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ZOOPLANKTON DENSITY AND DIVERSITY INDICES IN THE BHAKRA-YAMUNA LINK CANAL SYSTEM IN NARWANA REGION, HARYANA.

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ABSTRACT Present study was undertaken to analyse the qualitative and quantitative variations in abundance and diversity indices of zooplankton of Bhakra –Yamuna link canals in the Narwana region, Haryana. For analysis, samples were collected from three selected sites (S_1, S_2, and S_3) on Bhakra-Yamuna Link canals for a period of one year from January to December, 2013. For diversity index, Shannon and weaver diversity index, Simpson dominance index and Pielou evenness index were used and to calculate similarity index between selected sites, Jaccard similarity coefficient was used. Result revealed that a total of 13 species of zooplanktons were recorded belonging to group protozoa, rotifera, cladocera and insecta. Population density of zooplankton was low at site S_1 and higher at site S_2.The diversity indices revealed a significant decline in the population of zooplankton from site S_2 to S_3 after linking with site S_1. Similarity coefficient was more between S_2 and S_3 as compare to site S_3 and S_1 and site S_1 and S_2. Cladocerans were dominant at site S_1 and Protozoans were dominant at site S_2.

KEYWORDS : Zooplankton, Shannon diversity indices, Simpson dominance index, Pielou evenness index

Introduction

Zooplanktons are indispensable members of the aquatic food chain, connecting primary producers to higher trophic levels including economically important population of fish (Umadevi, 2013). They 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). Some studies on Yamuna river and Western Yamuna Canal have been undertaken by few workers which deals with heavy metal pollution (Jindal and Rumana, 2000; Kaushik *et al*.,2009), physicochemical parameters (Khaiwal *et al*.,2003, Bhatnagar *et al*.,2009, Chopra *et al*.,2012) and biological assessment (Chopra *et al*.,2011). However there is no information about diversity of zooplankton of Bhakra –Yamuna Link canals in Narwana region. Hence the present study was undertaken to analyse the zooplankton abundance and diversity indices in Bhakra-Yamuna link canals in the Narwana region of Haryana.

Materials and methodology

Study sites: For the present study, three sampling sites (S_1, S_2, and S_3) were selected on Bhakra-Yamuna link canal system (Figure 1). Site S_1 (29º63'N & 76 º17'E) is located 1 Km upstream from Dhakal head on Sirsa branch of Western Yamuna Canal. Site S_2 (29º61'N & 76 º15'E) is located 1 Km upstream from Dhakal head on Barwala link canal and site S_3 (29º59'N & 76 º14'E) is located 2.5 km downstream on Sirsa branch after junction with Barwala link canal in Narwana region, Haryana.

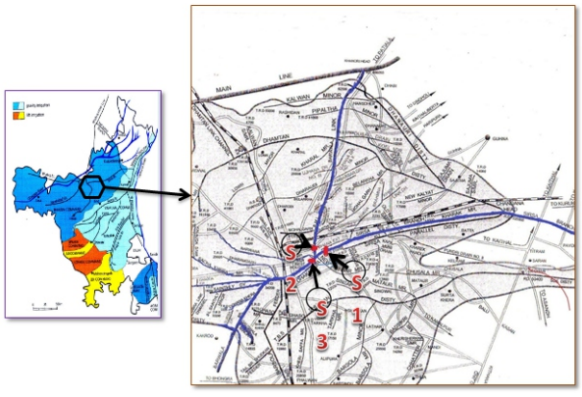

Fig. 1: Map of Haryana showing study sites on selected canals.

Plankton Analysis: For plankton study, 50 litres of water was filtered through planktonic net of mesh size 50 µm with demarcated tube fitted at the bottom, the concentrated sample preserved in 4% formalin. The literature consulted for the identification of plankton were: Ward and Whipple (1959), Needham and Needham (1962) and Gupta (1972). Counting of plankton was done with the help of "drop count method" and biodiversity indices were calculated by Shannon and weaver (1963), Simpson (1949) and Pielou (1966). Similarity coefficient was calculated by using Jaccard similarity coefficient (Jaccard, 1912).

Result and Discussion

Zooplankton, by their heterotrophic activity, plays a key role in cycling of the organic matter in an aquatic ecosystem. Zooplankton contributed a minor portion of total plankton and comprised of protozoans, rotifers, cladocearns and insects. A total of 13 species were recorded from all study sites. Cladocerans were dominant at site S_1 with percentage distribution of 37.5% of total species diversity. Malhotra, 2014 was also reported the similar results in Western Yamuna Canal in Yamunanagar. Protozoans were dominant at site S_2 with percentage contribution of 50% whereas at site S_3, their percentage decreases to 33.33% due to the influence of water from site S_1 (Fig. 1). Only two taxa i.e. *Peridinum* sp. and *Polyarthra* sp. were common at all sites (Table 1).

