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Research Article

Species Composition and Frequency Distribution of Different Classes of Micro-Zooplanktons in River Cauvery and Its Important Tributaries in South Karnataka

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ABSTRACT

The Species composition and frequency distribution of different classes of micro-zooplanktons in river Cauvery and its four upstream tributaries were studied. The river Lakshmanatheertha was entirely different in terms of biodiversity or species composition of micro zooplankton. For the study of micro zooplankton diversity, one liter of mid stream surface water samples were collected in polythene cans fortnightly and were preserved in 10% Lugols–Iodine solution, for 24 hours. The sedimentation was concentrated to only 20ml, by siphoning off the remaining 980ml of the supernatant. Their number was counted by drop count method and identification was done by using Epifluorescence microscope (BX40, Olympus, Japan). The result revealed that all the micro zooplanktons identified in this investigation were classified under Ciliates, Sarcodines (Amoebae), Copepods, Cladocerans and Rotifers. Based on species composition and frequency distribution zooplankton the Ciliata was the largest and most diverse group (15 genera) followed by Sarcodines (Amoebae) comprising 10 genera, Rotifera 6 genera and Copepoda and Cladocerans 1 genera each. Further, Ciliates form an important link in energy transfer from bacteria, ultra plankton and nanoplankton to higher trophic levels. In addition they also increase the availability of nutrients for phytoplankton growth. In this study more ciliate protozoan was recorded in the river Lakshmanatheertha. The presence of zooplankton species like Paramecium, Strobilidium, Glaucoma, Colpodium, Cyclidium, Coleps, Colpoda, Cyclops, Daphnia, Keratella, Lepadella, Brachionus etc., were recognized as pollution indicators. The presence of all these species in the fresh water indicates eutrophic condition. The eutrophic condition in the present investigation was noticed in river Lakshmanatheertha compared to other water courses studied.

Keywords: *Heterotrophic organism, Pollution indicators, Rotifers, Cladocerans, River cauvery*

INTRODUCTION

Water is aptly described as the 'Mother of life', and is the most essential and basic component of all living things (both plants and animals including microorganisms), as it supports the life processes by providing vital or essential nutrients to living organisms.

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As most of the bio-chemical reactions that takes place through the metabolism and growth of living (both unicellular and multicellular) organisms involves water, without water no life is possible to sustain on this planet Earth. The micro zooplanktons are ecologically and economically important heterotrophic tiny aquatic organisms between 2 to 200µm in size. They exhibit weak power of locomotion, as they move at the mercy of water current. Zooplanktons are taxonomically divers group includes ciliates, flagellates, dinoflagellates, sarcodines (Amoebae) and small metazoans (Stelfox et al., 2000). They are either herbivorous feeding on the phytoplankton or carnivorous feeding on other zooplankton and in turn which forms the food sources to the fishes. Thus, the fresh water micro zooplanktons are called primary consumers; they act as primary and secondary links in the aquatic food chain (Roberto et al., 1998). They also play an important role in indicating the presence or absence of certain species of fishes (Pulle & Khan, 2003). Further, without these primary consumers, the herbivorous and other levels of aquatic food chain would collapse (Wetzel, 2000). Among all the freshwater aquatic biota, the micro zooplankton population is able to reflect the nature and potential of any aquatic systems (Kumar et al., 2010). They are the effective consumers of prey as small as bacteria to organisms nearly as large as themselves (Murrell et al., 1998), and their predatory effects on the microbial community are species specific (Adrian & Schneider Olt, 1999; Mohr and Adrian 2000). Generally, zooplankton release nutrients, the released nutrients may enhance the growth of bacteria and other phytoplankton, both of which are serves as prey for heterotrophic nano flagellates (HNF) and ciliates. The micro zooplankton fraction (<200µm) is dominated by ciliates and dinoflagellates which at times they may constitute up to 43% of the biological seston (Froneman, 2000), and their role in the microbial food webs are to consume bacteria (Nakano et al., 2001). Further, the bacteriovorous flagellates could dramatically affect the rate of nitrification in aquatic systems by consuming the nitrifying bacteria (Rezai et al., 2003). Because of their grazing activity, bacteriovorous flagellates can play an important role in the recycling of nutrients (Auer and Arndt, 2001), and in turn they are consumed by the metazoan zooplankton and ciliate Protozoans (Jurgens and Gude, 1994). Generally, the heterotrophic nano flagellates are the most important consumers of bacteria (Nakano, et al., 1998), while ciliates can be temporarily significant bacterial consumers (Simek et al., 1995), rotifers are usually less important (Pace et al., 1990). Cladocera of the genus Daphnia are also among the most important consumers of bacteria and their impact is occasionally greatest of all heterotrophs (Sanders et al., 1989; Pace et al., 1990). Further, more than 50% of the primary production was channeled through the microbial loop. Ciliates responded rapidly to increased phytoplankton biomass and production. Because, the ciliates satisfied their food demand primarily by feeding on algae, as they consume up to 14% of primary production. While, the metazoan micro zooplankton i.e., copepod, nauplii and rotifers utilize only 7% of primary production. The Feeding rates of zooplankton were low during high turbidity, because light limitation of phytoplankton production intensifies in turbid waters. Under such conditions zooplankters with chemosensory food selection capabilities might be expected to predominate (Hart, 1988). However, there are many zooplankton which play important role in biological control for example, cyclopoids such as species of *Microcyclops*, *Megacyclops* and *Mesocyclops* attack mosquito larvae (Altaff, 2004). The micro zooplanktons are the vital and major fish food community is severely affected by pollutants and it is being reported that only few resistant species survived in affected waters (Sharma et al., 2000). Thus, zooplankton community can be considered as an indicator of environmental variability (Chiba et al., 2001). A number of studies have been carried out on ecological condition of freshwater bodies in various parts of India

