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***Research Article** (Open Access)*

DOCUMENTATION ON DISTRIBUTION AND ABUNDANCE OF MICRO-CRUSTACEANS (CLADOCERA AND COPEPODA) IN SEWAGE FED TANK OF BHADRAVATHI TALUK, KARNATAKA

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ABSTRACT
The cladocera and copepoda are the micro crustaceans and play a crucial role in aquatic organic phenomenon. In the present study, water quality status of sewage fed tank near Bhadravathi town of Shivamogga district was assessed by copepod and Cladoceran analysis. During this study, 06 species of cladocerans belonging to 6 families and 07 genera and 07 species of copepods were recorded. The very best density of copepods was recorded during September (55 O/L) and their number was least (14 O/L) in May. It was observed that nutrients like sulphate, nitrate, phosphate contents were high during December and January which harbor good number of Cladocerans during these months. During this study, as per the water quality recommended by WHO and BIS standards, the tank water isn't suitable for human usage without proper treatment and most of the water quality parameters exceeded the permissible limit. The water of the tank is used for agriculture, fisheries and human anthropogenic activities. Present findings revealed that the surface quality of the water body is productive in nature with nutrient rich status.

***Keywords**: Cladocera, Copepoda, Jannapura Tank, Sewage Pollution, Water Quality*

INTRODUCTION
Cladocerans are the micro-crustaceans in water. Around 620 species are recognized so far, with more un-described. They're ubiquitous in inland aquatic habitats, but rare within the oceans. The majority of the cladocerans are 0.2 to 6.0 mm in length, with a median eye, un-segmented thorax and abdomen. Copepods constitutes a serious zooplankton communities occurring in most of the water bodies, which serve as food for several fishes and play an important role in ecological pyramids. Uttangi (2001) reported almost 120 species from India.

Bijoy Nandan and Abdul Azis (1994), Hashemzadeh Farshad and Venkataramana (2012) and Shivashankar and Venkataramana (2013) reported that ecological factors such as rainfall, river water, minimum phytoplankton abundance and increased turbidity of water limited the distribution of copepoda. Zooplanktons are susceptible to changes within the aquatic environment and any variation in their composition is usually a reaction of serious alteration in ambient conditions within an aquatic ecosystem. Their abundance can also be regulated by abiotic and biotic factors (Ramesha and Sophia, 2013; Priyanka Malhotra and Ajay Kumar, 2014).

The population density of the cladocera indicates expansion in conjunction with algal bloom (Abrantes *et al.,* 2006). *Bosmina* efficiently graze on abundance of algae, and thereby improving the water quality, which is dependent on algal dynamics (Dodson *et al.,* 2010). Copepoda is the group of zooplankton that inhabits in a variety of habitats i.e. freshwater or marine water bodies. Their density is dependent upon algae, other invertebrates and larval fishes. Copepod densities maintain the biomass and the productivity of the freshwater environments.

Main objective of this study is to characterize selected water bodies of Bangalore through physical, chemical and biological parameters.
This work involves
• Analysis of the physicochemical and biological parameters in these lakes.
• Standardizing the amount to water to be filtered for zooplankton analysis.
• Quantitative and qualitative analysis of zooplankton composition to ascertain the water quality.
The main objectives of the present study are to know;

- The varieties of Micro crustaceans (cladocera and Copepoda) in sewage fed tank.
- The Monthly occurrence of Copepoda and Cladocera in Jannapura tank
- The physico-chemical parameters of water of the Jannapura tank of Bhadravathi taluk , Karnataka.

MATERIALS AND METHODS

Study area

Sewage fed Jannapura tank is located about 3 Kms away from Bhadravathi town (Figure 1) in Shivamogga district of Karnataka (13°48'37"-13°52'30"N & 75°40'42"-75°43'33"E) and it is a perennial tank and receives the water from Bhadra left bank channel also rainfall water . The area of the tank is about 20 ha and depth is around 5-10mt respectively. This water body is used for irrigation and fisheries.

