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Comparative Studies on Zooplanktonic Diversity of River Yamuna and Western Yamuna Canal in Relation to Industrial Pollution in Yamunanagar (Haryana), India

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Abstract: ***The present study deals with the diversity and abundance of zooplankton of river Yamuna and western Yamuna canal in Yamunanagar which are getting effluents from different point and nonpoint sources. Thirteen number of taxa were recorded from river Yamuna and only four taxa from western Yamuna canal belonging to groups Cladocera, Rotifera, Copepoda, Protozoa, Ostracoda and Trematoda. Sida crystallina and Daphnia spp. were the taxa common at both the lotic water bodies. Taxa Polynema spp., Cyclops spp., Nauplius spp., Cypris spp., Bosmina spp., Moina spp., Monostyla spp., Keratella spp., Branchionus spp., Physarum spp. and Trinema spp. were found only at river Yamuna but not at western Yamuna canal. Taxa Simocephalus spp. and Miracidium larva were found only at western Yamuna canal but not at river Yamuna. The abundance, distribution, total population and species diversity were studied and correlated with effect of effluents. Species diversity values indicated a decrease from pre-effluent point to point of influx of effluent and post effluent point in river Yamuna and western Yamuna canal.***

Keywords: Industrial effluents, River Yamuna, Species diversity, Western Yamuna canal, Zooplankton

1. Introduction

Zooplanktons are the very important component of aquatic ecosystem. They 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).

The present study deals with the zooplankton abundance and distribution of river Yamuna and western Yamuna canal in relation to industrial pollution. Both lotic water bodies along their path through city Yamunanagar, which is the major industrial city of Haryana, get effluents from various industries. Western Yamuna canal flows through the centre of the city getting effluents from paper, timber and sugar industries and municipal and sewage waste whereas river Yamuna flow along the side of the city making boarder with district Saharanpur of Uttar Pradesh, getting effluents from sugar industry, agriculture runoff and municipal and sewage waste. The present study has been conducted to evaluate their effect of different sources of effluents on zooplanktonic diversity of both lotic water bodies.

2. Materials and Methods

Western Yamuna canal and Yamuna river meander through/along the city Yamunanagar and are subjected to sewage and industrial effluents input through several point and non-point sources. Keeping in view the pollution sources, these two lotic water bodies, viz., western Yamuna canal and Yamuna river were selected for present studies. Three sampling stations were established and numbered W1, W2 and W3 on western Yamuna canal and Y1, Y2 and Y3 on river Yamuna consecutively downstream (Fig. 1) based on pollution load. Plankton samples were collected by filtering 25 L of water through plankton net of mesh size 50µm with demarcating collecting tube. These samples were collected in 100 ml plastic bottles and concentrated samples were then made up a standard volume of 50 ml with distilled water. Samples were preserved with 4% buffered formalin.

The abundance of zooplankton was expressed as organisms L^{-1}. The organisms counted by drop count method were expressed per litre using formula:

$$\text{Total Planktons } L^{-1} = \frac{\text{Number of Organisms per drop X Vol. of conc. sample in ml}}{\text{Volume of original sample in litres X Vol. of one drop}}$$

Species diversity of zooplankton was determined using Shannon and Weaver diversity index method (Shannon and Weaver, 1963; Washington, 1984).

$D = - \sum ni/ N \log_2 ni/N$

D = Species Diversity
ni = Number of individuals of i^{th} species
N = Total number of individuals in the sample

