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Studies on Zooplanktonic Diversity of River Yamuna in Yamunanagar (Haryana) India

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Abstract: ***Zooplankton contribute significant role in aquatic ecosystem. Any change in the quality of water is reflected in its community structure. The present paper deals with the qualitative and quantitative analysis of zooplankton in Yamuna river which receives industrial effluents and domestic sewage from point and nonpoint sources. The abundance, distribution, total population, group percentage and species diversity were studied and correlated with pollution indicating water quality characteristics. Species diversity values indicated a decrease from pre effluent point to effluent discharge channel and post effluent discharge point.Cladocera was recorded as the dominant group followed by Rotifera, Copepoda, Protozoa and Ostracoda.***

Keywords: Industrial effluents, Species diversity, Sewage, Yamuna River, Zooplankton

1. Introduction

Aquatic life depends upon Planktonic populations. Any change in the quality of water directly affects its planktonic population *i.e* they serve as good indicators of health of aquatic ecosystem. Zooplankton community structure has significant potential for assessing aquatic ecosystem health. Their dominance and seasonality are highly variable in different water bodies according to nutrient status, age, morphometry and other locational factors (Jose and Sanal kumar, 2012). They are sensitive indicators of pollution in comparison with phytoplankton (Umadevi, 2013).

Yamuna is the largest tributary river of Ganges in north India (Negi*et al*., 1991).Yamunanagar (30^0 6' N latitude and 77^0 17' E longitude) is an important industrialcity of Haryana.The river Yamuna meanders through the district Yamunanagar (Haryana), India, and form the eastern boundary with the neighbouring Saharanpur district. Along its path river is getting effluents from the maskaranala from Saharanpur (Uttar Pradesh), Indiawhich is affecting the ecology of the river. Hence the present study was undertaken in order to relate the effect of industrial effluents on zooplankton diversity of river Yamuna.

2. Materials and Methods

Keeping in view the point of influx of discharges into river, three stations have been selected. Station-Y1 lies in village Kalanaur at upstream of the river before the influx of discharges, Station-Y2 lies 4-5 Kms downstream from station Y1 at middle reach of the river where the industrial effluents joins the river, Station-Y3 at 5-6 kms downstream from station-Y2 after the influx of discharges (Fig. 1). Zooplankton samples were collected by filtering 25 L of water through plankton net of mesh size 50µm with demarcating collecting tube. 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).

$D = - \sum ni/ N \log 2ni/N$

Where, D = Species Diversity, ni = Number of individuals of i^{th} species, N = Total number of individuals in the sample. The coefficient of correlation "r" was calculated on computer using SPSS package.

