these, Rotifera shows its dominance at all the five sites. Rotifera is represented by 10 species belonging to 6 genera, Cladocera is represented by 8 species belonging to 6 genera, Copepoda is represented by 5 species belonging to 5 genera and Ostracoda is represented by 2 species belonging to 2 genera.

Rotifera

- *Asplanchna priodonta, Brachionus calyciflorus, Brachionus caudatus Brachionus rubens,* Brachionus spp., *Cephalodella gibba, Filinia longiseta, Keratella tropica, Keratella quadrata,* Pompholyx spp.

Cladocera

- *Bosminia longirostris, Ceriodaphnia cornuta, Chydorus sphaericus, Daphnia magna, Daphnia carinata, Macrotrix goeldi, Moina branchiate, Moina daphnia.*

Copepoda

- Cyclops spp., Diaptomus spp., Eudiaptomus spp., *Heliodiaptomus vidus, Mesocyclops leucarti*

Ostracoda

- *Cypris subglobosa, Hemicypris fossulate.*

In the study 2014 - 2015, maximum population density of zooplanktons recorded was 2563 org/l at site-1 and minimum population density of zooplanktons recorded was 1427 org/l at site-4. In the study 2015 -2016, maximum population density of zooplanktons recorded was 2481 org/l at site-1 and minimum population density of zooplanktons recorded was 1174 org/l recorded at site-2 (Table 1).

3.1.1 Rotifera

In the study 2014 - 2015, the seasonal population density of zooplanktons was recorded. Maximum number of Rotifera recorded was 362 org/l during summer at site-1 and minimum number of Rotifera recorded was 168 org/l during winter at site-5. In the study 2015-2016, the seasonal population density of zooplanktons was recorded. Maximum number of Rotifera recorded was 382 org/l during summer at site-1 and minimum number of Rotifera recorded was 160 org/l during winter at site-3 (Fig. 3&4).

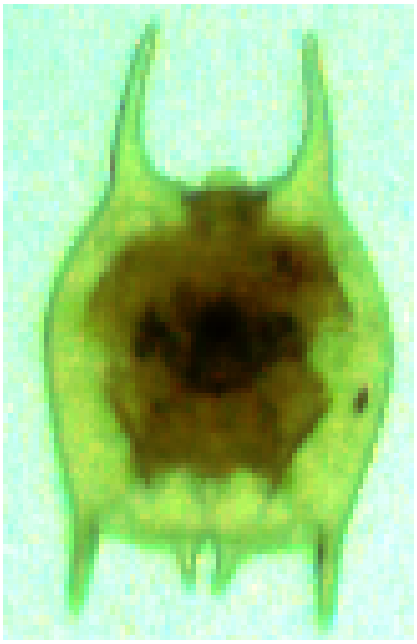
3.1.2 Cladocera

In the study 2014-2015, the seasonal population density of zooplanktons was recorded. Maximum number of Cladocera recorded was 310 org/l during summer at site-1 and site-3 and minimum number of Cladocera recorded was 138 org/l during winter at site-5. In the study 2015-2016, the seasonal population density of zooplanktons was recorded. Maximum number of Cladocera recorded was 328 org/l during summer at site-1 and minimum number of Cladocera recorded was 166 org/l during winter at site-1(Fig. 5 & 6).

3.1.3 Copepoda

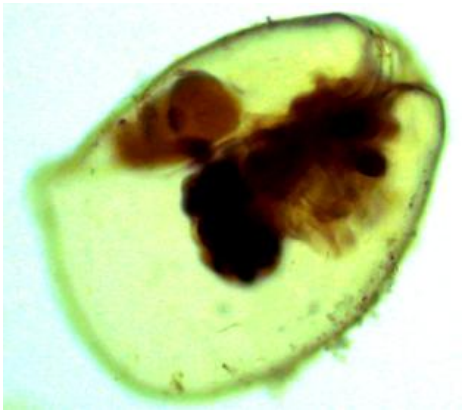
In the study 2014-2015, the seasonal population density of zooplanktons was recorded. Maximum

number of Copepoda recorded was 289 org/l during summer at site-1 and minimum number of Copepoda recorded was 18 org/l during monsoon at site-5. In the study 2015-2016, the seasonal population density of zooplanktons was recorded. Maximum number of Copepoda recorded was 236 org/l during summer at site-1 and minimum number of Copepoda recorded was 18 org/l during monsoon at site-4 (Fig. 7&8).



