*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **5(1),** 32-38, January **(2016)** *Int. Res. J. Environment Sci.*

Diversity of Zooplankton and their Seasonal Variations of Gogi Lake, Shahapur taluk, Yadgir district, Karnataka, India

YD Imran Khan, Sunil Nautiyal*, Pavan Tikhile, Vani Sastry and K. Bhaskar
Centre for Ecological Economics and Natural Resources (CEENR), Institute for Social and Economic Change, 560 072, Bangalore, Karnataka, INDIA
nautiyal_sunil@rediffmail.com

Available online at: www.isca.in, www.isca.me
Received 17th November 2015, revised 24th December 2015, accepted 18th January 2016

Abstract

Zooplanktons are microscopic organisms that have a criticcal role in aquatic ecosystems. Zooplanktons are indicators of water quality and purity of aquatic ecosystems. The present study was carried out to study the species diversity and their seasonal changes in fresh water lake ecosystem located in semi-arid region of Karnataka. The study was conducted across the seasons of the year 2012. A standard methodology was followed during this study and the samples were collected during various seasons from the studied aquatic ecosystem. We recorded a total of 22 species of zooplanktons during the study period. Phylum Rotifers comprises 15 species, Cladocera 3, Copepoda 3 and Ostrocoda 1 species. A season wise analysis shows the maximum number of species during summer and the minimum number of species in rainy season. Species density was recorded high during summer season as compared to rainy season. The lake is shelter to many migrating bird species, fishes, aquatic plants and other insects. The lake is surrounded by human settlements and is prone to pollution due to several activities viz. washing clothes, bathing animals, dumping domestic waste and other similar activities. In this regard, urgent actions are required to conserve the aquatic biodiversity of this lake.

Keywords: Zooplankton, Fresh water ecosystem, Gogi Lake, Semi-arid region.

Introduction

Fresh water ecosystems are extensively involved with human culture. In India, fresh water ecosystems are integral part of village ecosystems. The fresh water ponds and lakes are used for several purposes such as their domestic purposes such as washing clothes, cleaning animals and vehicle, religious rituals, agricultural purposes and other daily activities. Aquatic systems are classified into two types such as Lentic and Lotic ecosystems. Aquatic systems play important role in landscapes as they are habitats for different biodiversity (Lower lever organisms to higher level organisms) which will play an important role in food chains or food webs. Many organisms start their lives in aquatic systems for example amphibians spend their juvenile stages in aquatic bodies and aquatic ecosystems are shelter for many native and migrating bird species and it will provide shelter for other organisms[1]. All these higher organisms are depending on lower organisms such as Phyto and Zooplanktons for their food and survival. Water bodies provide many services to the society in various sectors such as Agriculture, tourism, Aquaculture, Livestock etc. But now these water bodies are facing several problems due to pollution, and other anthropogenic impacts due to these reasons aquatic organisms are facing the problems and this impacts are showing effects on water quality as well[2]. Phyto and zooplanktons are the lower organisms and they will serve as a food for other higher organisms in aquatic ecosystems. Phytoplankton has a great ecological importance as they serve as primary producers in ecosystems. Majorly all the zooplankton depends on the phytoplankton for their food purposes. Again these zooplanktons will be serving as a food for other higher organisms. Zooplankton transfers the energy from primary level to higher levels; several biological factors such as concentration of phytoplankton, predation, breeding, and physical factors such as temperature, pH, alkalinity of water etc influences the zooplankton density and diversity in aquatic systems[3].

Zooplankton has an important role in aquatic ecosystem, providing the link between phytoplankton primary production and higher tropical level, such as commercially exploited fish stocks. Because of this zooplankton are important ecologically as well as economically[4]. Few groups of species are having good economic importance as follows *Brachionus species* can be mass cultivated and used as food in aquaculture, dried *Cladoceran species* are healthy food for aquarium fishes and by the feeding of enriched zooplankton *Heterobranchus longisfilis* larvae growth rate will be increased[5].