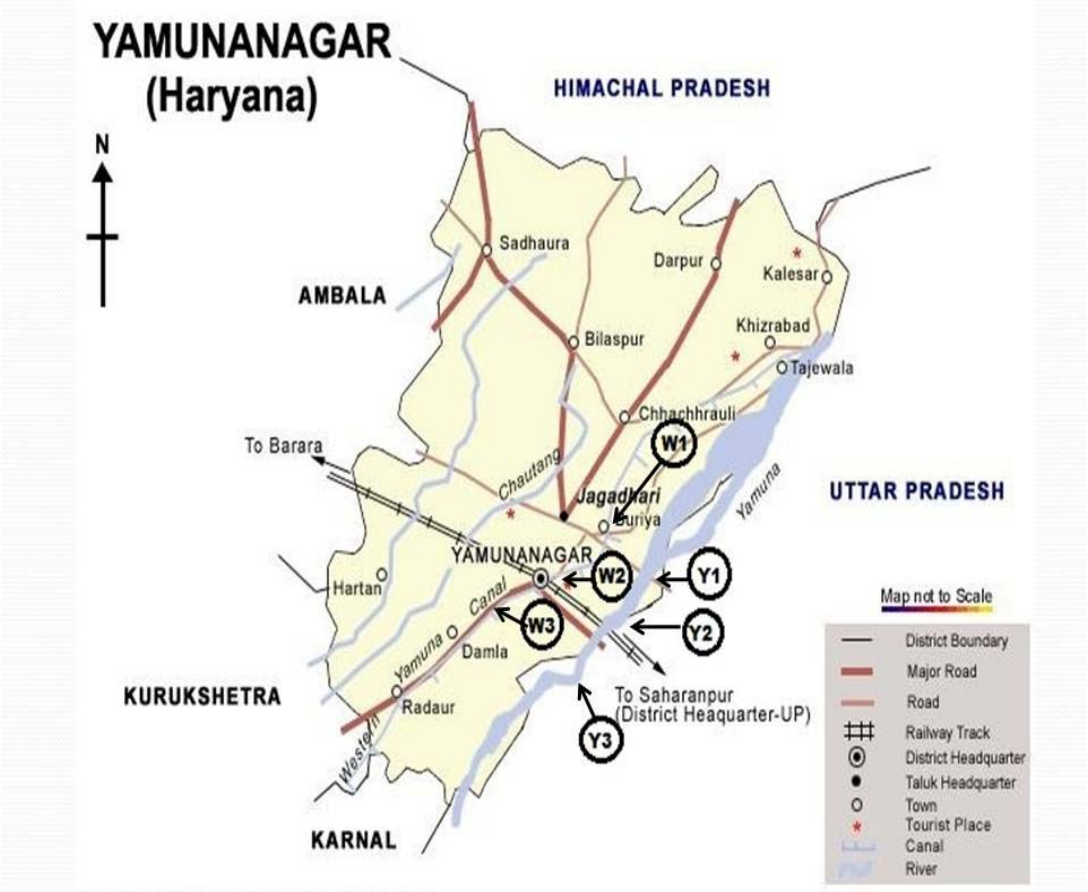

Figure 1: Map of Yamunanagar showing location of selected stations on river Yamuna and Western Yamuna canal.

3. Results and Discussion

River Yamuna shows higher number of taxa as compared to western Yamuna canal. Thirteen number of taxa were recorded from river Yamuna and only four taxa from western Yamuna canal belonging to groups Cladocera, Rotifera, Copepoda, Protozoa, Ostracoda and Trematoda (Fig. 3). Cladocerans were recorded as dominant from both the water bodies. Cladocerans indicate eutropic condition resulting from pollution (Malhotra, 2014; Abrantes *et al.,* 2006). Michael (1985) also designated Cladocerans as bio-indicators.

Total zooplankton's population of river Yamuna varied from 532-95 no L^{-1} and of Western Yamuna canal it was 120-25 no L^{-1}. Total population of zooplankton of river Yamuna show a decline from station Y1 to Y2 and further increase at station Y3 whereas total population showed a decrease from station W1 to W3 in case of western Yamuna canal (Table 1). This may be due to the diversion of the path of flow of western Yamuna canal from station W2 so the station W3 got the effluents in a more concentrated form. A decline in number of planktons with influx of effluents was recorded by many authors (Malhotra *et al.,* 2014; Bhatnagar *et al.*, 2013).