(Singh et al., 2002; Smith et al., 2007; Rajagopal et al., 2010). However, the information on relation to micro zooplankton fauna is very limited in fresh water ecosystems (Ahmad and Siddiqui, 1995, Choudhary and Singh, 1999). Only few studies are recorded in the other rivers, For eg., in river Gomti (Bhattacharya & Ratan, 1988), in river Cauvery and Kapila (Somashekar, 1988), in river Arpa (Nomita Sen et al., 1992), in river Sabarmati (Rana & Jameson, 2000), and also in other water bodies like temperate estuary (Froneman, 2000), in lake (Ferrara et al., 2002). So the present investigation attempts to study the species composition and frequency distribution of micro zooplankton species in the river Cauvery and its four upstream tributaries.

MATERIALS AND METHODS

One liter of mid stream surface water samples from rivers Lakshmanatheertha, Harangi, Hemavathy, Lokapavani and Cauvery were collected in polythene cans fortnightly during the study period. For the study of micro Zooplankton, the water samples were preserved in 10% Lugols–Iodine solution. The Lugols-Iodine solution helps to promotes settling of plankton cells. Further, it stains the cells and also preserves cilia and flagella of zooplankton intactly. Micro Zooplankton, from one liter preserved samples was concentrated by sedimentation method for 24 hours. The sedimentation was concentrated to only 20ml, by siphoning off the remaining 980ml of the supernatant. Their number was counted by Lackey's (1938) drop method using Epifluorescence microscope (BX40, Olympus, Japan). Identification was done by following Fritsch (1975), Desikachary (1959) and Anand (1998). The number of micro Zooplanktons was calculated by employing the following formula as advocated by Nomita Sen et al. (1992).

$$\text{Number of Organisms ml}^{-1} = \frac{A \times 1/L \times n/V}{1000}$$

Where, A= Number of organisms per drop.
V= Volume of one drop (0.05 ml)
n= Total volume of concentrated sample (20 ml)
L= Volume of original sample (1 liter).

