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E: ISSN NO.: 2455-0817 *Remarking An Analisation*

Effect of Urbanization on the Zooplanktonic Diversity of Gang Canal in Sriganganagar, Rajasthan

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Abstract

Zooplanktons are good indicator of the changes in water quality so their diversity is one of the most important ecological parameters in water quality assessment. So the present study was undertaken to explore the diversity and ecology of Zooplanktons in three sites of gang canal. The present observations were made for a period of fifteen months from September, 2012 to November, 2013. They were identified by following standard taxonomic keys and illustrations. The zooplanktons were identified in the gang canal water which was belonged to three groups: Rotifera, Cladocera and Protozoa. Six Genera of zooplankton were observed in three sites of gang canal belonging to above three groups. Rotifera was the dominant group followed by Cladocera and Protozoa. Zooplankton of site III showed the dominance of Rotifers like Brachionus spp.,and Keratella spp throughout the investigation and medium amount of abundance of Cladocera like Moina spp. occurred in comparison of site I and Site II . These zooplanktonic forms Brachionus spp., Keratella spp and Moina spp. were observed at site III of Gang Canal in the present study as indicators of organic pollution. Therefore, they can be significantly applied as indicators of organic pollution. It can be concluded that site III is going to polluted and rapidly turning towards eutrophication in future. So our findings highlighted the deterioration of water quality at the site III in the Gang canal due to urbanization and human activities. The study recommended avoiding as far as possible the discharge of untreated sewage and other pollutants into the water.

Keywords: Zooplankton, Gang Canal, Sriganganagar, Organic Pollution, Eutrophication, Urbanization.

Introduction

Zooplanktons that are heterotrophic planktonic animals floating in water constitute an important food source for many species of aquatic organisms (Guy, 1992). Ovie (2011) defined zooplankton as the free-floating, aquatic invertebrates, often described as microscopic because of their usual small sizes that range from a few to several micrometers and are rarely exceeding a millimeter. The zooplankton contribute significantly to the secondary production of aquatic ecosystem and occupy an intermediate position in the food web by transferring energy from lower trophic level to higher trophic level (Dhanasekaran, 2017). It occupies central position in the food webs of aquatic ecosystem between phytoplankton and other aquatic animals including fish. Zooplanktons play a critical role not only in converting plant food to animal food but also they themselves serve as source of food for higher organisms in aquatic ecosystem (Rajashekhar *et al.*, 2010). Zooplankton are one of the most important biotic components that influence all the functional aspects of an aquatic ecosystem, such as food chains, food webs, energy flow and cycling of matter (Murugan *et al.,* 1998; Dadhick and Sexena, 1999; Sinha and Islam, 2002; Park and Shin, 2007; khan MF *et al.*, 2014). So zooplankton occupies an important position in the trophic structure and plays an important role in the energy transfer of an aquatic ecosystem. Zooplankton community represented by Protozoa, Rotifera and two subclasses of Crustacea i.e. Cladocera and Copepoda and other micro invertebrates that are planktonic in water bodies.

Generally, they play an important role in fish nutrition, both in aquaculture and capture fisheries. So the Zooplanktons not only increases fish production but also helps in bioremediation of heavy metals and other toxic material. Zooplankton can also act as biomarker for water quality assessment for fish production (Arunava Pradhan *et al.,* 2008).

Zooplankton study is of necessity in fisheries agriculture and paleo-limnological research (Guy, 1992). Zooplankton species are cosmopolitan in nature and they inhabit all freshwater habitats of the world, including polluted industrial and municipal waste waters (Mukhopadhyay *et al.*, 2007).

The distribution of zooplankton depends on a complex of factors such as change of climatic conditions, physical and chemical parameters and vegetation cover (Neves *et al.,* 2003). The variability observed in the distribution of zooplankton is due to abiotic parameters (e.g. climatic or hydrological limitation) and biotic parameter (predation, competition) or combination of both (Beyst *et al.,* 2001; Kolhe, 2013). Fluctuation of abiotic factors i.e., concentration of dissolve oxygen, temperature, total alkalinity, total nitrogen, phosphate and pH can influence the growth zooplankton (Sarkar and Chowdhury, 1999).