Zooplankton are micro organisms present in water bodies. They play a very critical role in aquatic ecosystems. Which includes energy transfer from primary levels to higher level in an ecosystem[6,7]. Zooplanktons play a major role in the detection and assessment of water pollution[8] and are considered a major ecological parameter in assessing water quality. The nutrient status and water quality govern the biomass of zoo planktons in

water[9]. A favorable pH range for the growth of zooplankton in fresh water ecosystems is 7.2-8.5. The species occurrence is mainly dependent on factors such as climate change, Physico-chemical parameters and vegetation cover[10,11] and along with the pressure from a direct consumption and use of water by humans. Present days all the aquatic systems are facing several challenges such as degradation of water, Loss of aquatic biodiversity, expansion of Invasive species etc., which are caused by several factors. These factors increase the spatial scale through cumulative impacts and enhanced anthropogenic activities around the water bodies. Due to these pressures, it is not only difficult to protect and maintain the diverse biota of fresh water, but also to conserve water resources of lakes[12]. Environmental effects are another factors which causing the damage of fresh water ecosystem. Frequent monitoring of different environmental parameters will ensure discovery of harmful impacts on fresh water ecosystems early, thereby ensuring easy assessment and handling in early stages itself[13]. Lake ecosystems are influenced by several factors that tend to change from year to year. Urbanization, pollution and Eutrophication lead to changes in the composition of zooplankton diversity[14].

In various parts of India, several studies have been carried out by researchers on zooplankton specific to fresh water lake ecosystems, but there are very few studies related to dry land aquatic ecosystems where conducted. Keeping this in view, the present study was undertaken to explore the diversity of zooplankton in Gogi-lake where anthropogenic pressure is more on this lake due to several factors.

Materials and Methods

Study area: Gogi Lake is positioned nearby two adjoining villages namely Gogipeth and Gogikona in Shahapur taluk of Yadgir district, Karnataka, India, see figure-1. It lies between latitude 16°43' and 16°44'N to longitude 76°44'E at an elevation of 1609 ft above the sea level. Gogipeth and Gogikona are locally known as "Gogi". Gogipeth is a companion village of Gogikona which lies less than half a kilometer to the southeast, across a small stream. Gogi is one of the largest villages in Shahapur taluk with a population of 16684 and 2809 households**.** Gogi Lake is located in the north-west side of the village. The lake is mainly dependent on rain water and fills up with water during monsoon, but during summer, the water level goes down. The lake is connected to a canal through upper Krishna project, so there is a continuous water flow in to this lake. As this lake is located within the village, several households are dependent on this lake for their domestic and daily activities such as agriculture, washing clothes, bathing animals, cleaning vehicles, dumping solid waste and other human activities such as open defecation, urinating etc. This lake is a shelter to several bird species such as Indian Cormorant (*Phalacrocorax fuscicollis*), Common Coot (*Fulica atra*), Purple moorhen (*Porphyrio porphyrio*), Glossy ibis (*Plegadis falcinellus*), Black ibis (*Pseudibis papillosa*) etc., and other aquatic biodiversity. Some aquatic plants such as, *Ipomia auatica, Hydrilla, Pistia, Eichornia Ipomia carnia, Typha angustifolia*, *Cyprus spp.*, were observed during the study period in this lake apart from the above species 21 species of phytoplankton were also documented[15]. Around this lake, several developmental activities are being undertaken and this lake plays significant role in the village economy. Against this backdrop, the present study was carried out. The main aim of this study was to find out the diversity structure of zooplankton community in Gogi Lake in that context of development related pressures and climate change. To understand the changes in the population structure during various seasons, an investigation was carried out.

