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Pollution effect on the Benthic Macro-invertebrates of Bagmati river: North Bihar

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ABSTRACT

Benthic macro-invertebrates are important water pollution indicator. The change in aquatic environment causes the qualitative and quantitative changes of benthic macro-invertebrates. The quantitative and qualitative analysis of Benthic macro-invertebrates along with physico-chemical analysis of the Bagmati river water, were done for two years from January 2014 to January 2016 in three seasons at 8 different selected sites. The benthic macro-invertebrates abundance and composition were low and total 2153 individuals were counted. Total 41 benthic macro-invertebrates families were identified which have distributed in 16 orders of three phylum, i.e., Mollusca, Annelida, and Arthropoda. 51.83% of total individuals in the dry season and rest 48.17% in the wet season were found. The first major taxon was Mollusca with 56.99% (snails=48.54% + mussels =8.45%), the second major taxon Ephemeroptera with 10.92% and the third major taxon Diptera with 10.68% were found. The forth, the fifth, and the sixth, taxon were found worms with 4.92%, Odonata with 3.67% and Trichoptera with 3.25%. Benthic samples were collected by standard qualitative method with Surber sampler (500µm mesh size, base area 0.16m^2, dimension 40cm × 40cm) and Kick Net (500µm mesh size).

Keywords: *Bagmati river, Benthic macro-invertebrates, Analysis*

INTRODUCTION

Water has always been an important and life sustaining drink to humans and it is essential for the survival of all organisms. Bihar in general and North Bihar particularly is very rich in water resources. It has a river mesh of the Ganga and its tributaries. The Bagmati river is the main tributary among them. Around the world, freshwater habitats are being subjected to increased levels of human disturbance (F.A.O., 1967). Agricultural run-off, urban sewage, industrial wastes, dumping of garbage, and house hold wastes affect the water quality and biota of river (W.H.O., 1984). Pollution of river is common in India except the difference in the degree and extent of pollution. Like other rivers of India, the Bagmati river is also becoming polluted gradually by different types of human activities.

The pollution indicator Benthic macro-invertebrates are small aquatic animals without backbone that live on or in the sediment of the water body or attached to rocks and aquatic plants or debris at the bottom and retained by mesh sizes of ~200-500 mm (Rosenberg and Resh, 1993). Molluscs such as snails and mussels, aquatic worms and leeches, and the immature forms of many aquatic insects such as stonefly, mayfly, dragon fly and damsel fly nymphs are important benthic macro-invertebrates. Benthic macro-invertebrates are of great significance because they form the food of fishes and important link in the food chain and food webs. They are easy to collect and identify, have limited mobility, differ in their tolerance to amount and types of pollution. The change in the natural quality of water will

generate loss in BMI biodiversity which disrupt aquatic food chains and food webs leading to the disturbance of the ecosystem. Considering these serious problems, we have undertaken the present ecological status on the topic **"**Pollution effect on the Benthic Macro-invertebrates of Bagmati river: North Bihar**"**

MATERIALS AND METHODS

For the study of ecological status of Bagmati river, eight different sites or stations were selected on the bank of Bagmati river keeping in mind pollution point of views. The name of sites and its Latitude, Longitude and Altitude are mentioned in Table1.

Table1
Selected Sites on the bank of the Bagmati River

Site no.	Site's Name	Direction of river flow	Latitude (N-Coordinate)	Longitude (E-Coordinate)	Altitude (Elevation)
1	Ratanpurghat	WN to ES	26°02'20.64" N	85°43'45.21" E	181 ft
2	Rasulpurghat	WS to NE	26°02'47.48" N	85°44'23.01" E	179 ft
3	Debhraulighat	WN to ES	26°02'43.35" N	85°46'28.87" E	177 ft
4	Manikaulighat	W to E	26°02'35.57" N	85°46'36.95" E	169 ft
5	Rajpaghat	W to E	26°02'07.78" N	85°47'45.54" E	168 ft
6	Jatmalpurghat	WN to ES	26°01'57.33" N	85°48'53.47" E	164 ft
7	Morwaraghat	W to E	26°01'32.24" N	85°50'23.82" E	163 ft
8	Hayaghat	ES to WN	26°01'40.75" N	85°52'29.82" E	163 ft