Species richness was found highest at site S_2 (five species) and lowest at site S_3 (one species) (Fig. 2). Zooplankton density in different months ranged from 49±1.98 L^{-1} to 18± 2.09 L^{-1} at site S_1, 94±2.38 L^{-1} to 38±2.09 L^{-1} at site S_2 and 86±4.78 L^{-1} to 22±6.31L^{-1} at site S_3. Comparatively, population density of zooplankton was low at site S_1 than site S_2 and S_3. Bhatnagar *et al*. (2013); Malhotra and Kumar (2014), also observed low values of zooplankton density coupled with low species diversity at WYC. At site S_3 population density was lower from the month of July to September when water current and water level at site S_1 were high which affect their prevalent biota (Fig. 2).

Diversity indices are good indicator of pollution in aquatic ecosystem. Mean value of Shannon diversity index were found maximum at site S_2 (2.77±0.58) and minimum at site S_1 (1.45±0.39). Site S_3 shows decline in the values of diversity as compared to site S_2 but values were greater than site S_1 (Table 2). Simpson diversity index was high at site S_1 (0.33±0.12) than site S_2 and S_3. Species evenness of zooplankton varied from 0.78 to 0.85 showed little variation at site S_2 as compare to site S_1 (0.60-0.78) and S_3 (0.61-0.84). Evenness was lowest at site S_1 during rainy months. At site S_3, evenness was low when it received water from site S_1 and when S_1 became dry species evenness approached similar to the site S_2. Zooplankton tends to show a negative relationship with water flow and a positive relationship with water residence time (Basu and Pick,

1996; Lair, 2006; Strayer *et al*., 2008). Basu *et al*. (2010) have reported positive correlation of all the physico-chemical parameters except the dissolved oxygen and TDS with zooplankton community.

Similarity coefficient calculated on the basis of zooplankton revealed that site S_2 and S_3 was more similar as compare to site S_3 & S_1 and site S_1 & S_2 throughout the study period (Table 2). This may be due to the fact that site S_3 carried higher volume of water from site S_2 throughout the year and more species were common at these two sites site while site S_1 was dry during some part of the year.

Conclusion: In present study, high values of population density of zooplankton coupled with high species diversity recorded at site S_2 which decreased at site S_3 after joining with site S_1 which altered the overall ecology of the canal.

Table 1: Zooplankton recorded at selected study sites (site S_1, S_2 andS_3)during study period

Sr. No.	Scientific name	Site S_1	Site S_2	Site S_3
I	**Family Protozoa**			
1	*Alona* sp.	+	+	+
2	*Ceratium* sp.	-	+	-
3	*Diffusia* sp.	-	++	-
4	*Peridinum* sp.	+	++	++
II	**Family Rotifera**			
5	*Brachionus* sp.	+	-	+
6	*Nothalca* sp.	-	+	-
7	*Polyarthra* sp.	-	+	-
8	*Trichocerca* sp.	-	+	-
III	**Family Cladocera**			
9	*Daphnia* sp.	++	-	+
10	*Sida* sp.	++	-	-
11	*Simocephalus* sp.	++	-	-
IV	**Family Insecta**			
12	*Chironomous* larvae	+	-	+
13	Water mite	-	++	+

+ Present, - Absent, ++ Abundant

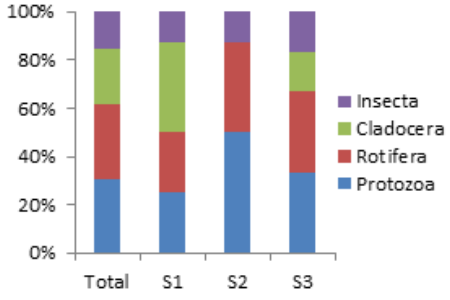

Fig.2: Per cent distribution of different groups of zooplankton at study sites

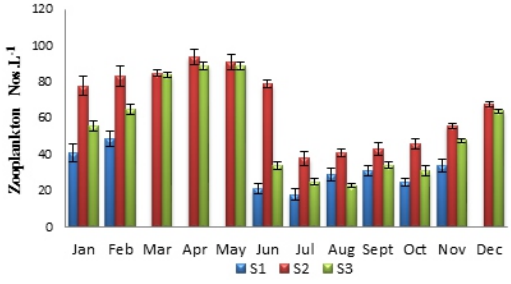

Fig. 3: Monthly variation in population density (Nos. L-1) of zooplankton at study sites.

Table 2: Range and mean ± S.E. (with in parenthesis) of Species richness, species diversity and evenness of zooplanktons reported at selected sites during study period.

Diversity indices/Sites	Site S_1*	Site S_2	Site S_3
Species richness	2-5	3-7	1-5
Shannon diversity index	1.12-1.92 (1.45±0.39)	2.61-3.01 (2.77±0.58)	1.98-2.85 (2.40±0.31)
Simpson's diversity index	0.28-0.41 (0.33±0.12)	0.16-0.23 (0.18±0.05)	0.17-0.26 (0.21±0.07)
Equitability index	0.60-0.78 (0.68±0.05)	0.78-0.85 (0.81±0.03)	0.61-0.84 (0.72±0.08)
Similarity coefficient	(S_1 and S_2) 0.311	(S_2 and S3) 0.798	(S_3 and S_1) 0.520

Sampling could not be done from March to May as the canal was completely dry

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