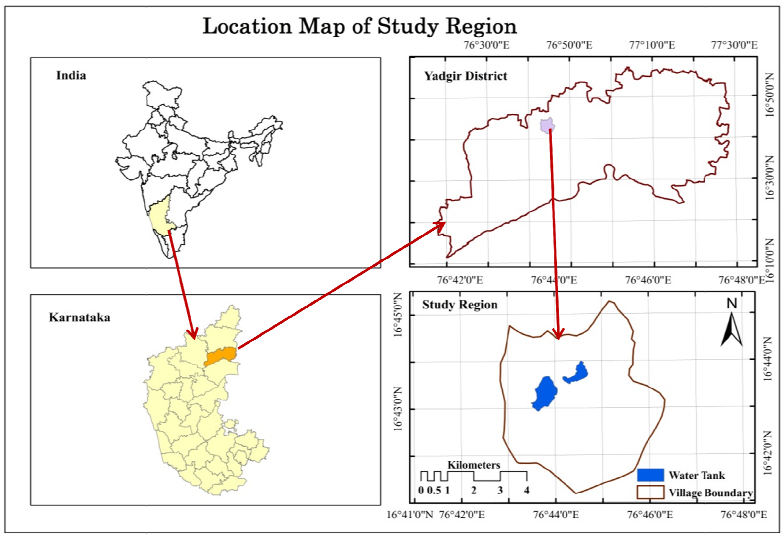

Figure-1
Location map of the Study area

Sample collection, Preservation: A Qualitative and quantitative analysis: Sample collection from the study region was done byrandom sampling method was applied for the collection of sample from the selected site. Samples were collected during the period January 2012 to December 2012 in early hours (6 am to 9 am) during various seasons across different fixed sites of the lake. A qualitative and quantitative analysis was carried out after collecting the sample. For a qualitative analysis, we adopted standard methods[16]. The samples were collected by using conical shaped towing plankton net with mesh with a size of 50µm, made up of nylon silk with a bottle and a closing devise at the end. For a quantitative analysis 10 liters of water samples were filtered through the plankton net. After collection, the samples were labeled and preserved with 4% formaldehyde in airtight bottles[17]. These collected samples were shifted to a laboratory for a further analysis. In qualitative analysis, zooplanktons were identified by using standard keys[18-24] under a microscope. Land Use and Land Cover of the study area was done using ArcGis Software. Satellite data was collected during various points of time (1992, 2000 and 2014) to understand the changes in the village landscape.

Results and Discussion

The present study identified a total of 22 species belonging to four groups, namely, Rotifera, Cladocera, Copepoda and Osrocoda, see Table-1. Out of 22 species, Rotifers comprises 15 species (*Asplanchna priodonta, Brachionus bidentata, Brachionus calyciflorus, Brachionus falcatus, Brachionus urceolaris, Cephalodella gibba, Habrotrocha bidens, Keratella tropica, Lecane luna, Monostyla bulla, Mytilina ventralis, Mytilini acanthophora, Platyias quadricornis, Rotifer tardus, Filinia longiset*); Cladocera 3 (*Ceriodaphnia cornuta*, *Chydorus sphaericus, Moina brachiat*); Copepoda 3 (*Heliodiaptomus viduus, Mesocyclops leuckarti, Tropocyclops prasinus*); and Ostrocoda 1 (*Hemicypris* fossiculata). The results reveal variations in the presence and absence of species in different seasons and density. Among 22 species, 17 species were recorded in summer season, 12 species in rainy season and 14 species in winter season; see Table-2). The occurrence of zooplankton was found high in summer, low in rainy season and moderate in winter season. The results were observed during summer. Based on the results Rotifers showed a maximum density, while Ostrocods a minimum density. In rainy season, Rotifers showed a maximum density, while Cladocera a minimum density. In winter, Rotifer showed a maximum density, where as ostrocods a minimum density. The seasonal occurrence of species is given below in the increasing order.

Summer: Ostrocoda< Copepoda <Cladocera<Rotifera
Rainy: Cladocera < Copepoda < Rotifera
Winter: Ostrocoda< Cladocera and Copepoda< Rotifera

Table-1
Diversity of Zooplanktons in Gogi Lake

Rotifera	**Cladocera**	**Copepoda**	**Ostracoda**
Asplanchna priodonta	*Ceriodaphnia cornuta*	*Heliodiaptomus viduus*	*Hemicypris fossiculata*
Brachionus bidentata	*Chydorus sphaericus*	*Mesocyclops leuckarti*	
Brachionus calyciflorus	*Moina brachiata*	*Tropocyclops prasinus*	
Brachionus falcatus			
Brachionus urceolaris			
Cephalodella gibba			
Habrotrocha bidens			
Keratella tropica			
Lecane luna			
Monostyla bulla			
Mytilina ventralis			
Mytilini acanthophora			
Platyias quadricornis			
Rotifer tardus			
Filinia longiseta			