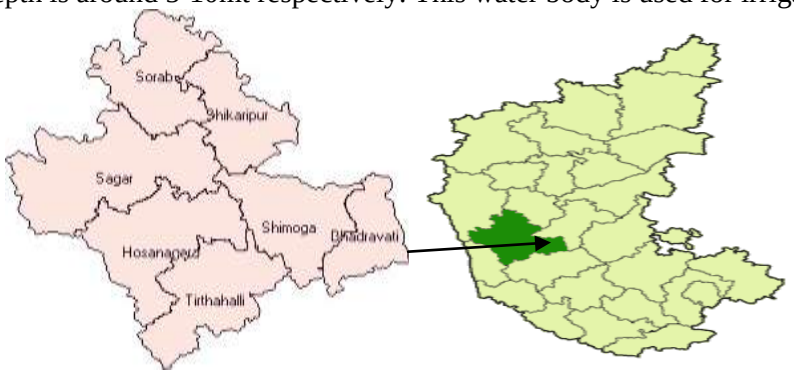

Figure 1: Location of Jannapura tank in Bhadravathi taluk (Source: www.wikipedia.org)

Micro crustacean and water Analysis

Micro crustacean samples were collected on monthly basis. The plankton net is formed of bolting nylon silk (mesh- size 50µm) is employed for collection and which is conical in shape and reducing cone with the bottle at its end. For a particular collection , the plankton net is towed horizontally and obliquely (for Qualitative) in surface water. About 100 liters of water is filtered through plankton net. Zooplankton samples were washed in bottles and preserved by adding 5% formalein solution. 1 ml of the preserved sample was put on a Sedgwick-Rafter counter cell and observed it under a microscope. Micro-crustaceans are identified as per the standard keys (Edmondson, 1959; Needham and Needham, 1962; Pennak, 1978; Tonapi, 1980) and results were expressed as Organisms per liter (O/L).
Water samples were collected by using good quality polythene bottles on monthly basis, between 8 to 10 AM from January to December 2008. Temperature of the water and pH of the tank were recorded at the sampling spot itself. Remaining water quality parameters were estimated as per the water quality methods of APHA (1998).

RESULTS AND DISCUSSION

During this study, cladocerans were represented by 6 species and the species spectrum includes; *Daphnia carinata, Moina micrura, Diaphanosoma sarsi, Bosmina longirostris. Alona pulchella* and *Macrothrix*

spinosa Table 1 depicted the scientific classification of cladocera. The utmost density of Cladocera was recorded in the December month (96 O/L) and the minimum density found in the month of August (15 O/L) (Figure 1). Maximum population of Cladoearns in winter season attributed to favorable temperature and availability of food (phytoplankton, falling of leaves from the plants during winter season) and similar findings was made by Mirgane *et al.*, (2015). Arvind and Rao (2001) recorded *Ceriodaphnia, Moina* and *Daphnia* species from polluted sewage ponds and they considered *Moina* as the foremost tolerant cladoceran. In Yeldari reservoir Sakhare and Joshi (2006) have identified 8 species of rotifers, 7 species each of cladocera, copepoda and 4 species of ostracoda.

Table 1: Scientific classification of Cladocera and copepoda in Jannapur tank

Genus		**Genus**	
Daphnia carinata	Class- Branchiopoda Order-Cladocera Family- Daphniidae	*Bosmina longirostris*	Class- Branchiopoda Order-Cladocera Family- Bosminidae
Moina micrura	Class- Branchiopoda Order-Cladocera Family- Moinidae	*Alona pulchella*	Class- Branchiopoda Order-Cladocera Family- Chydoridae
Diaphanosoma sarsi	Class- Branchiopoda Order-Cladocera Family- Sididae	*Macrothrix spinosa*	Class- Branchiopoda Order-Cladocera Family- Macrothricidae
Copepoda			
Phylum-Arthropoda Class - Maxillopoda Order – Cyclopoida Family – Cyclopidae *Mesocyclops hyalinus* *Eucyclops speratus* *Paracyclops fimbriatus* *Cyclops vicinus*		Phylum-Arthropoda Class - Maxillopoda Order – Calanoida Family – Diaptomidae *Diaptomus castor* *Leptodiaptomus minutus* *Heliodiaptomus viduus*	

Table 2: BIS and WHO Permissible limit of physico-chemical characteristics of water

Parameter	**Maximum permissible limit, BIS (2012)**	**WHO (2004)**	**Water quality range (Present study)**
pH	8.5	9.2	7.3-8.3
TDS (mg/l)		500	-
DO (mg/l)	6	6	2.4-4.8
BOD (mg/l)	5	6	4.8-16.8
Total Hardness (mg/l)	600	300	280-390
Calcium(mg/l)	200	100	18-50
NO_3 (mg/l)	No relaxation	-	14.6-54.4
Chloride (mg/l)	1000	250	180-270
Sulphate (mg/l)	400	200	48.6-70.8
Magnesium (mg/l)	100	150	16-40
Alkalinity (mg/l)	600	-	