Zooplankton has short life span (usually days to weeks in length) and they respond more quickly to environment leads to change in plankton communication in terms of tolerance, abundance, diversity and dominance in the habitat. Zooplankton communities respond to a wide variety of disturbances including nutrient loading (McCauley and Kalff 1981; Pace 1986; Dodson 1992), acidification (Barrett, 1989; Keller and Yan 1991; Marmoreka and Kormann 1993), Contaminants (Yan *et al.,*1996), Fish densities (Carpenter and Kitchell, 1993), and sediment inputs (Cuker, 1997).Zooplankton plays an important role in indicating the water quality, eutrophication status and productivity of a freshwater body (Mikschi E,1989). Species variation of these order deceased in polluted water. Some species were not found in some highly polluted area though these species have high tolerance level. Zooplankton represents a sensitive indicator of pollution and it has significant potential for assessing aquatic ecosystem health (Mathivanan *et al.*, 2007; Sousa *et al.*, 2008; Jose and Sanal Kumar, 2012, Smitha *et al.*, 2013). According to Rajagopal *et al.,* (2011) zooplankton plays an integral role and serves as bio-indicator and it is a well-suited tool for understanding water pollution status. They are sensitive indicators of pollution in comparison with phytoplankton (Umadevi, 2013). Zooplanktons are sensitive to changes in habitat and pollution, especially to organic pollution (Ramachandra *et al.*, 2005). So zooplankton are globally recognized as pollution indicator organisms in the aquatic environment (Yakubu *et al.*, 2000).

Review of literature

Several authors have used zooplankton as an indicator for monitoring water quality, tropic status and pollution levels (Welch, 1952; Evison and James 1978; Ahmad, 1996; Chandrashekhar and Kodharkar 1997; Shebba and Ramanujan 2005; Contreras *et al.*, 2009). Many reports on different water bodies about the effect of sewage on zooplankton diversity are available (Pawar, 2010, Mathivanan *et al.*, 2007). Ferdous and Muktadir (2009) reviewed the potentiality of zooplankton as bio-indicator. They concluded that potentiality of zooplankton as bio-indicator is very high.

Objective of the Study

Gang Canal has become polluted at some places at sriganganagar due to the confluence of sewage, domestic wastes and industrial effluents of some small enterprises with various types of pollutant deterioted to human health and aquatic organisms.
The information regarding zooplankton of the polluted river is still scanty. The Zooplankton plays an important role in the early detection and monitoring the pollution of water. Therefore, an attempt to evaluate the effect of domestic sewage on zooplankton population in Gang Canal, Sriganganagar, Rajasthan, India is made in this paper. Assessment will be done by using zooplankton as bio-indicator of pollution.

Material and Methods

Study Area

Sriganganagar is the North most District of Rajasthan state of India is situated between Latitude 28.4^o to 30.6^o and Longitude 72.2^o to 75.3^o. The Ganganagar is named after Maharaja Ganga Singh, the ruler of former Bikaner State, whose continuous efforts resulted in the advent of Gang Canal in this thirsty and arid land of the district. Gang Canal and introduction of other irrigation facilities, most of the portion of the block has been reclaimed for intensive farming. Consequently, Ganganagar today bears the proud title of being the granary of Rajasthan. Gang canal is the life line of Sriganganagar District. City of Sriganganagar get canal water supplies from Z-distributary and that divides into three *a, b*, and *z*-minor. Three sites were established in Gang Canal which are almost equidistant to each other. The Sampling sites have recognized as I, II, III and their brief description is as follows:

Table 1: Sites selected in Gang Canal, Sriganganagar, Rajasthan, India.

S. No.	Site	Minor canal of Gang Canal
1.	I	*z*-minor
2.	II	*b-minor*
3.	III	*a*-minor

Site I

It is selected at origin of *z-minor* from Z-disty. near the origin of a-minor. Not much human activities is evident at this sites except for some human bathing and utensils & cloth washing which are done by villagers. The water is comparatively clean at this point.

Site II

It was established at *b-minor* from 5 km from its origin from Z-disty. There is no evidence of human activities at this site so water quality is comparatively good.