RESULT AND DISCUSSION

In the current investigation, all the micro zooplanktons identified in the five watercourses were classified under Ciliates, Amoebae, Copepods, Cladocerans and Rotifers. The Ciliates and Sarcodines (Amoebae) were the dominant groups followed by Rotifers, Copepods and Cladocerans. The group Ciliates represented more in density (Org. ml^{-1}) than the remaining zooplankton groups. Comparatively, the Cladoceran group represented less in number and was also sparsely distributed, but are completely absent in the rivers Harangi, Hemavathy and Cauvery. However, the group Osterocoda was completely absent in all the five watercourses studied (Table. 1). The Species composition and frequency distribution of different classes of micro zooplankton was revealed that, the largest and most diverse group noticed was the Ciliata (15 genera) followed by Sarcodines (Amoebae) comprising 10 genera, Rotifera 6 genera and Copepoda and Cladocerans 1 genera each (Table. 2). The common Ciliates represented in this study were *Paramecium*, *Cyclidium*, *Strobilidium*, *Colpidium*, *Glaucoma and Coleps*. Generally, *Nassula* sp. was absent in the rivers, Harangi, Hemavathy and Cauvery. *Chilodinella*, *Vorticella* and *Gastrotricha* sp, were absent in the rivers Harangi, Hemavathy and Lokapavani, whereas *Pleuronema* and *Stylonychia* were noticed only in the river Lakshmanatheertha. All the ciliate species recorded in the present study were more common in the river Lakshmanatheertha. The species like *Paramecium*, *Strobilidium*, *Cyclidium*, *Colpodium*, *Coleps*, *Nassula and*

Colpoda were found frequently, whereas the *Glaucoma* was the only species found to be more in the river Lakshmanatheertha than the other four water courses. The presence of ciliates in the fresh water indicates eutrophic condition, because most of the ciliates are extremely tolerant of the range of conditions found in fresh water (Beaver & Crisman, 1982). Further, Ciliates form an important link in energy transfer from bacteria, ultra plankton and nanoplankton to higher trophic levels (Beaver & Crisman, 1982). In addition to their role in energy transfer to higher trophic levels, they increase the availability of nutrients for phytoplankton growth (Beaver & Crisman, 1982). Thus, in the present investigation, comparatively more ciliate protozoan was noticed in the river Lakshmanatheertha. The low water level, maximum anthropogenic activities, contamination of sewage, agricultural wastes and untreated effluents, and eutrophic nature of water, all of which enriches the nutrient level in the water, might be the reason. Similar findings have been reported in higher Eutrophic Lake by Nakano et al., 1998. Further, ciliates were the dominate fauna in eutrophic condition (Forsyth and James, 1991). Frequently encountered forms of Sarcodines (Amoebae) include *Amoeba radiosa, Vampyrella, Acanthamoeba, Amoeba, Entamoeba, Nucleria, Acanthocystis,* and *Oxnerella.* All these species were commonly noticed in the river Lakshmanatheertha. However, *Vampyrella, Actinophrys,* were absent in the rivers Harangi, Hemavathy and Cauvery, whereas, *Acanthamoeba, Oxnerella* and *Entamoeba* were present only in the river Lakshmanatheertha, but were absent from the remaining water courses studied. Sarcodines (Amoebae) represented as second group in terms of species composition (Table 2). Further, the commonly encountered forms i.e., *Amoebae radiosa, Vampyrella, Acanthamoeba, Actinoprys, Nucleria, Oxnerella* and *Entamoeba* were the common species noticed in the river Lakshmanatheertha only. The organically enriched aquatic habitats generally contain more number of Sarcodines (Amoebae) species (Patterson, 1983; 1984 and 1985). In the present survey river Lakshmanatheertha was considered as nutrient enriched environment, so that, more number of sarcodines species was encountered in this river. The group Rotifera was represented by *Keratella, Monostyla, Lepadella, Mytilina, Brachinous* and *Lacane,* all these species were common in the river Lakshmanatheertha. However, *Keratella* was absent in the rivers Harangi, Hemavathy and Cauvery. Whereas, *Lepadella* was absent in the rivers Hemavathy and Cauvery; *Monostyla* was absent in the river Harangi and *Lacane* in the river Hemavathy. Similarly, *Mytilina* was absent in the rivers Harangi, Hemavathy and Lokapavani. In Rotifers, among the 6 species represented the *Brachinous* found frequent in rivers Lakshmanatheertha and Lokapavani. However, all the six species of rotifers were found common in the river Lakshmanatheertha only. The presence of more rotifers species in this river was indicated the eutrophic condition of the water. This was in agreement with the similar findings in eutrophic and oligo-mesotrophic lakes (Maier and Buchholz, 1996). Copepods represented by only 1 genus i.e. *Cyclops,* which was common in all the five watercourses, but more frequently seen in river Lakshmanatheertha. The presence of *Cyclops* can tolerate substantially low level of oxygen indicating the organic pollution (Aycock, 1942; Bhattacharya and Ratan, 1988; Pandey et al., 2000). The group Cladocera was totally absent in the rivers Harangi, Hemavathy and Cauvery throughout the study period. The group Cladocera was represented by only one genus i.e. *Daphnia*, which was found rarely, in rivers Lakshmanatheertha and Lokapavani. Predominance of *Daphnia* is characteristic of oligo-mesotrophic condition of the aquatic ecosystem (Ferrari, 1972; Ferrara, 1984; Ferrara et al., 2002). However, in the present study *Daphnia* was found rarely which showed Oligotrophic status of these watercourses. Interestingly, none of the Osterocoda species were found in all the rivers during the study period. Thus, in this investigation, the presence of zooplankton species like *Paramecium, Strobilidium, Glaucoma,*