Where: W-West, E-East, N-North, S-South

Benthic macro-invertebrates were analyzed mainly in two seasons *i.e.*, dry season (March to June-summer season) and wet seasons (November to January-winter season) for two years from January 2014 to January 2016. Benthic samples were collected by standard qualitative method with Surber sampler (500µm mesh size, base area 0.16m^2, dimension 40cm x 40cm) and Kick Net (500µm mesh size). The samples collected were sieved through 500µm (0.5mm) aperture size sieve and immediately preserved in 5% formalin on the site and then transferred to 70% ethyl alcohol (APHA., 1985 and Welch, E. B., 1980). Sorting was done to get the clean samples of the benthic organisms. Most organisms were identified by naked eyes or using only a dissecting microscope, but Oligochaeta, Chironomidae and some mayfly structure were identified with a compound microscope. The sorted macro benthic fauna were identified to family level where possible. They were counted and recorded. Identification was done with the help of Key modified from aquatic entomology by Mc Cafferty (1981) and Mandaville (2002).

RESULTS AND DISCUSSION

The quantitative and qualitative analysis of Benthic macro-invertebrates along with physico-chemical analysis of the Bagmati river water, were done for two years from January 2014 to January 2016 in three seasons at 8 different selected sites. The benthic macro-invertebrates abundance and composition were low and total 2153 individuals were counted.

Total 41 benthic macro-invertebrates families were identified which have distributed in 16 orders of 3 Phylums, *i.e.*, Mollusca, Annelida, and Arthropoda. 51.83% of total individuals in the dry season and rest 48.17% in the wet season were found. The first major taxon was Mollusca with 56.99% (snails=48.54%+mussels=8.45%), the second major taxon Ephemeroptera with 10.92% and the third major taxon diptera with 10.68% were found. The forth, the fifth, and the sixth, taxon were found worms with 4.92%, odonata with 3.67% and trichoptera with 3.25%. The characterization of macro-invertebrate communities is highly influenced by decisions about sampling design, parameters calculated and sampling devices employed (Brown, 2001 and Mandeville, 2002)(Fig. 1).

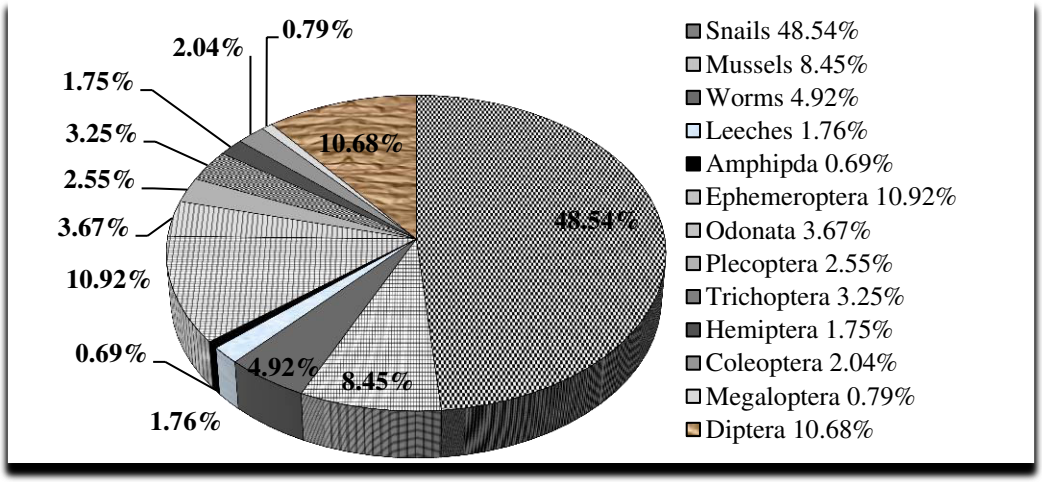

Fig.1. Percentage Abundance of calculated Benthic Macro-Invertebrates.