Site III

Site III is selected 5 km from the origin of *a*-minor at its downstream. *a*-minor originates from Z-disty. at Teen Puli region on Hindumal Kot Road which is situated Northern most outer part of the Sriganganagar City. It passes through the mid of the Sriganganagar city from many kuchi basti, colonies, private and Rajasthan Roadways bus stand, Hotels, Dhabas, Mandir, Gurudwara, Cremation House and motor market. Two or three Sulabh Complex and Public Urinals are also situated on its either side.

From its origin the water quality is not bad. As this minor flows through Sriganganagar City and effect of increasing population, urbanization, and colonization can be seen easily on this minor, it receives high amount of untreated municipal sewage, garbage and house hold wastes, in the form of partly or fully decomposed organic matter and other form along its both the banks at various places. Here human activities including bathing, washing of utensils, cloth & vehicle washing, and discharge of human faecal are done almost all round the year. The pollution load increases due to municipal sewage, domestic refuge and human activities as it flows downstream upto 10-*a* village on Padampur road which is situated 10km away from Sriganganagar city.

Study duration and Sampling Procedure

The sampling on monthly basis was done for a period of 15 months from September, 2012 to November, 2013 from the three sites by plankton net (Plankton net number 25 of mesh size 20 µm). 100 liters of water was measured in a graduated bucket and filtered through the net and concentrated in a 100 ml bottle. Samples were collected as close to the water surface as possible in the morning hours and preserved for further analysis.

Preservation of the sample

For a plankton sample to be analyzed for an extended period, commonly two preservatives are used: Lugol's iodine using acetic acid which will stain cells brownish yellow and will maintain cell morphology and of 4% formaldehyde. But here sample were preserved with Lugol's iodine in 10:1 ratio i.e. 10 ml water sample: 1 ml Lugol's iodine (Trivedy *et al.*, 1986).

Concentration technique

The 100 ml preserved sample was allowed to settle for 24-48 hours and was further concentrated to approximately 30 ml by decanting. The concentration factor is used during the calculations.

Mounting the slides

Concentrated samples in a bottle are mixed uniformly by gentle inversion. Then by using bore pipette 1 ml of sample was transfer on Sedgwick Rafter count cell. Now it was covered by using cover slip, avoiding any kind of air bubble. Then it was kept for 10-15 minutes so that all plankton may settle down. Now the Sedgwick rafter counting cell is placed under microscope and then plankton was indentified by moving the cell horizontally and vertically. The process was repeated twice.

Zooplankton Identification under microscope

Identification of specimen was carried out by taxonomic keys and illustrations given by Ward and Wipple (1959); Michael & Sharma (1988); Battish, (1992); Altaff, K. (2004).

Result and discussion

Table 2: Number of Genera of zooplankton and their percentage in all three sites of Gang Canal, Sriganganagar (Raj.)

Name of order/phylam	No. of Genera	Percentage
Rotifera	03	50%
Cladocera	02	33.33%
Protozoa	01	16.67%
Total	15	100%

Fig. 1: Pie chart showing percentage of species in each family of Zooplankton in all three sites of Gang Canal, Sriganganagar, Rajasthan, India.

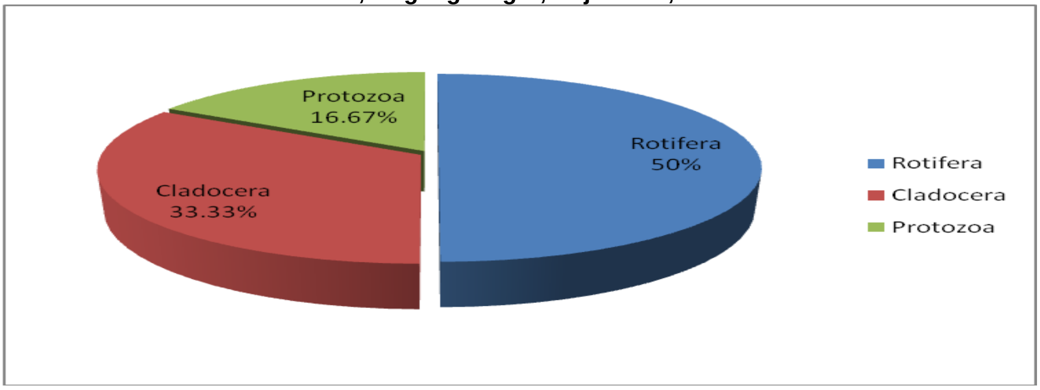

Table 3: Distribution pattern for each species of zooplakton in all three sites of Gang Canal, Sriganganagar, Rajasthan :

(+) Low, (++) Moderate, (+++) High, (-) absence of Genus.