3. Results and Discussion

Thirteen tax a of zooplankton were recorded from different stations of river Yamuna including 4 of Cladocera, 3 of Rotifera, 2 of each Copepoda and Protozoa and 1 each of Ostracoda and Hymenoptera. The maximum density was recorded at station Y1 followed by station Y3 and station Y2. The mean zooplankton population was 300 L^{-1} at station Y1, 193 L^{-1} at station Y2 and 248 L^{-1} at station Y3. Maximum numbers of total zooplankton were found in Julyat all the stations (Table 1). With increase in warmth, the animals become more active, grow more rapidly and breed more quickly (Mellanby, 1963). Cladocera was the dominant group followed by Rotifera, Copepoda, Protozoa and Ostracoda. One genera of Hymenoptera, Polynema spp. was also observed along with zooplankton. Dominant group Cladocera with 33.5% was represented by Moina spp., Sida spp., Bosmina spp. and Ceriodaphnia spp.(Fig. 3). According to Szerocry n' Ska (2002) and Abranteset 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. Bilgramiet al. (1985) and Bulusuetal. (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. The mean values for Sida spp. was high at station Y1 but showed a decline at Y2 and Y3 depicting it as sensitive taxa. Rotifera the second dominant group was represented by Brachionus spp., Keratella spp. and Monostylaspp.. The role of Rotifera as bioindicators has been emphasized by Arora (1966). In the present studies, Keratella spp. and Brachionus spp. were common rotifers with a wide range of tolerance to different physicochemical conditions. Copepoda was represented by Cyclops spp. and Nauplius larva. Bhatti and Rana (1987) and Wolfram et al. (2002) regarded Cyclops spp. and Ostracods as strictly pollution sensitive taxa. In the present studies, it was although present at all stations but number was low. Similarly, Cypris spp. the only member of Ostracoda was also low in number. Protozoans were represented by two genera Trinema spp. and Physarumspp.. Total population of zooplankton showed a significant ($P<0.05$) decrease from station Y1 ($300\pm41L^{-1}$) to station Y2 ($193\pm28L^{-1}$) and then increase at station Y3 ($248\pm31L^{-1}$). This may be due to mixing of effluents through 'maskaranala' at station Y2. Statistically also, zooplankton showed a significant positive correlation with DO ($r=0.604$, $P<0.05$) and significant negative correlation with ammonia ($r=-0.498$, $P<0.05$) advocating that ammonia was the important pollution indicating parameter causing a decline of plankton population. BOD also showed a significant negative correlation with zooplankton but the values were not statistically significant. Species diversity of zooplankton depicts a decreasing trend from station Y1 to Y2 and further increased at station Y3 indicating the effect of industrial pollution and sewage waste (Fig. 2).Trivedi (1981) and Malhotra et al. (2014) have emphasized the role of species diversity index in pollution and stated that a decrease in species diversity values point to polluted waters. These results depict station Y2 as stressed area with reference to species diversity.

4. Conclusion

The low population density of the Zooplanktons in river water depicted thatriver Yamuna is in a very poor tropic status. Total number and Species diversity of zooplankton decreased at station Y2 where industrial and sewage channel joins the river depicts the altered overall ecology of the stream thus reducing the capture fishery statistics. Therefore, the proper and efficient treatment of sewage should be carried out before discharging them into the river system.

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Legends to Figures

[1] Fig. 1: Map showing location of selected stations on river Yamuna.
[2] Fig. 2: Species diversity of zooplankton of river Yamuna at various stations.
[3] Fig. 3: Percentage distribution of zooplankton of river Yamuna at various stations.