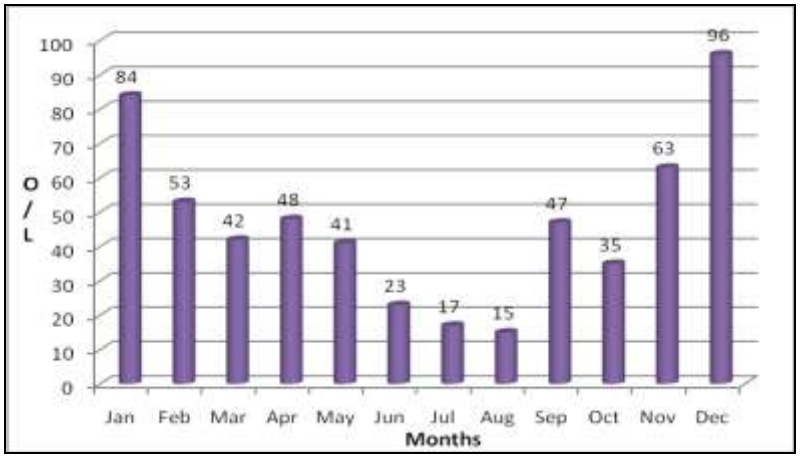

Figure 2: Monthly abundance of Cladocerans (O/L) in Jannapura tank

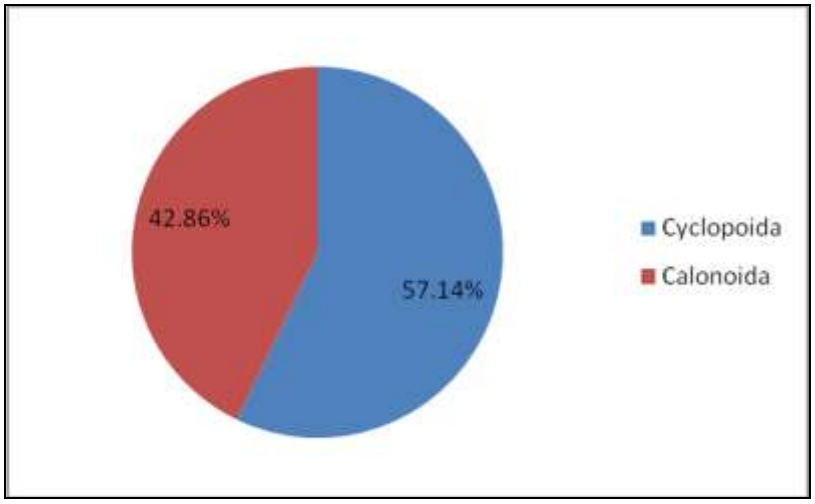

Figure 3: Percentage composition of orders of Copepoda in Jannapura tank

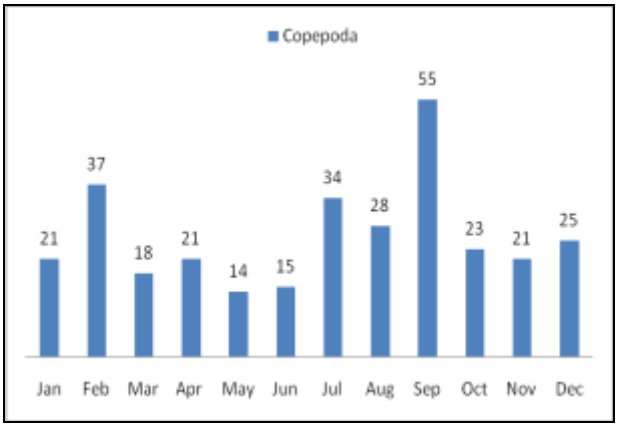

Figure 4: **Monthly abundance and distribution of Copepoda (O/L) in Jannapura tank**