Name of order or Phylam	Name of the Zooplankton	Site I	Site II	Site III
PROTOZOA	*1.* Arcella spp.	+	+	+
ROTIFERA	*1.* Brachionus spp.	+	+	+++
	2. Keratella spp.	+	+	+++
	3. Filinia spp.	+	+	+
CLADOCERA	*1.* Bosmina spp	+	+	+
	2. Moina spp.	+	+	++
Total Number of Genera of Zooplanktons		*06*	*06*	*06*

Six Genera of zooplankton were observed in three sites of gang canal belonging to three groups: Rotifera, Cladocera and Protozoa. Rotifera was the dominant group followed by Cladocera and Protozoa.

Rotifera

Rotifers are the most important soft-bodied microscopic aquatic metazoans (invertebrates) having a very short life cycle among the plankton. They are characterized by the presence of an anterior wheel like rotating structure called corona. Rotifers are also called as "pioneer organisms" because they first appear in newly created water bodies (Kippen, 2005). This group was represented by 3 genera *Brachionus spp., Keratella spp., and Filinia spp*.

Cladocera

Cladocerans are commonly known as water fleas and they have generally minute size ranging from 0.2 - 5.0 mm. They belong to order *Cladocera* of subclass *Brachiopoda* under subphylum *Crustacea.* Cladocerans are primary consumers feed on microscopic algae and fine particulate matter in the detritus, influencing cycling of energy. These are a crucial group among zooplankton and form a most useful and nutritive group of crustaceans for higher members of fishes in the food chain. Cladorerans attract many taxonomists due to their cyclomorphic characters. This group was represented by 2 genera Bosmina spp. and Moina spp.

Protozoa

Planktonic protozoans are diverse group of unicellular ciliated or flagellated organisms. Protozoans are the smallest and first aquatic organisms in the form of zooplanktons. It is an important component of the zooplankton community of a water body. Most of the protozoans are usually not sampled due to their minute size (Ferdous and Muktadir, 2009). This group was represented by 1 genera Arcella spp.

All the above Zooplanktons are found in all three sites of Gang Canal. Similar phytoplankton diversity has been observed by Bishnoi and sharma, 2016 in Gang Canal of Sriganganagar in their studies. Zooplankton of site III showed the dominance of Rotifers like Brachionus spp.,and Keratella spp throughout the investigation and medium amount of abundance of Cladocera like Moina spp. occurred in comparison of site I and Site II .