Table-2
Seasonal variations in zooplanktons in Gogi Lake

Scientific name	Family	Phylum	Summer	Rainy	Winter
Ceriodaphnia cornuta (Sars,1885)	Daphniidae	Cladocera	+	+	-
Chydorus sphaericus (O.F.Muller,1785)	Chydoridae	Cladocera	+	-	+
Moina brachiata (Jurine,1820)	Moinidae	Cladocera	-	+	+
Heliodiaptomus viduus (Gurney,1916)	Diaptomidae	Copepoda	-	+	+
Mesocyclops leuckarti (Claus,1857)	Cyclopidae	Copepoda	+	+	+
Tropocyclops prasinus (Fischer,1860)	Cyclopidae	Copepoda	-	+	-
Hemicypris fossiculata	Cyprididae	Ostracoda	+	-	+
Asplanchna priodonta (Gosse 1850)	Asplanchnidae	Rotifera	+	-	+
Brachionus bidentata (1889)	Brachionidae	Rotifera	+	+	-
Brachionus calyciflorus (Pallas,1766)	Brachionidae	Rotifera	+	-	+
Brachionus falcatus (Zacharias,1898)	Brachionidae	Rotifera	-	+	+
Brachionus urceolaris (Muller, 1773)	Brachionidae	Rotifera	+	+	-
Cephalodella gibba (Ehrenberg,1832)	Notommatidae	Rotifera	+	-	+
Habrotrocha bidens (Gosse 1851)	Habrotrochidae	Rotifera	+	-	+
Keratella tropica (Apstein,1907)	Brachionidae	Rotifera	+	+	-
Lecane luna (Muller,1776)	Lecanidae	Rotifera	+	-	+
Monostyla bulla (Gosse, 1851)`	Lecanidae	Rotifera	+	-	+
Mytilina ventralis (Gosses,1886)	Mytilinidae	Rotifera	+	+	-
Mytilini acanthophora (Hauer)	Mytilinidae	Rotifera	+	-	-
Platyias quadricornis (Ehrenberg,1832)	Brachionidae	Rotifera	-	+	+
Rotifer tardus (Ehrenberg,1838)	Philodinidae	Rotifera	+	-	-
Filinia longiseta	Trochosphaeridae	Rotifera	+	+	+

Land Use and Land Cover Changes in Gogi Village: A Land Use and Land Cover analysis in Gogi village was carried out for the years 1992, 2000 and 2014. The results show that there are several changes in the Gogi land use pattern within a span of 22 years (1992 to 2014). Settlements have increased from 25 hectares to 63 hectares. There has been an increase in the land under agriculture along with settlements, while water tanks, open/Grass/ Scrub Lands show a decrease, see Table-3 and Figure-2. A population trend from past four decades (1981 to 2011) has shown in Table-4. This population growth is showing the pressure on natural ecosystem which were surrounded by human habitats.

Discussion: Zooplanktons play an important role in aquatic ecosystems. The diversity of zooplanktons depends on various factors (physico-chemical and biological). Several studies have been carried out in various parts of India to understand the diversity and distribution of zooplankotons.

Rotifera: Rotifers are soft bodied and most important invertebrates inhabiting aquatic ecosystems. These play a major role in aquatic systems, besides being an important food for fishes [25]. Some studies while reporting the dominant patterns of these rotifers note that they are the same in tropical and subtropical water bodies[26,27]. The presence of rotifers indicates Eutrophication of waterbodies, while that of *Brachionus* species the alkaline nature of water[28,29]. The present study has found out that rotifers diversity is dominant in summer season as compared to rainy and winter seasons, however, rotifers show a similar kind of diversity in rainy and winter seasons.

Table-3
Area under different LULC (1992 to 2014)

Land Use/ Land Cover (Area in hectare)	Year		
	1992	**2000**	**2014**
Human settlements	25	35	63
Water Tank	123	117	110
Open/ Grass/ Scrub Land	424	273	198
Fallow Land	560	151	185
Agriculture	1942	2498	2518
Total Area	**3074**	**3074**	**3074**

Copepoda: copepods are present in almost every water body; these copepods play a major role in the food chain. Irregular rainfall, water discharge and decreased phytoplankton have restricted the diversity and distribution of copepods[30,31]. The Present study results reveal that, Copepods show a similar kind of diversity in summer, rainy and winter seasons. We have recorded three copepod species (*Heliodiaptomus viduus*, *Mesocyclops leuckarti, Tropocyclops prasinus*) from Gogi lake.

Cladocera: Cladocerans are called as water fleas and are small crustaceans. They generally stay in deep waters. Cladoceran diversity and density depend on food supply (Phyto plankton)[32]. Temperature, food availability and water turbidity play a major role in controlling the Cladocerans[8,33,34]. The present study has found less Cladoceran in rainy season as compared to summer and winter seasons. Cladocerans show a moderate diversity in summer and winter seasons mainly due to a dense growth of rotifers.