Brachionous caudatus

Brachionous spp.

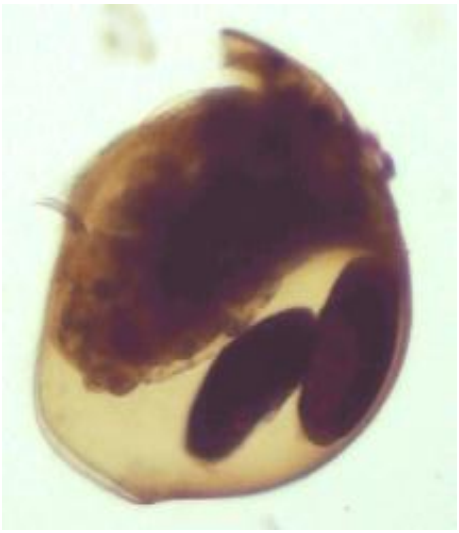


Asplancha priodonta

Pompholyx spp.

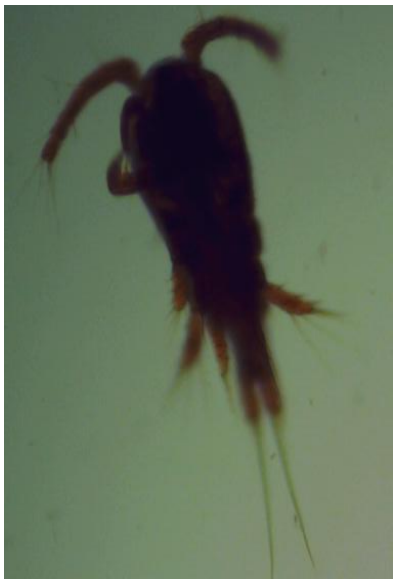
Filina longiseta

Plate 1. Some representative species of Rotifera



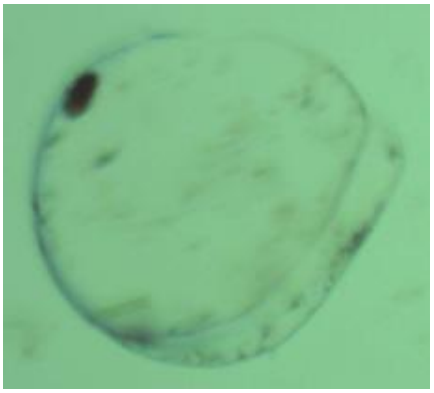
Chydorus sphaericus

Daphnia spp.



Mesocyclops spp.

Cyclops spp.



Cypris spp.

Plate 2. Some representative species of Cladocera, Copepoda & Ostracoda

Fig. 3. Seasonal population variation in Rotifera (org/l) at different sites of Kunigal Tank during 2014 - 2015

Fig. No. 4: Seasonal population variation in Rotifera (org/l) at different sites of Kunigal Tank during 2015 - 2016

3.1.4 Ostracoda

In the study 2014-2015, the seasonal population density of zooplanktons was recorded. Maximum number of Ostracoda recorded was 28 org/l during summer at site-2 and minimum number of Ostracoda recorded was 4 org/l during monsoon at site-4. In the study was 2015-2016, the seasonal population density of zooplanktons was recorded. Maximum number of Ostracoda recorded was 38 org/l during summer at

site-1 and minimum number of Ostracoda recorded was 4 org/l during monsoon at site-5 (Fig. 9&10).

3.2 Percentage Composition of Zooplanktons

Percentage composition of zooplanktons from five sites of Kunigal tank during 2014 -2016 is presented in Table 1.