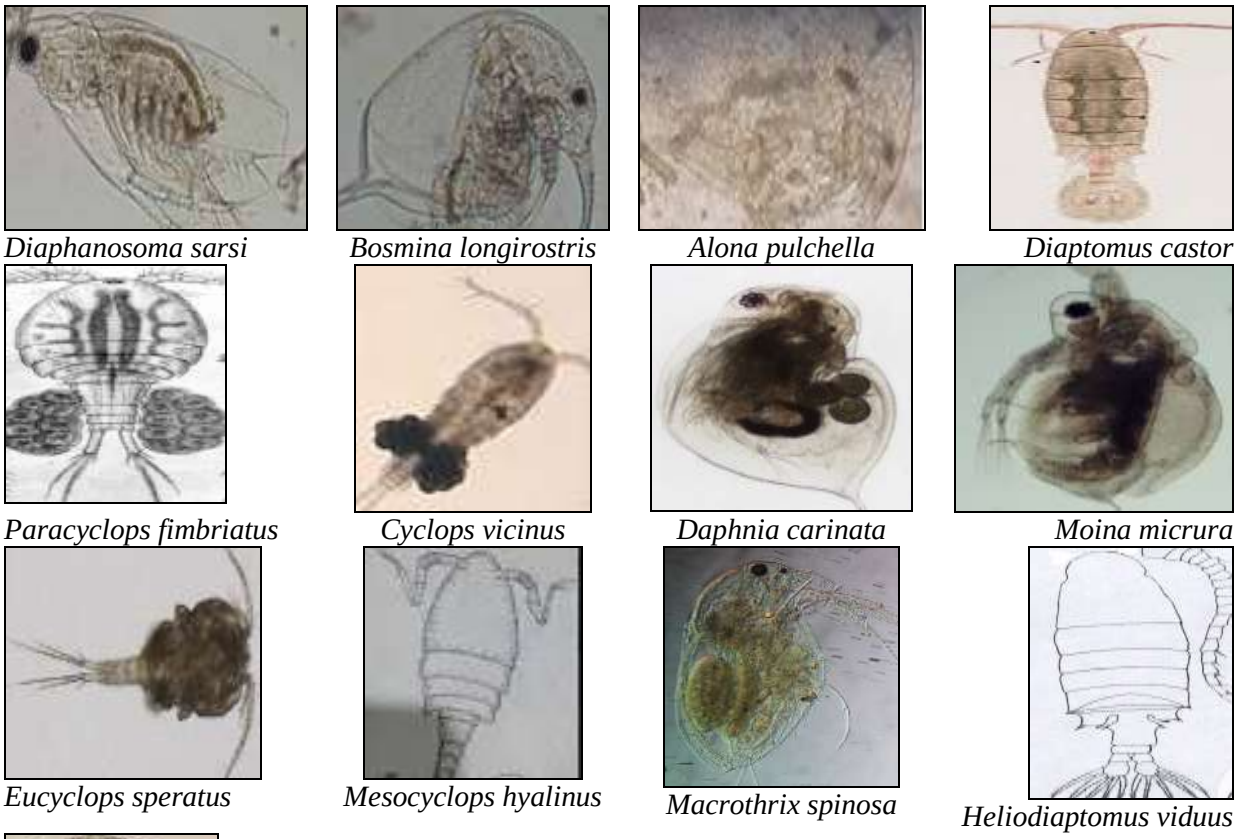

Figure 5: Micro-crustaceans(Cladocera &Copepoda) in Sewage fed tank,Bhadravathi taluk

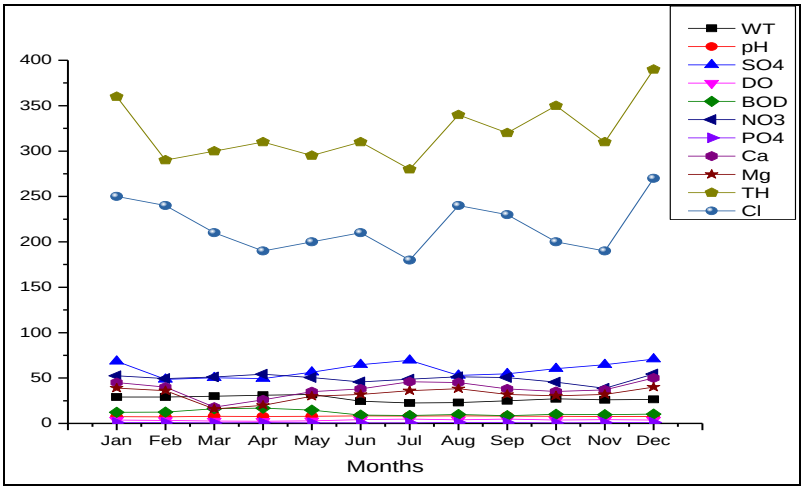

Figure 6: Monthly water quality data of Jannapura tank *(All the parameters are in mg/L except pH)*