Ostrocoda: Ostrocads look like small seeds. They are bivalve crustacean. They are found in both fresh and marine water ecosystems[20]. These are a good food for other aquatic organisms. The occurrence of ostrocods has been reported from various parts of India[8,35-37]. The present study has recorded only one species (*Hemicypris fossiculata*) of zooplankton. Our study results reveal that, ostrocods diversity and population are very low as compared to others in all seasons. The present didn't find any Ostrocods during rainy season.

Table-4
Population of Gogi Village (Gogi peth and Gogi Kona) - 1981, 1991, 2001 and 2011

Year	**Name of the Village**	**No. of HH**	**Total Population**
1981	Gogi peth	800	4679
	Gogi Kona	913	5118
Total		**1713**	**9797**
1991	Gogi peth	873	5566
	Gogi Kona	938	5790
Total		**1811**	**11356**
2001	Gogi peth	1045	6557
	Gogi Kona	1112	7046
Total		**2157**	**13603**
2011	Gogi peth	1238	7544
	Gogi Kona	1571	9140
Total		**2809**	**16684**

Source: Census department.

Conclusion

Water bodies are the most important shelter for various aquatic organisms (plants, animals and other micro organisms). The present study was conducted in Gogi lake which is adjacent to Gogi village, where most of the people depend on this lake for their daily activities such as bathing, washing clothes, cleaning vehicles and dumping waste. Apart from that, several insecticides and chemicals are used in their agricultural fields also flow into this Lake. Because of these reasons, there is a heavy pressure on Gogi Lake, which may affect several organisms dependent on this lake and also human beings who are dependent on this lake for several purposes. Conserving these water bodies like Gogi Lake and maintenance of water quality is a big task in the development context. But still, there are chances to conserve these water bodies through proper planning and management. Creating awareness among local people is one of the major suggestions for protecting such water resources for future. The Present study is intended to be useful for further research as a baseline study in Gogi Lake. The

preliminary data on the diversity of zooplanktons and the variations in different seasons could be useful to understand the status of Gogi Lake in future. The government and Local people should take initiatives to formulate proper management measures for improving the lake quality besides conservation of various species which are critical to the village economy and water bodies.

Acknowledgements

Authors are thankful to Board of Research in Nuclear Sciences (BRNS), Department of Atomic Energy (DAE), Government of India for providing financial support. We extend our thanks to Dr. Jayasree Thilak Zoological Survey of India, Chennai, Tamil Nadu for her support and guidance to conduct the laboratory experiments.

References

1. Scott S. (2015), How Lakes differ in Lake Scientist, Retrieved online at: http://www.lakescientist.com/lake-facts/how-lakes-differ/. On 23 August 2015 (Online).

2. Oertli B., Jeremy biggs J., Céréghino R., Grillas P., JOLY P. and Jean-bernard lachavanne J.B. (2005). Conservation and monitoring of pond biodiversity: introduction. *Aquatic Conservation: Marine and Freshwater Ecosystems.*, 15(6), 535-540.

3. Lalli C.M. and Parsons T.R. (1997). Biological Oceanography an Introduction (2nd edition). Elsevier, Burlington 314.

4. Harris R.P., Wiebe P.H., Lenz J., Skjoidal H.R. and Huntley M. (2000). ICSE-Zooplankton methodology manual, Academic Press, London, UK. 684.

5. Singh A., Sharma S.K., Mishra V. and Singh E. (2015). Freshwater Zooplankton: An introduction and Their Role in Aquaculture. Retrieved online at: aquafind.com/articles/Role_of_Zooplankton.php. on 23 August 2015 (Online)

6. Tiwari R.P., Tripathi K. and Sahu R. (2011). Studies on monthly population of total zooplanktons and their correlation coefficient with physicochemical factors of Lony dam Theonthar, Rewa (M.P.). *Ind J Biol Stud Res.*, 1(1), 33-38.

7. Sehgal K., Phadke G.G., Chakraborty S.K. and Reddy S.V.K. (2013). Studies on Zooplankton Diversity in Dimbhe Reservoir, Maharashtra, India. *Advances in Applied Science Research*, 4(1), 417-420.

8. Shivashankar P. and Venkataramana G.V. (2013). Zooplankton diversity and their seasonal variations of Bhadra reservoir, Karnataka, India. *Int. Res. J. of Environment Sci.*, 2(5), 87-91.