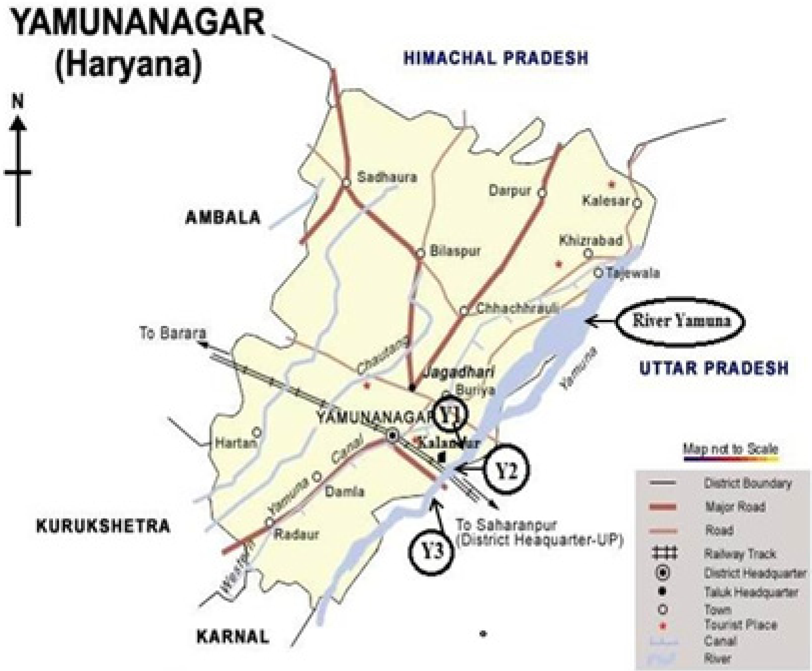

Figure 1: Map showing location of selected stations on river Yamuna

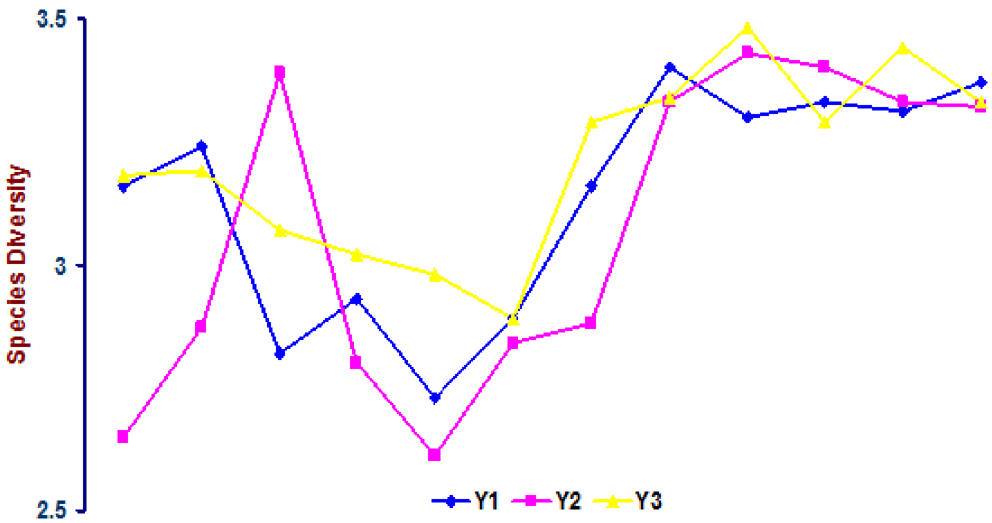

Figure 2: Species diversity of zooplankton of river Yamuna at various stations

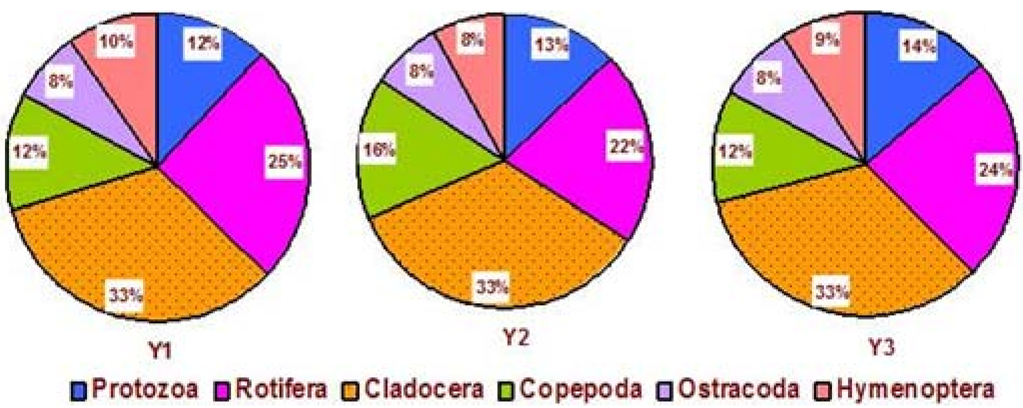

Figure 3: Percentage distribution of zooplankton of river Yamuna at various stations

Table 1: Total number of zooplankton (L-1) (mean± S.E of mean) of river Yamuna at various stations

	Station Y1	Station Y2	Station Y3
August	178±9.94	107±11.3	172±21.6
September	192±5.66	134±11.5	175±3.56
October	173±11.2	136±23.5	166±10.1
November	192±13.0	128±3.78	154±12.9
December	135±14.7	110±11.4	148±11.7
January	218±12.7	127±2.12	184±19.1
February	207±5.3	95±0.47	156±3.77
March	348±34.6	248±3.6	316±5.44
April	433±4.64	210±2.88	365±10.8
May	500±15.5	274±14.1	321±7.64
June	492±41.6	336±29.6	350±17.9
July	532±32.6	412±33.9	473±27.5