Colpodium, Cyclidium, Coleps, Colpoda, Cyclops, Daphnia, Keratella, Lepadella, Brachionus etc., were recognized as pollution indicators. Further, the zooplankton diversity responds rapidly to changes in the aquatic environment. Several zooplankton species are served as bio indicators (Ahmad et al., 2011, Mola, 2011).

Table 1: Species density of micro-zooplankton (Org l^{-1}) under different Classes in river Cauvery and its tributaries

Sl. No.	Classification	Lakshmanatheertha	Harangi	Hemavathy	Lokapavani	Cauvery
1	Ciliates	3,36,000	72,000	86,000	1,10,000	1,14,000
2	Amoebae	1,12,000	20,000	18,000	29,000	37,000
3	Copepods	19,000	4,000	2,000	5,000	3,000
4	Cladocerans	14,000	Absent	Absent	5,000	Absent
5	Rotifers	42,000	5,000	4,000	18,000	12,000

Table 2: Species composition and frequency distribution of different groups of Zooplankton in river Cauvery and its tributaries

Sl. No	Zooplankton	Lakshmanatheertha	Harangi	Hemavathy	Lokapavani	Cauvery
Ciliates						
1	Euplotes	+	-	-	-	-
2	Paramecium sp.	++	+	+	+	+
3	Cyclidium sp.	++	+	+	++	+
4	Strobilidium sp.	++	+	+	+	+
5	Colpidium sp.	++	+	+	+	++
6	Glaucoma sp.	+++	+	+	+	+
7	Coleps sp.	++	+	-	+	+
8	Nassula sp.	++	-	-	+	-
9	Chilodinella sp.	+	-	-	-	+
10	Blepharisma sp.	+	+	-	+	-
11	Pleuronema sp.	+	-	-	-	-
12	Vorticella sp.	+	-	-	-	+
13	Colpoda sp.	++	-	-	-	+
14	Gastrotricha sp.	+	-	-	-	+
15	Stylonychia sp.	+	-	-	-	-
Amoebae						
1	Amoebae radiosa	++	-	-	-	+
2	Vampyrella sp.	+	-	-	+	-
3	Acanthamoeba sp.	+	-	-	-	-
4	Amoeba.	++	+	+	+	+
5	Actinophrys sp.	+	-	-	+	-
6	Arcella sp.	-	-	-	-	+
7	Nucleria sp.	+	+	+	+	+
8	Raphidiophrys sp.	-	+	-	+	-
9	Oxnerella sp.	+	-	-	-	-
10	Entamoeba.	+	-	-	-	-
Copepods						
1	Cyclops sp.	++	+	+	+	+
Cladocerans						
1	Daphnia sp.	+	-	-	+	-
Rotifers						
1	Keratella sp.	+	-	-	+	-
2	Monostyla sp	+	-	+	+	+
3	Lepadella sp.	+	+	-	+	-
4	Mytilina sp.	+	-	-	-	+
5	Brachinous sp.	++	+	+	++	+
6	Lecane sp.	++	+	-	+	+

+++ = Abundant, ++ = Frequent, + = Rare, - = Absent.