In the study 2014-2015 and 2015-16, at site-1, Rotifera constitutes 37.89%, 41.39%, Cladocera 29.96%, 29.91%, Copepoda 29.77%, 25.47% and Ostracoda 2.38%, 3.22% respectively. In the study 2014-2015 and 2015-2016, at site-2, Rotifera constitutes 46.01%, 46.53%, Cladocera 40.16%, 37.48%, Copepoda 11.2%, 12.52% and Ostracoda 2.62%, 3.47% respectively. In the study 2014-2015 and 2015-2016, at site-3, Rotifera constitutes 51.77%, 39.11%, Cladocera 30.68%, 43.66%, Copepoda 15.56%, 14.95% and Ostracoda 1.99%, 2.28% respectively. In the study 2014-2015 and 2015-2016, at site-4, Rotifera constitutes 47.94%, 44.66%, Cladocera 37.25%, 41.24%, Copepoda 12.72%, 11.99% and Ostracoda 2.1%, 2.11% respectively. In the study 2014-2015 and 2015-2016, at site-5, Rotifera constitutes 48.56%,41.42%, Cladocera 33.7%, 41.3%, Copepoda 15.27%,15.25% and Ostracoda 2.48%,2.04% respectively.

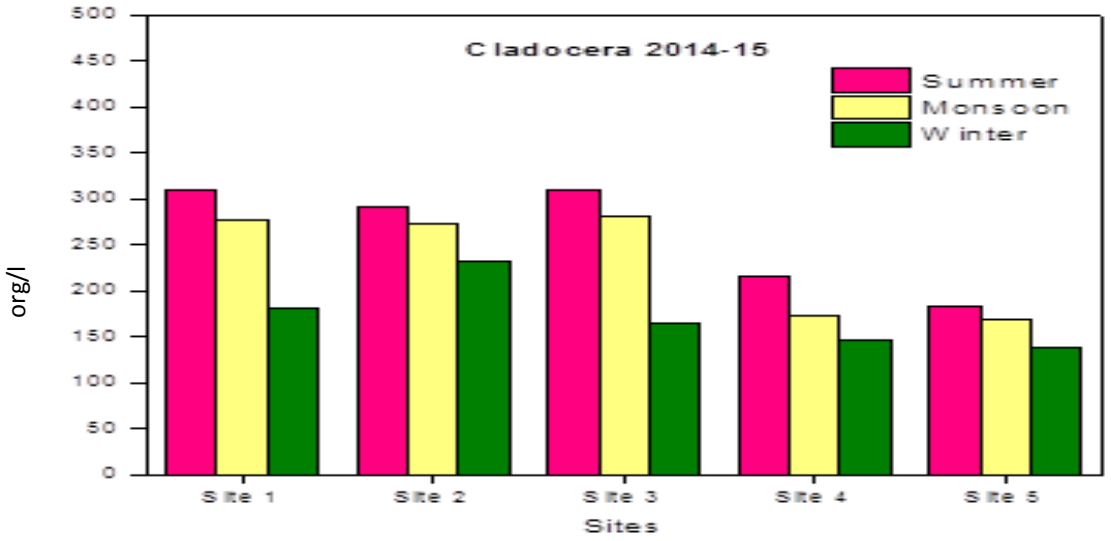


Fig. 5. Seasonal population variation in Cladocera (org/l) at different sites of Kunigal Tank during 2014 – 2015

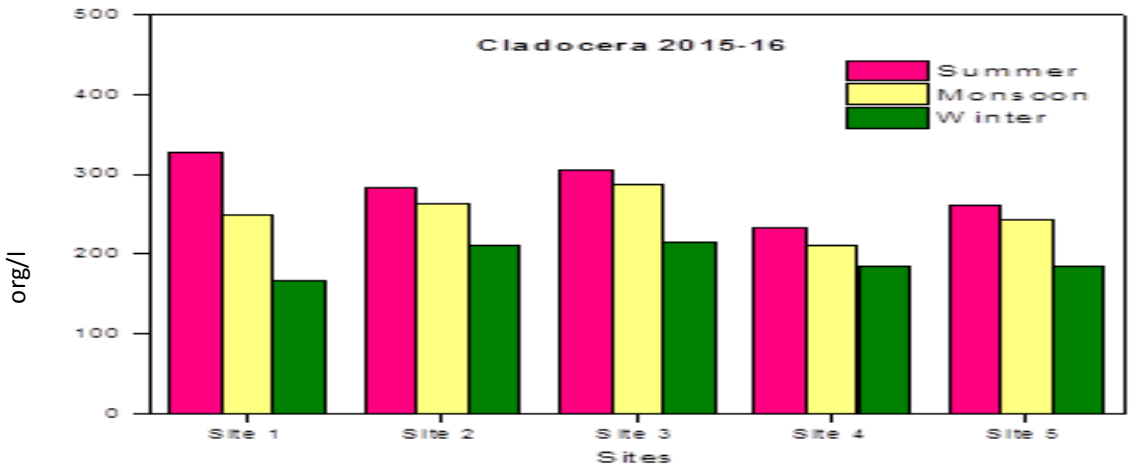


Fig. 6. Seasonal population variation in Cladocera (org/ l) at different sites of Kunigal Tank during 2015 - 2016