The mean values of species diversity of river Yamuna were found maximum at station Y3 (3.20±0.05) and minimum at station Y2 (3.07±0.08) whereas western Yamuna canal showed maximum values at W1 (1.9±0.1) and minimum at station W2 (1.6±0.0). Low values of species diversity at influx of effluent point were also reported by Trivedi (1981); Bhatnagar and Garg (1998); Malhotra *et al.* (2014) and Malhotra (2014) (Fig. 2).

Sida crystallina and *Daphnia* were the taxa common at both the lotic water bodies indicate them as tolerant taxa (Richard Albert, 2010; Leitao *et al.*, 2013 and Malhotra *et al.*, 2014). Taxa *Polynema* spp., *Cyclops* spp., *Nauplius* spp., *Cypris* spp., *Bosmina* spp., *Moina* spp., *Monostyla* spp., *Keratella* spp., *Branchionus* spp., *Physarum* spp. and *Trinema* spp. were found only at river Yamuna but not at western Yamuna canal showing their insufficiency to tolerate effluents from paper and timber industries. Taxa *Simocephalus* spp. and Miracidium larva were found only at western Yamuna canal but not at river Yamuna showing their intolerance to agricultural runoff.

Table 1: Mean values of total population of zooplankton (Mean±S.E) of river Yamuna and western Yamuna canal at various stations.

	Pre-effluent point	Flux of effluent point	Post effluent point
River Yamuna	300±43.3	193±29.8	248±31.8
Western Yamuna canal	89.3±7.05	50.6±5.09	44±3.43