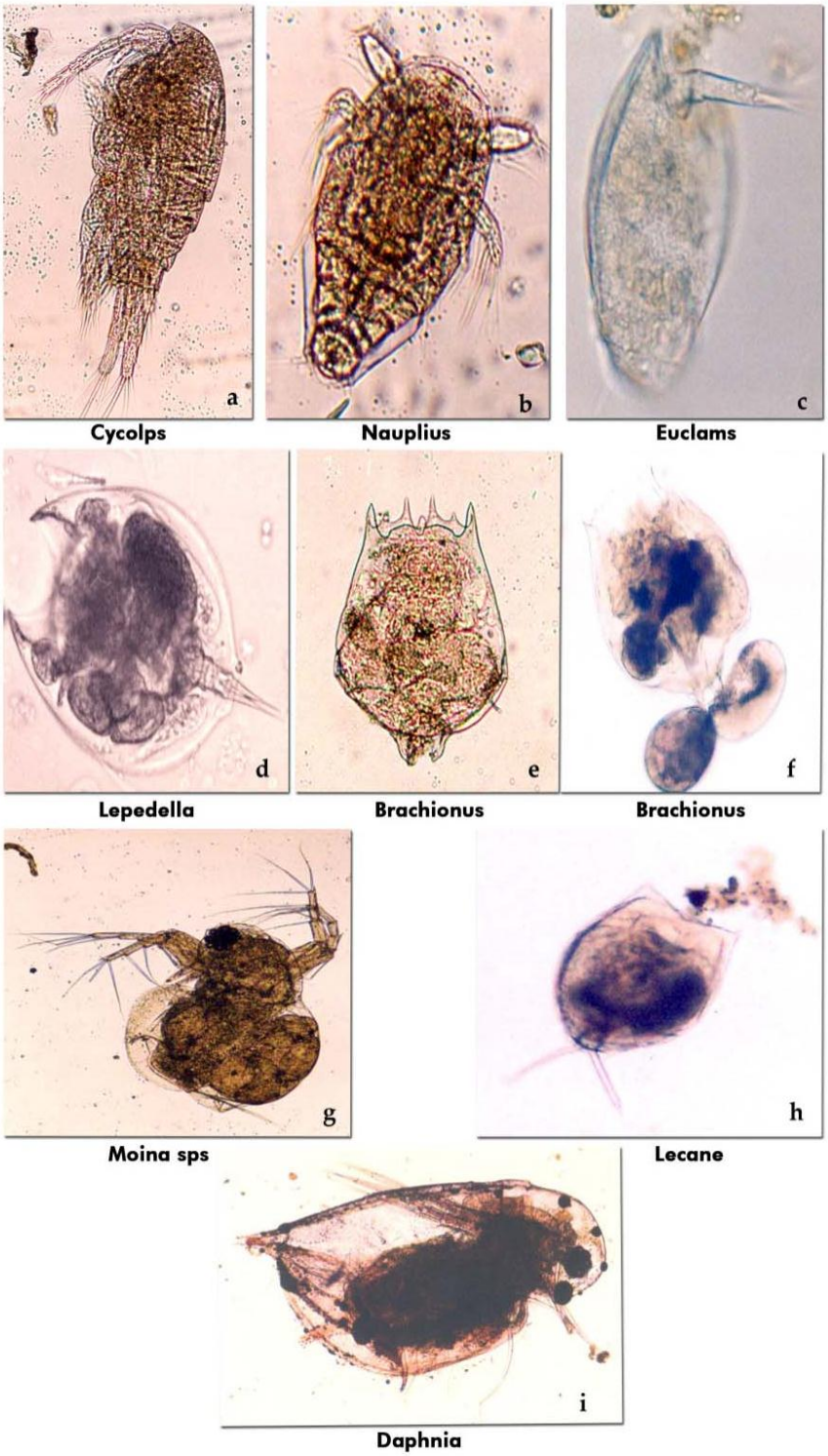

Plate 1: Representative micro-zooplanktons from the surface waters of five lotic ecosystems of river Cauvery