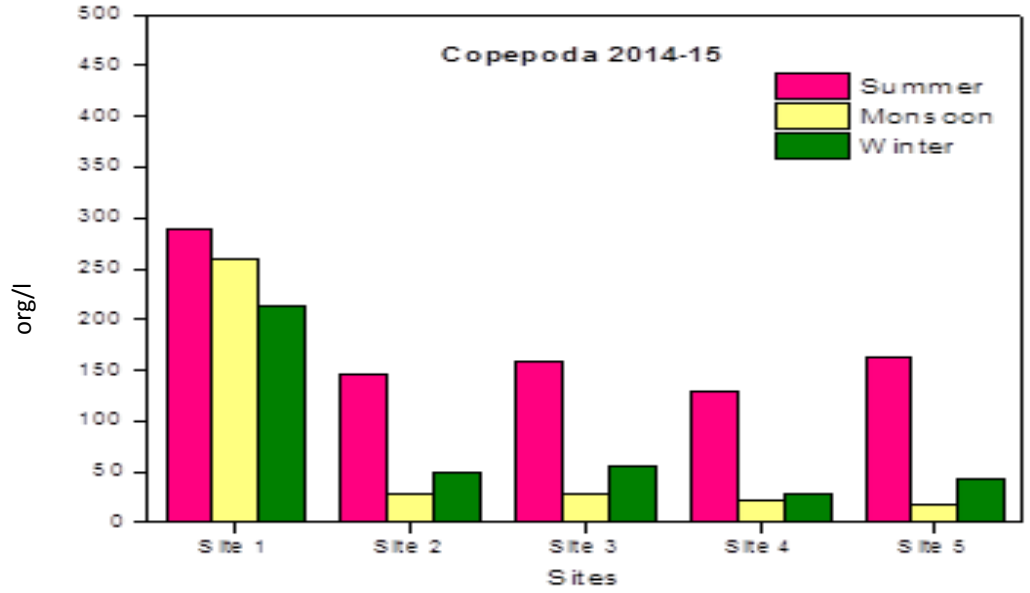


Fig. 7. Seasonal population variation in Copepoda (org/l) at different sites of Kunigal Tank during 2014 - 2015

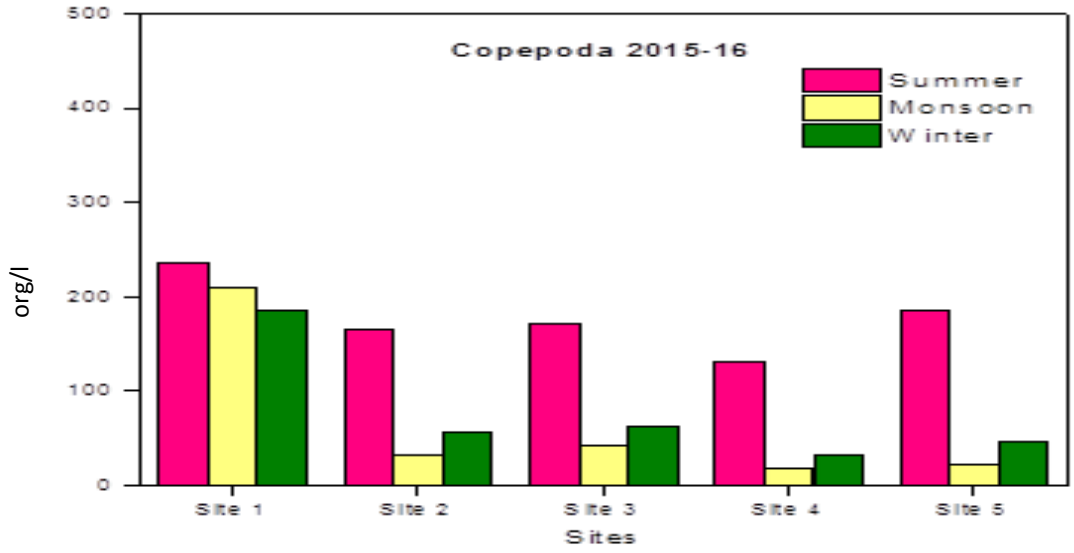


Fig. 8. Seasonal population variation in Copepoda (org/ l) at different sites of Kunigal tank, during 2015 - 2016