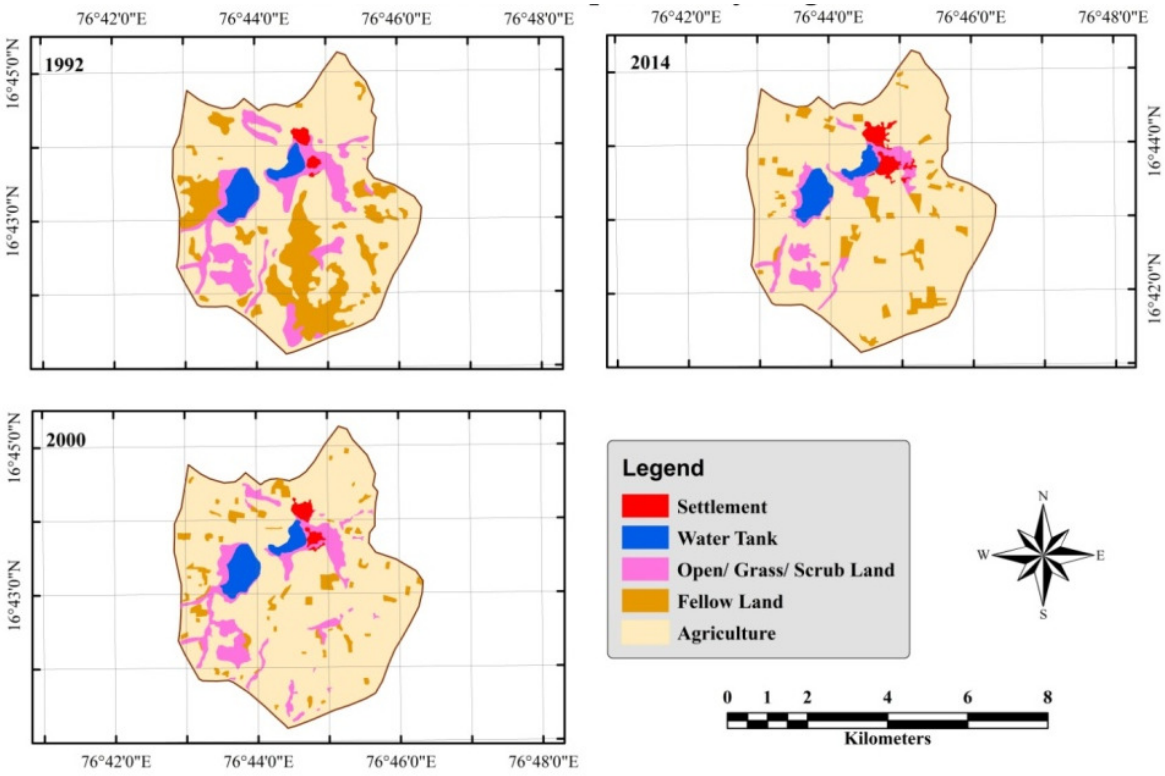

Figure-2
Land use Land cover changes (1992 to 2014) in Gogi village

9. Sakhare V.B. (2007). Reservior Fisheries and Limnology. Narendra Publishing House, New Delhi, India.

10. Mishra A., Srivastava A. and Singh U.P. (2003). Limnological studies of fish ponds in Tarai Region of Uttar Pradesh. *Environment and Ecology*., 21(3), 623-627.

11. Rocha O., Matsumura-tundisi T., Espindola E.L.G., Roche K.F. and Rietzler A.C. (1999). Ecological theory applied to reservoir zooplankton. In: Theoretical reservoir ecology and its application Eds. J.G. Tundisi and M. Straskraba. *Internat Inst. Ecol.,* Sao Carlos., 457-476.

12. Basavarajappa S.H., Raju N.S., Hosmani S.P. and Niranjana S.R. (2010). Algal diversity and Physico-chemical parameters in Hadhinaru Lake, Mysore, Karnataka state, India. *The Biosca*., 5(3), 377-382.

13. Karthick B. (2010). Ecology of Stream Diatom Communities central western ghats. *Ph.D thesis*, University of Mysore, Mysore.

14. Rajashekhar M., Vijaykumar K. and Parveen Z. (2009). Zooplankton diversity of three freshwater lakes with relation to trophic status, Gulbarga district, North-East Karnataka, South India. *International journal of systems Biology,* 1(2), 32-37.