Vipul Sharma *et al.,* (2012) opined that nutrients, weeds and depth of the water bodies favored rich abundance of cladocerans. Cladocerans are food source for fry, fingerlins and adult of the many food fishes. Cladocerans are the indicators of eutrophic water bodies (Sharma, 2001; Dutta and Patra, 2013). *Moina* species demonstrates the power to survive in waters containing low oxygen levels also as high salinity and other impurities and commonly eutrophication (Vignatti *et al.,* 2013).

Verma and Dalela (1975) reported that *Bosmina, Daphnia,* and *Alona* species were found in polluted waters, whereas, Rao (1987) stated that cladocerans were occurred in eutrophic water bodies. Cladocerans are recognized to be plentiful in water with good quality littoral plants, while, ponds and lakes without plant life have fewer cladoceran speices (Idris and Fernando, 1981). In this study nutrients like nitrate and phosphate contents were fluctuated from 14.6-54.4 mg/L and 0.28-1.08 mg/L respectively which in turn supports good number of cladocerans. Therefore, present findings are in conformity with the above researchers.

A total of 07 genera and 07 species of copepods were recorded (Table 1 & Figure 5) and the species include *Mesocyclops hyalinus, Eucyclops speratus, Paracyclops fimbriatus, Cyclops vicinus, Diaptomus castor, Heliodiaptomus viduus* and *Leptodiaptomus minutus* (Table 1 & Figure 5). The families like cyclopidae and Diaptomidae consists of 4 species and 03 species of copepods respectively. Figure 3 depicted percentage composition of orders of Copepoda in Jannapura tank. The highest density of copepods recorded during September (55 O/L) and their number was least (14 O/L) in May (Figure 4). Analogous findings were made by Padmavati and Goswami (1996), Ahmad *et al.,* (2011) and Mirgane *et al.,* (2015) in various water bodies.

Water Quality

Figure 6 depicts monthly data of the physico-chemical parameters of the tank water. The water temperature varied from 22.5^{o} C to 32^{o} C. pH of the tank water was alkaline. The sulphate content fluctuated between 48.6 and 70.8 mg/L. Dissolved oxygen level of 2.4 to 4.8 mg/L was recorded. BOD content fluctuated from a minimum of 4.8mg/l to a maximum of 16.8 mg/L. Calcium content deviated from 18 to 50 mg/L but magnesium content was slightly less than calcium and ranged between 16-40 mg/L. However, the nitrate and phosphate contents were deviated from 14.6-54.4 mg/L and 0.28-1.08 mg/L respectively. Total hardness of water ranged from 28- to 390 mg/L and it included under hard category. Chloride content deviated from 180 to 270 mg/L. It was found that Jannapura tank receives sewage water from surrounding areas and therefore the depth of the tank is slowly reduced due to deposition of sediment from surface runoff. Consistent with Bureau of India Standards (1993) and World Health Organization (1991) standards and it's found that, tank water is included under eutrophic category because it possesses low DO and high BOD, phosphate and nitrate. Most of the water quality parameters exceeded the permissible limit prescribed by WHO and BIS standards (Table 2) and the tank water is not good for human usage.

CONCLUSION

From these findings on physico-chemical relationship with micro crustaceans of a sewage fed tank the water isn't suitable for human usage because it possess higher values of phosphate and nitrate from incoming sewage. Cladocera contributed to secondary production of the tank. Zooplankton species like *Ceriodaphnia, Moina* and *Daphnia* indicate organic pollution and considered *Moina* as the foremost tolerant species. Copepoda species like *Cyclops* and *Diaptomus* indicate organic pollution. The Jannapura tank is included under eutrophic category which is an account of disposal of sewage and human anthropogenic activities. The tank are often conserve and manage by the concerned authorities. There is a correct disposal method for the raw sewage in Jannapura tank as this is often seriously threatening public health. Constructed ponds can reduce the ecological implications as they will remove BOD, nutrients (phosphate and nitrate) to significant levels. Therefore, it's necessary to implement

practices and policies to preserve the standard of water and water is one among the foremost valuable natural resources and citizenry depend upon it greatly.

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