Table 1. Total number and group wise total percentage of zooplanktons (org/l) at Kunigal Tank during 2014-2016

Year		2014-2015		2015-2016	
Site	**Order**	**Total Zooplankton**	**Total percentage (%)**	**Total Zooplankton**	**Total percentage (%)**
Site 1	Rotifera	2563	37.89	2481	41.39
	Cladocera		29.96		29.91
	Copepoda		29.77		25.47
	Ostracoda		2.38		3.22

Year		2014-2015		2015-2016	
Site	**Order**	**Total Zooplankton**	**Total percentage (%)**	**Total Zooplankton**	**Total percentage (%)**
Site 2	Rotifera	1982	46.01	2020	46.53
	Cladocera		40.16		37.48
	Copepoda		11.2		12.52
	Ostracoda		2.62		3.47
Site 3	Rotifera	1555	51.77	1846	39.11
	Cladocera		30.68		43.66
	Copepoda		15.56		14.95
	Ostracoda		1.99		2.28
Site 4	Rotifera	1427	47.94	1518	44.66
	Cladocera		37.25		41.24
	Copepoda		12.72		11.99
	Ostracoda		2.1		2.11
Site 5	Rotifera	1454	48.56	1666	41.42
	Cladocera		33.7		41.3
	Copepoda		15.27		15.25
	Ostracoda		2.48		2.04

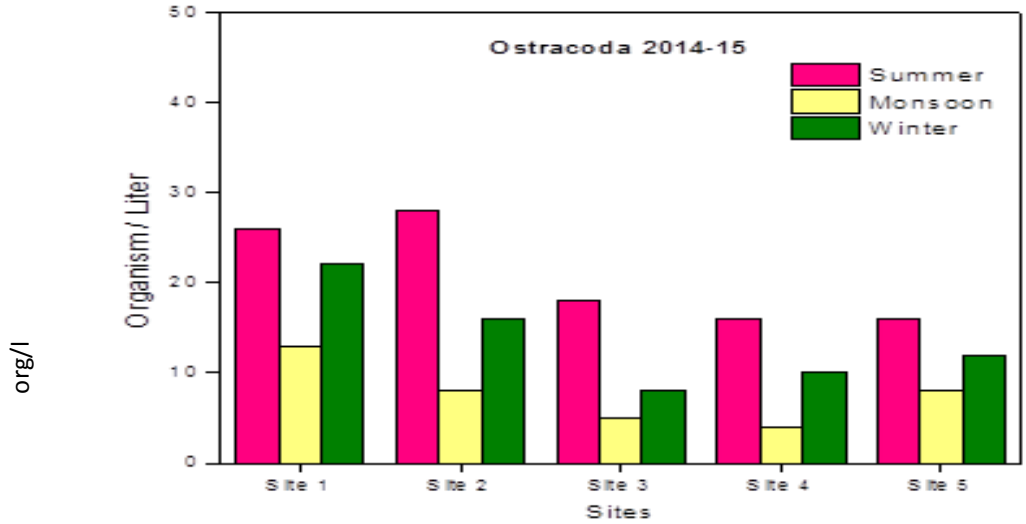
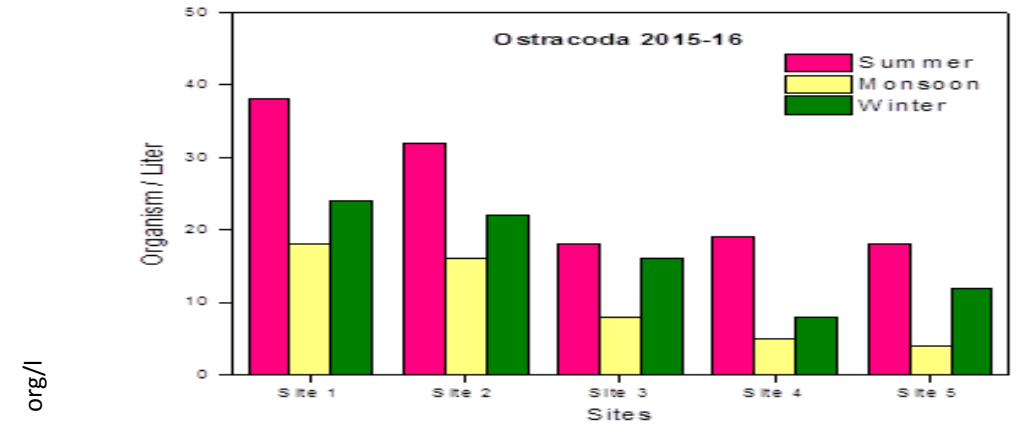