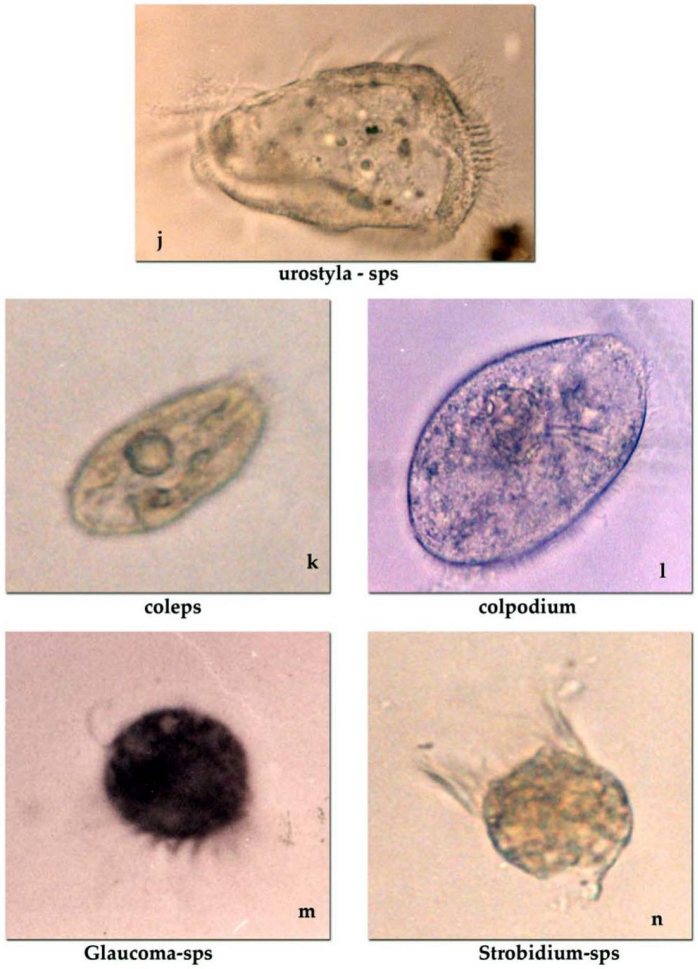

Plate 2: Representative micro-zooplanktons (Ciliates) from the surface waters of five lotic ecosystems of river Cauvery

CONCLUSION

Over all it was concluded that, the species composition and frequency distribution of different classes of micro-zooplanktons in river Cauvery and its four upstream tributaries were studied and revealed that, the river Lakshmanatheertha was entirely different in terms of species composition of micro zooplankton. Low water level, indiscriminate human activities, contamination of sewage, agricultural wastes and untreated effluents, and eutrophic nature of water might have interference with this change. The result revealed that all the zooplanktons identified in the five watercourses were classified under Ciliates, Amoebae, Copepods, Cladocerans and Rotifers. The species composition and frequency distribution of different classes of zooplankton was revealed that, largest and most diverse group recorded was the Ciliata (15 genera) followed by Sarcodines (Amoebae) comprising 10 genera, Rotifera 6 genera and Copepoda and Cladocerans 1 genera each. The presence of zooplankton species like *Paramecium, Strobilidium, Glaucoma, Colpodium, Cyclidium, Coleps, Colpoda, Cyclops, Daphnia, Keratella, Lepadella, Brachionus etc.*, were recognized as pollution indicators. The presence of all these species in the fresh water indicates eutrophic condition. Thus, in the present investigation, it was noticed that, more species composition of micro zooplanktons was noticed in the river Lakshmanatheertha when compared to other four watercourses studied. The low water level, maximum anthropogenic

activities, contamination of sewage, agricultural wastes and untreated effluents, and eutrophic nature of water, all of which enriches the nutrient level in the river Lakshmanatheertha, might be the reason for increased species composition in this ecosystem.

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