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A report on diversity of cladocera in sewage fed tank of Bhadravathi taluk, Karnataka

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Abstract
The Cladocera are a zooplankton and play an important role in aquatic food chain. In the present study water quality status of sewage fed tank near Bhadravathi town of Shimoga district was assessed by Cladoceran analysis during January to December 2008. In this study, 06 species of cladocerans were recorded, belonging to six families viz. the, Daphniidae, Moinidae, Bosminidae, Macrothricidae, Sididae and Chydoridae. It was observed that rich nutrients coupled with the presence of aquatic weeds favored abundance of cladocerans. In this study, as per water quality recommended by WHO and BIS standards, the tank water is not suitable for human consumption and most of the water quality parameters exceeded the permissible limit prescribed by WHO and Central pollution control Board standards. The present findings revealed that the surface quality of the water body is productive and eutrophic.

Keywords: Cladocera, Jannapura tank, sewage pollution, water quality parameters.

1. Introduction
The Cladocera are an order of small crustaceans commonly called water fleas. Around 620 species have been recognized so far, with many more un-described. They are ubiquitous in inland aquatic habitats, but rare in the oceans. Most are 0.2–6.0 mm (0.01–0.24 in) long, with a down-turned head with a single median compound eye, and a carapace covering the apparently unsegmented thorax and abdomen. Most species show cyclical parthenogenesis, where asexual reproduction is occasionally supplemented by sexual reproduction, which produces resting eggs that allow the species to survive harsh conditions and disperse to distant habitats (en.wikipedia.org) [19].
Zooplankton are sensitive to changes in the aquatic environment and any variation in their composition is often a reaction of significant alteration in ambient conditions within aquatic ecosystem. The factors regulating their abundance may be hydrological, chemical, physical and biotic (Ramesha and Sophia, 2013; Priyanka Malhotra and Ajay Kumar, 2014) [10, 9]. Therefore, the current investigation deals with diversity of cladocerans in relation to physico-chemical factors of sewage fed tank of Bhadravathi taluk, Karnataka.

2. Materials and Methods
2.1. Study area
Sewage fed Jannapura tank is located near Bhadravathi town in Shimoga district of Karnataka (13o48'37"-13o52'30"N & 75o40'42"-75o43'33"E) and it is perennial one and receives the water from Bhadra left bank channel as well as rain water. The area of the tank is 20 ha and depth of about 5-10mt.This water body is used for irrigation and fish culture.
Water samples were collected by using good quality polythene bottles on monthly basis, between 8 to 10 AM from January to December 2008. Water temperature and pH were recorded at the sampling site itself. Dissolved oxygen was fixed on the spot itself in BOD bottles. Remaining water quality parameters were estimated as per the standard methods of APHA (1998) [1].

2.2. Cladoceran Analysis
Cladocera samples were collected on a monthly basis. The plankton net is made of bolting nylon silk (mesh- size 50 µm) is used for collection and which is conical shape and reducing cone with the bottle at its end. For a precise collection, the plankton net is towed horizontally and obliquely (for Qualitative) in surface water of the study area.

About 100 liters of water is filtered by passing water through plankton net. Samples were then washed into wide mouth bottles and were preserved by adding 5% formaldehyde solution. Further analysis was done by putting 1 ml of the preserved sample on a Sedgwick-Rafter counter cell and studying it under an inverted microscope. For qualitative analysis, the keys given in Edmondson (1959) [5], Needham and Needham (1962) [7], Pennak (1978) [8] and Tonapi (1980) [14] were utilized and results were expressed as Organisms per liter (O/L).

3. Results and Discussion

In this study cladocera was represented by 6 species. The species includes; Daphnia, Moina, Diaphanosoma, Bosmina sp. Allona sp. and *Macrothrix* sp. Table 1 depicted scientific classification of cladocera.

The maximum density of Cladocera was in the month December 2008 (96 O/L) and the minimum density recorded in month August (15 O/L) (Figure 1). Maximum population of Cladocerans in winter attributed to favorable temperature and availability of food and the similar findings was made by Mirgane *et al.* (2015) [6].

Arvind and Rao (2001) [2] recorded *Ceriodaphnia, Moina* and *Daphnia* species from polluted sewage ponds and they considered *Moina* as the most tolerant cladoceran. Sakhre and Joshi (2006) [12] reported 8 species of rotifers, 7 species each of cladocera and copepoda and 4 species of ostracoda in Yeldari reservoir. Vipul Sharma *et al.* (2012) [16] reported that rich nutrients, the presence of weeds and shallow waters favored rich diversities of cladocerans.