Rotifers dominant in rivers due to their short generation time and high reproductive rate and they occupy a wide range of habitat existing in aquatic ecosystem so They are economically and ecologically important group. Recently it has shown that diversity abundance of rotifers is sensitive to change in water variables. Rotifers may be ideal bio-indicators as they are discriminating in their responses to the environment, they are typically numerically dominant in the zooplankton, species rich, and communities likely integrate environmental conditions over time (Duggan *et al.*, 2001). Among the zooplankton, rotifers respond quickly to the environmental stress so they can be used as bio-indicators of pollution (Supratim *et al.*, 2015). The dominance of Rotifera have also been reported in other waterbodies in desert region (Bahura, C.K.,1989; Lubana, 1991; Saxena and Bhargava, 1981). Among Rotifera, *Brachionus* and *Keratella* were also reported from other different waterbodies (Lubana, 1991; Bahura, C.K., *et al.,* 1993). Smitha *et al.*, 2013 observed dominance of Rotifer species in the Darasaguppe site of Chikkadevaraya Canal water of Cauvery river among zooplanktons due to organic pollution and its eutrophic conditions, than any other sites. Rotifer's contributions to the zooplankton community may increase with eutrophication (Park and Marshall, 2000). Taxonomic dominance of Rotifers were reported by researchers, Cavalli *et al.*,(2001), Sampaio *et al.,*(2002). Arora (1963) has listed rotifer species as indicators of water quality classified into clean, polluted and heavily polluted categories. The role of Rotifera as bioindicators has been emphasized by Arora (1966). In fact, rotifers were found to be characteristic zooplankton of the zones of pollution (Das and Pandey, 1978). Rotifers are considered as most sensitive indicator of water quality (Ali *et al.* 1990). Sampath *et al.,* (1979) also regarded rotifers as biological indicators of water quality in Cauvery river. Certain species and genera of rotifers were used as indicators of water quality, eutrophic status and productivity of an aquatic ecosystem and Genus *Brachionus sp.* indicate eutrophic aquatic body (Sladecek, 1983). Dirican *et al.,* (2009) permanent dominancy of rotifer species such as Brachionus and Keratella are indicative of eutrophic condition of Camligoze dam lake, Turkey and stated that rotifer are more abundant than other zooplankton groups and account for major portion of food chain.The dominance of *Brachionus* and *Keratella* is the general trend in freshwater bodies in India (Singhal *et al.,* 1989; Sharma, 1988, Sukumaran and Das, 2003; Vishwakarma et. al., 2014). The genus *Brachionus* is considered as a biological indicator for the eutrophication, and *Keratella* species has been indicated as an indicator of pollution (Nogueira, 2001; Sampath *et. al*., 1978; Bahura *et. al*.,1993). Similar observation was also noticed by various workers Arora, (1996), Patil *et. al*., (2006) and Malhotra *et al.* (2014). *Brachionus* genus is renowned to tolerate polluted waters(Sampaio *et al.* 2002; Dulic *et al.*, 2006 and Sousa *et al.*, 2008; Supratim *et al.*, 2015). Also, *Keratella* species has been indicated as an indicator of pollution (Bahura, 1993). The occurrence of *Brachionus* is related to eutrophic condition of water (). The study of Kumari et al, 2008 and Khalifa and Bendary, 2016 recorded rotifer as indicator of water pollution and described *Keratella* sp. and *Brachionus* sp. pollution indicator species. So Rotifers were the dominant group and formed a main component of freshwater zooplankton and significantly contribute to their dynamics and production (Sharma, 1991).

Cladocerans has been considered to be very important in terms of density, biomass production and nutrient regeneration (Pace and Orcutt, 1981). According to Szerocry, N Ska.Krystyna (2002) and Abrantes *et al.* (2006) Cladocera indicated the eutrophic conditions resulted from pollution. Michael (1985) also designated Cladocerans as bio-indicators. High number of Cladocera in the present studies supports the view. Moina spp. was recorded as tolerant taxa common to all stations. Bilgrami *et al.* (1985) and Bulusu *et al.* (1967) have reported that Moina spp. is tolerant to heavy pollution. Mageed

(2007) has also designated Moina spp. as dominant and tolerant taxa in lake Manzala of Egypt.

Conclusion

As the Zooplankton can be used to assess overall water body health, so it can speak to the condition of the water. It is concluded from this study that the zooplankton population of Gang Canal at Sriganganagar Distict is highly influenced by the discharge from different domestic sewage and other effluents. The shift in the zooplankton community structure and dominance of pollution tolerant forms at discharge zone indicated deterioration of water quality in this stretch of the canal. Rotifera was the dominant group followed by Cladocera and Protozoa. Zooplankton of site III showed the dominance of Rotifers like Brachionus spp.,and Keratella spp throughout the investigation and medium amount of abundance of Cladocera like Moina spp. occurred in comparison of site I and Site II . These zooplanktonic forms Brachionus spp., Keratella spp and Moina spp. were observed at site III of Gang Canal in the present study as indicators of organic pollution. Therefore, they can be significantly applied as indicators of organic pollution. It can be concluded that site III is going to polluted and rapidly turning towards eutrophication in future. Therefore, the proper and efficient treatment of sewage should be carried out before discharging them into the canal system.

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