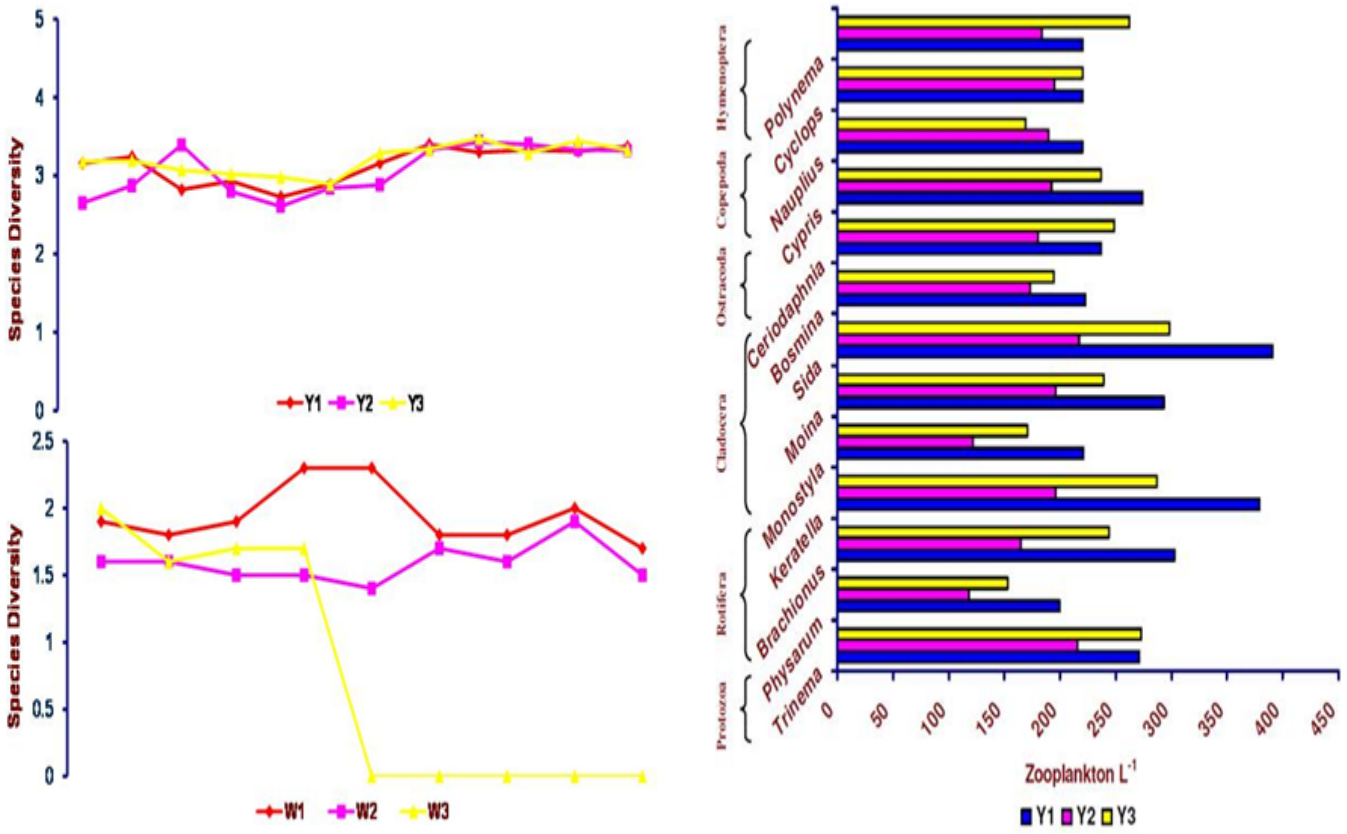

Figure 2: Graphs showing species diversity of zooplankton at various stations on river Yamuna and western Yamuna canal.

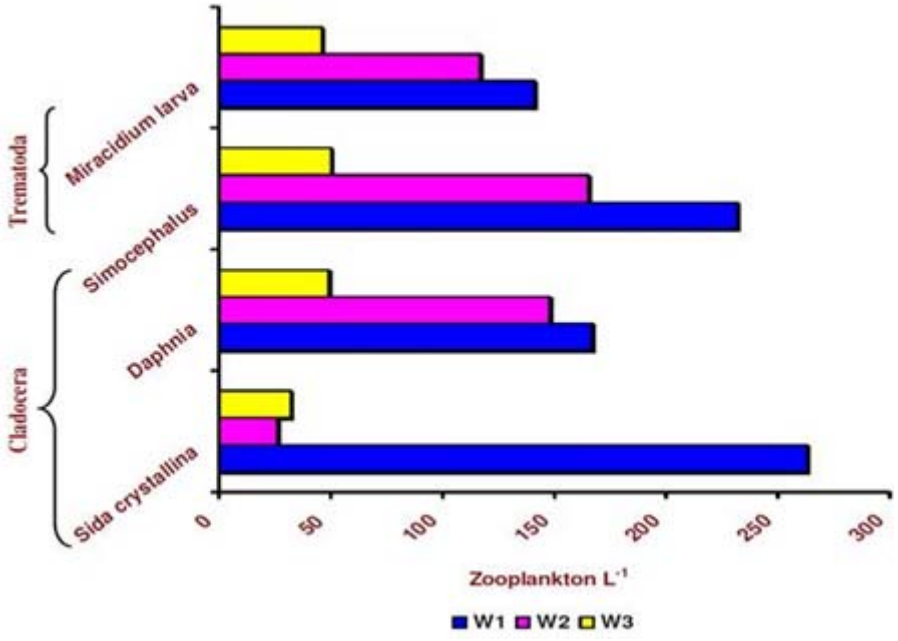

Figure 3: Graphs showing relative abundance of zooplankton on river Yamuna and western Yamuna canal at various stations.

4. Conclusion

Western Yamuna canal has low biodiversity of zooplankton as compared to river Yamuna. Western Yamuna canal is getting effluents from more and diverse number of industries which is adversely affecting its ecosystem. Although river Yamuna has rich biodiversity yet the values are declining at the point of influx of effluents. So, in order to manage the pollution load of river Yamuna and western Yamuna canal it is recommended that various methods of sewage/industrial wastes treatment should be used before the disposal of effluents.

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