Fig. 9. Seasonal population variation in Ostracoda (org/ l) at different sites of Kunigal tank, during 2014 – 2015



.10: Seasonal population variation in Ostracoda (org/l) at different sites of Kunigal tank, during 2015 - 2016

Table 2. Percentage composition of Zooplanktons at Kunigal Tank during 2014-2015

Sl. No.	Order	Number of organisms	Total	Percentage
1.	Rotifera	4080		45.42
2.	Cladocera	3064	8981	34.11
3.	Copepoda	1627		18.11
4.	Ostracoda	210		2.33

Table 3. Percentage composition of zooplanktons at Kunigal Tank during 2015-2016

Sl. No.	Order	Number of organisms	Total	Percentage
1.	Rotifera	4057		42.56
2.	Cladocera	3619	9531	37.97
3.	Copepoda	1597		16.75
4.	Ostracoda	258		2.70

Table 4. Species diversity indices of Rotifera in Kunigal Tank during 2014-2016

Sites	Year	Shannon-Weiner Index	Simpson Index
	2014-15	2.48	0.92
Site 1	2015-16	2.48	0.92
	2014-15	2.47	0.91
Site 2	2015-16	2.47	0.92
	2014-15	2.44	0.91
Site 3	2015-16	2.44	0.91
	2014-15	2.46	0.91
Site 4	2015-16	2.46	0.91
	2014-15	2.45	0.91
Site 5	2015-16	2.46	0.91

Table 5. Species diversity indices of Cladocera in Kunigal Tank during 2014 - 2016

Sites	Year	Shannon-Weiner Index	Simpson Index
	2014-15	2.45	0.91
Site 1	2015-16	2.44	0.91
	2014-15	2.47	0.91
Site 2	2015-16	2.47	0.92
	2014-15	2.45	0.91
Site 3	2015-16	2.47	0.91
	2014-15	2.46	0.91
Site 4	2015-16	2.47	0.91
	2014-15	2.46	0.91
Site 5	2015-16	2.46	0.91

Table 6. Species diversity indices of Copepoda in Kunigal Tank during 2014 – 2016

Sites	Year	Shannon-Weiner Index	Simpson Index
	2014-15	2.47	0.91
Site 1	2015-16	2.47	0.91
	2014-15	2.24	0.87
Site 2	2015-16	2.24	0.87
	2014-15	2.24	0.87
Site 3	2015-16	2.28	0.88
	2014-15	2.15	0.86
Site 4	2015-16	2.13	0.85
	2014-15	2.10	0.85
Site 5	2015-16	2.12	0.85

Table 7. Species diversity indices of Ostracoda in Kunigal Tank during 2014 - 2016

Sites	Year	Shannon-Weiner Index	Simpson Index
	2014-15	2.39	0.90
Site 1	2015-16	2.41	0.90
	2014-15	2.35	0.89
Site 2	2015-16	2.42	0.90
	2014-15	2.30	0.88
Site 3	2015-16	2.38	0.90
	2014-15	2.31	0.88
Site 4	2015-16	2.27	0.88
	2014-15	2.40	0.90
Site 5	2015-16	2.24	0.87

4. DISCUSSION

The population density, composition and abundance of zooplanktons vary with season, type of freshwater body, its physico-chemical parameters, and biotic components [18 and 19].