Cladocerans are important food source for fry, fingerlings and adult of many economically important fish species. Cladocerans are also reported to be the indicators of eutrophic nature of water bodies (Sharma, 2001; Tapas Kumar Dutta and Bidhan C. Patra. 2013) [13, 15].

Moina species demonstrates the ability to survive in waters containing low oxygen levels as well as high salinity and other impurities and commonly eutrophication (Biota Neotropica, vol.13 no.3 Campinas July/Sept. 2013).Verma and Dalela (1975) [17] recorded *Bosmina, Daphnia*, and *Alona* species in polluted waters. While, Rao (1987) [11] stated that cladocerans are rich in eutrophic waters. Therefore, present findings are in conformity with the above researchers.

Table 1: Scientific classification of Cladocera in the present study

Genus		Genus	
Daphnia	Class- Branchiopoda Order-Cladocera Family- Daphniidae	*Bosmina*	Class- Branchiopoda Order-Cladocera Family- Bosminidae
Moina	Class- Branchiopoda Order-Cladocera Family- Moinidae	*Alona*	Class- Branchiopoda Order-Cladocera Family- Chydoridae
Diaphanosoma	Class- Branchiopoda Order-Cladocera Family- Sididae	*Macrothrix*	Class- Branchiopoda Order-Cladocera Family- Macrothricidae

3.1. Water Quality

The water temperature varied from 22.5 ^{o}C to 32 ^{o}C. pH of the water was alkaline in nature and the sulphate of water fluctuated from 48.6 to70.8 mg/L respectively. High Dissolved oxygen level of 4.8 mg/L and minimum of 2.4 mg/L was recorded. BOD level fluctuated from 4.8 to 16.8 mg/L. Calcium content deviated 18 to 50 mg/L but magnesium content was slightly lower 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. It is found that Jannapura tank receives sewage water from surrounding areas and the depth of the tank is slowly reduced due to deposition of sediment from surface runoff. According to Bureau of India Standards (1993) and World Health Organization (1991) standards and it is found that, tank water is included under eutrophic category as it possesses low DO and high BOD, phosphate and nitrate. Most of the water quality parameters exceeded the permissible limit prescribed by WHO and Central pollution control Board standards (Table-2).

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

Parameter	Maximum permissible limit, CPCB (1995)	WHO (2004)
pH	6.5-8.5	7.0-8.5
TDS (mg/l)	500	500
TSS (mg/l)	100	-
BOD (mg/l)	30	6
COD (mg/l)	250	-
Calcium (mg/l)	75	-
NO_3 (mg/l)	45	10
Chloride (mg/l)	200	-
Sulphate (mg/l)	200	-
Total hardness (mg/l)	-	500
Alkalinity (mg/l)	30	120

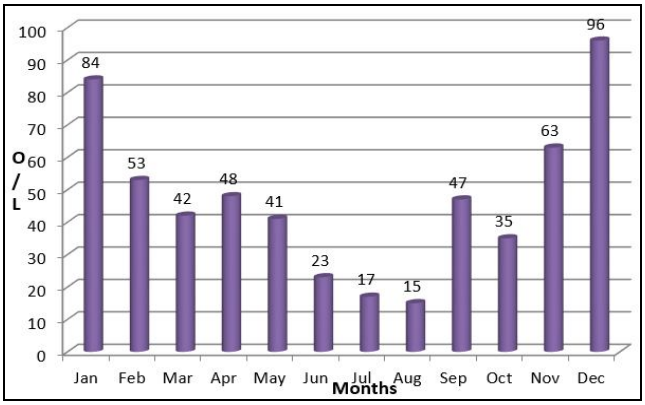

Fig 1: Monthly abundance of Cladocerans (O/L) in Jannapura tank during 2008

4. Conclusion

From the present findings on physico-chemical relationship with cladocera zooplankton of a sewage fed tank the water is not suitable for human consumption as it possess higher values of phosphate and nitrate from incoming sewage. Cladocera constitute the zooplankton population and contributed significantly to secondary production of the tank. Zooplankton species such as *Ceriodaphnia, Moina* and *Daphnia* indicate organic pollution and considered *Moina* as the most tolerant cladoceran. The Jannapura tank is under eutrophic condition which is an account of disposal of sewage and human anthropogenic activities. The tank can be conserve and manage by the concerned authorities.

There is a need to establish a proper disposal method for the raw sewage in Jannapura tank as this is seriously threatening public health. Constructed wetlands can reduce BOD, suspended solids, phosphate and nitrate to significant levels. Therefore, it is necessary implement practices and policies to preserve the quality of water and water is one of the most valuable natural resources and human beings depend on it greatly.

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