15. Bhaskar K., Nautiyal S., Khan Y.D.I. and Rajanna L. (2015), A preliminary study on Phytoplankton in Fresh water-Lake of Gogi, Yadgir district, Karnataka. *International journal of Innovative Research in Science, Engineering and Technology*, 4(4), 2030-2037.

16. APHA (1998). Standard Methods for the Examination of Water and Waste water, (20th edition). *American Public Health Association*, Washington DC.

17. Pennak R.W. (1978). Freshwater invertebrates of the United states. John Wiley and Sons, New York.

18. Altaff K. (2003). A Manual of Zooplankton. Department of Zoology, The New College, Chennai.

19. Battish S.K. (1992). Freshwater Zooplankton of India. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi, India.

20. Edmondson W.T. (1959). Freshwater Biology (2nd edition). John Wiley and Sons, New York. 1248.

21. Kurian C.V. (1982), Sebastian V.O. Prawns and Prawn Fisheries of India. Hindustan Publishing Corporation, New Delhi, India. 286.

22. Needham J.G. and Needham P.R. (1966). A guide to the study of fresh water biology (5th edition). Holden Day Inc., San Francisco, California, USA. 104.

23. Sharma B.K. (1998). Rotifera. In: Faunal diversity of India. Eds. J.R.B. Alfred., A.K. Das and A.K. Sanyal. Envis center, Zoological Survey of India, 57-70.

24. Sharma B.K. and Sharma S. (2000). Fresh water Rotifers (Rotifera: Eurotatoria). In. State Fauna Series: Fauna of Tripura, Zoological Survey of India, Calcutta, 7(4), 163-224.

25. Hutchinson G.E. (1967). A Treatise on Limnology, Vol. II: Limnoplancton. Wiley, New York. 1015.

26. Sampio E.V., Rocha O., Tundisi T.M. and Tundisi J.G. (2002). Composition and abundance of zooplankton in the limnetic zone of seven reservoirs of the parana panama river, Brazil. *Braz. J. Biol*, 62(3), 525-545.

27. Neves I.F., Rocha O., Roche K.F. and Pinto A.A. (2003). Zooplankton community structure of two marginal lakes of the river Cuiaba (Mato grass, Brazil) with analysis of rotifer and cladocera diversity. *Braz. J. Biol.,* 63(3), 329-343.

28. Schindler D.W. and Noven B. (1971). Vertical distribution and seasonal abundance of zooplankton in two shallow lakes of the Experimental Lakes Area, North western Ontario, *J. Fish. Res. Board Can.* 28, 245-256.

29. Saksena D.N. and Sharma S.P. (1981). Zooplankton fauna of some lentic water of Gwalior, Govinda sagar, Chhattri tankSawarkar Sarovar and Matsya Sarovar. *Environment India*. 13-17.

30. Nandan S.B. and Azis P.K.A. (1994). Organic matter of sediments from the retting and the non-retting areas of Kadinamkulam estuary, Southeast coast of India. *Ind J Mar Sci*. 25, 25-28.

31. Farshad H. and Venkataramana G.V. (2012). Impact of Physico-Chemical Parameters of Water on Zooplankton Diversity in Nanjangud Industrial Area, India. *Int. Res. J. Environment Sci*. 1(4), 37-42.

32. Singh S.P., Pathak D. and Singh R. (2002). Hydrobiological studies of two ponds of Satna (M P), India. *Eco. Environ. Cons.* 8, 289-292.

33. Edmondson N.T. (1965). Reproductive rates of planktonic rotifers related to food, temperature in nature. *Ecol.* 5, 61-68.

34. Qadri M.Y. and Yousuf A.R. (1980). Limnological studies on Lake Malpur sar1. *The Biotope Geo bios*. 117-119.

35. Patil C.S. and Gouder B.Y.M. (1989). Freshwater invertebrates of Dharwad (Karnataka state, India). *Prasaranga Karnatak University, Dharwad, India.* 144.

36. Sunkad B.N. and Pail H.S. (2004). Water quality assessment of Fort Lake of Belgaun, Karnataka with special reference to zooplankton. *J. Envion. Biol.,* 25(1), 99-102.

37. Watkar A.M. and Barbate M.P., Studies on Zooplankton Diversity of River Kolar Saoner, Nagpur District, Maharashtra. *J. Life Sci. Technol*. 1(1), 26-28 (2013)