In the present study, 25 species of zooplanktons were recorded with10 species of rotifera,8 species of cladocera, 5 species of copepoda and 2 species of Ostracoda which showed similar observations with (1) who reported 39 species of zooplankton in the lake Sharanabasaveshwara, composed of 9 taxa of

Rotifera, 4 taxa of Cladocera,4 taxa of Copepoda and 3 taxa of Ostrocoda and also observed 10 species of rotifera, 6 species of cladocera, 5 species of copepoda and 3 species of Ostracoda in freshwater reservoir, Khaji Kotnoor, Gulbarga District. Whereas (3) recorded 80 zooplankton species including 60 rotifers, 18 cladocerans and 02 copepods in Bandam Kommu Pond, Medak District, Telangana and found that the rotifers are the most dominant component in the zooplankton community. These observations support the present work with Rotifera as the dominant group.

In the present study, the total zooplanktons showed their high population density during summer season in all the sites and low during monsoon and winter. Similar results were recorded by [20] where maximum zooplankton population density was found during summer and minimum during monsoon season in Temple Pond at Thiruvottiyur.

In the present study, the increased density of zooplanktons during summer is due to increased temperature which enhances rate of decomposition making the water nutrient rich. The evaporation of water causing low water level increases the nutrient concentration providing abundant food for zooplanktons in the form of phytoplanktons and microorganisms. Low density during monsoon and winter is attributed to low nutrients, decreased temperature, dilution due to increased water level, heavy flood, and freshwater inflow.

4.1 Rotifera

Rotifers are aquatic, soft bodied, microscopic, pseudocoelomate animals living mostly in fresh water. The rotifers play a significant role in the food chain and biological production of waters and serve as pollution indicators and water quality monitors. Temperature was the main factor in the appearance and abundance of Rotifer species [21].

During the two years of study period, maximum population density of Rotifers was found during summer season in all the sites and minimum population during monsoon and winter. The present findings were supported by the similar observations made by [22]. But [23] recorded dominance during summer season followed by winter season.

In the present study, highest population density of Rotifera during summer season may be due to the high temperature, intensity of light, accelerating the phytoplanktons. The lowest population density of Rotifera during winter and monsoon season may be due to the low temperature, increased water level through rainwater. Among Rotifera, genera Brachionus and Keratella were recorded throughout the study period.

Shannon-Weiner Index and Simpson Index values of present study were similar to [24], where they found Shannon-Weiner diversity index value of Rotifers 2.373 and Simpson Index value 0.897 in Khaji Kotnoor reservoir and [16] recorded Shannon-Weiner Index values and Simpson Index values values 2.0294, 0.8487 during summer, 1.9992, 0.8466 during southwest monsoon and 2.0029, 0.8255 during northwest monsoon respectively at Dharmasagar Lake.

4.2 Cladocera: (*Branched horns*)

Cladocerans, popularly called as ‘water flea’ are the minute organisms found in all natural aquatic ecosystems including manmade wells and rivers. The group Cladocera was the second dominant group represented by 8 species belonging to 6 genera.

During the two years of study period, maximum population density of Cladocera was found during summer season and minimum population density during winter season. The present work was supported by [25] who recorded maximum population of Cladocera in summer and minimum in winter and monsoon in Wilson dam of Ahmedanagar and of the opinion that the factors like water temperature, dissolved oxygen, turbidity and transparency play an important role in controlling the diversity and density of cladocerans.

The maximum population of Cladocerans in summer may be attributed to favorable temperature and availability of food in the form of bacteria, nanoplankton and suspended detritus while during monsoon months the factors like water temperature, dissolved oxygen, turbidity, and transparency play an important role in controlling the diversity and density of Cladocera [23 and 26].

Daphnia and Moina genera were found throughout the study period. The presence of Moina species indicates the absence of organic pollution and clear tank water [24]. The presence of these cladocerans in Kunigal tank indicates that the tank water is in good condition.

[24] found Shannon-Weiner Index value of the cladocera 2.29 and Simpson Index value 0.81 at Khaji Kotnoor reservoir and [16] recorded Shannon-Weiner Index values and Simpson Index values 1.0817, 0.6212 during summer, 0.8674, 0.4889 during southwest monsoon and 1.0288, 0.5953 during northwest monsoon respectively at Dharmasagar Lake. Similar results were observed in the present

study with high Shannon-Weiner Index and Simpson Index values which indicate the good quality of water of Kunigal tank where Cladocerans prefer to live in clean and clear water.

4.3 Copepeda

Copepods constitute one of the major zooplankton communities found in both freshwater and marine water habitats. The important factors which controlled the distribution of copepods were rainfall, river discharge and decreased phytoplankton abundance due to increased turbidity [27].

During the two years of study period, maximum population density of Copepoda was found during summer season and minimum population was found during monsoon and winter. Similar observations were made by [28] recorded maximum population density during summer and minimum during monsoon. [24 and 29] also reported low density of copepods in monsoon season in Khaji Kotnoor reservoir and Karanja reservoir (Karnataka) respectively and indicate that they prefer low temperature.

In the present study, favorable temperature, availability of food may be the reasons for higher population during summer and low density may be due to low water temperature, dissolved oxygen. In the presented investigation, Cyclops species were recorded throughout the study period. [30] was of the opinion that Cyclops indicates oligotrophic condition of the water body.

Shannon-Weiner Index and Simpson Index values of present study were similar to [24], where they found Shannon-Weiner diversity index value of copepoda was 0.23 and Simpson Index value was 0.83 in Khaji Kotnoor reservoir and [16] recorded Shannon-Weiner Index values and Simpson Index values 1.1041, 0.4207 during summer, 0.8983, 0.4921 during southeast monsoon and 0.8397, 0.4952 during northwest monsoon respectively at Dharmasagar Lake.

4.4 Ostracoda

Ostracoda are small, free-living, fresh water or marine water crustaceans found in a wide range of aquatic habitats like lakes, pools, and streams.

Cypris subglobosa, *Hemicypris fossulate* were found throughout the study period. Generally, Ostracods recorded very less in other reservoirs also [8] recorded 2 species in Dalvoi lake and reported maximum population density during summer season and least during winter and opined that as water quality index (WQI) increases, population density of ostracods increases but species diversity decreases. [31] also reported only one genus of Ostracoda from Irrukkangudi reservoir (Tamil Nadu).

During the two years of study period, maximum population density of Ostracoda was found during summer season and minimum population density during monsoon season at all the sites. The results of the present work were correlated with the observations made by [22] in Alamatti reservoir. In Hattikuni reservoir also [28] recorded maximum number of ostracoda in premonsoon and very less in monsoon season and [32] found the population density of ostracoda was higher in summer season and less in monsoon in Majalgaon reservoir.

Shannon-Weiner Index and Simpson Index values of present study were similar to [24] where they found Shannan-Weiner Index value of Ostracoda was 2.1 and Simpson Index values was 0.81 in Khaji Kotnoor reservoir and [16] recorded Shannon-Weiner Index and Simpson Index values 0.3968, 0.2384 in summer, 0.5195, 0.3428 in northeast monsoon and 0.6365, 0.4761 in southwest monsoon respectively at Dharma Sagar Lake.

In the present study, Shannon-Weiner Index value of zooplanktons ranges between 2.0 - 3.0 which indicates the moderate plankton diversity and less pollution level. Simpson Index values are found between 0 and 1, where the greater value indicates the good diversity. In the present study the Shannon-Weiner Index and Simpson Index values of the zooplanktons indicate the good diversity with less water pollution of the Kunigal tank.

In the present study, the percentage composition of zooplankton species during the year 2014-2015 and 2015-16 in Kunigal tank were Rotifera 45.42 %, 42.56 %, Cladocera 34.11, 37.97 %, Copepoda 18.11 %, 16.75 %, and Ostracoda 2.33 %, 2.70 % respectively. (Table 2 &3). Among these zooplankton species, Rotifera is dominant followed by Cladocera, Copepoda and Ostracoda species. The trend of zooplanktons with respect to number is found as Rotifera > Cladocera > Copepoda > Ostracoda.

5. CONCLUSION

The present study shows that the tank is diversified with a greater number of species making the tank least polluted with good quality of water. The Shannon-Weiner Index and Simpson Index values of the zooplanktons indicate the good diversity in Kunigal tank. Finally, it can be concluded that, as the

zooplanktons act as the bioindicators, their diversity indicates the less pollution status of Kunigal tank which help in planning of successful fisheries management and to improve the productivity of the tank.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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