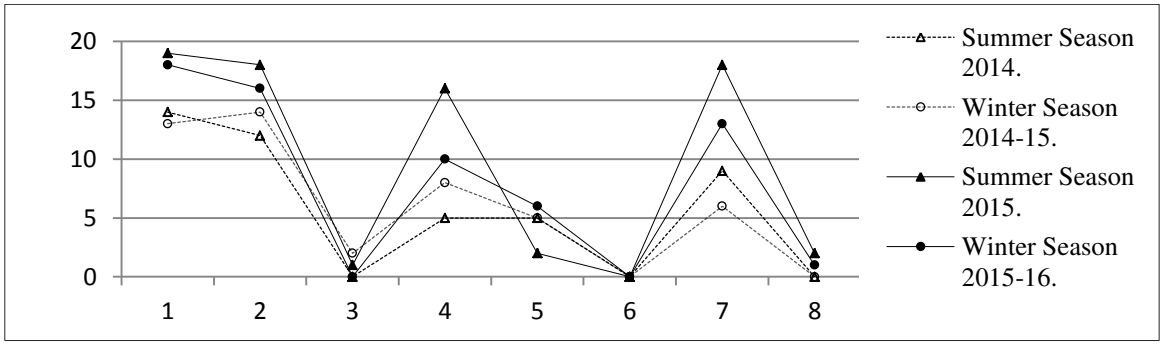

Fig.2. Abundance of Ephemeroptera at different sites

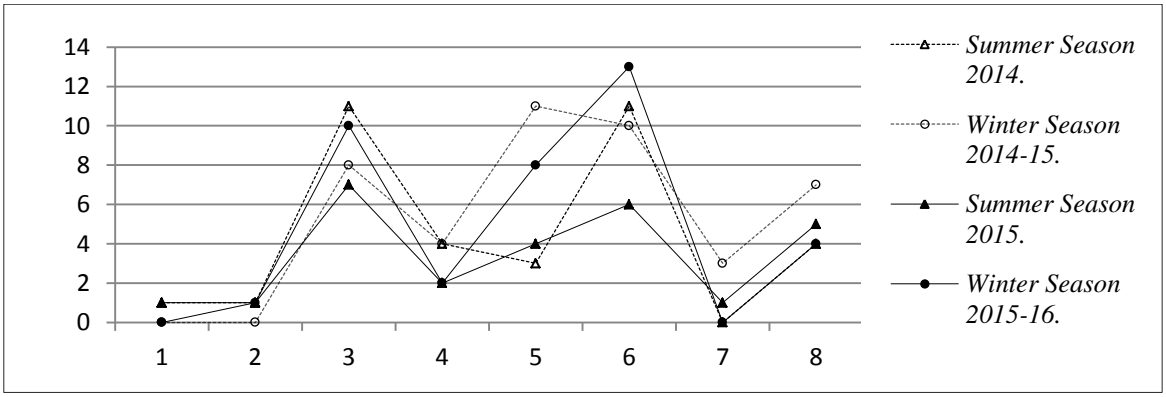

Fig.3. Abundance of Worms and Leeches at different sites

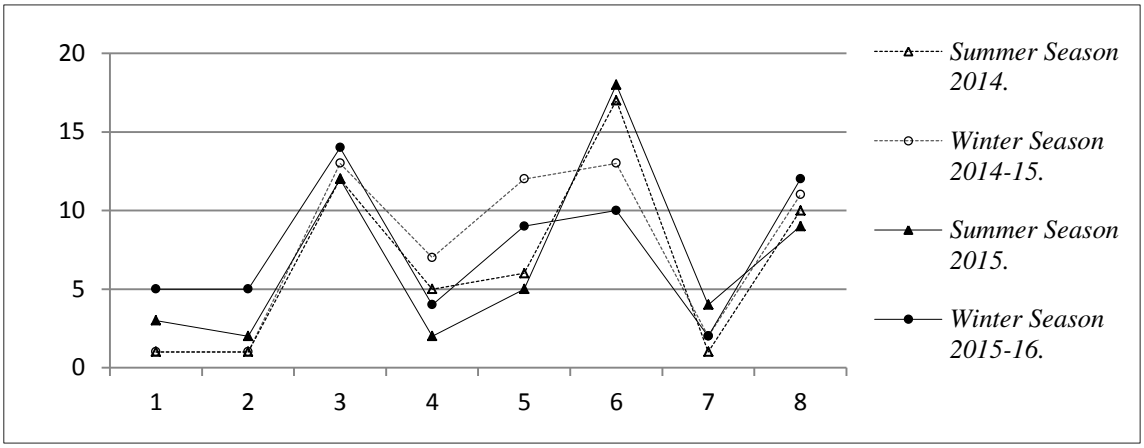

Fig.4. Abundance of Diptera(Chironomidae) at different sites

More individuals were recorded in dry season than in the wet season during whole of the period of study. This might be related to the fact that the river had its lowest volume and highest temperature during early summer. The macro-benthic abundance and composition were low and the more dominant taxonomic groups were molluscs (Seba Roy and Abhik Gupta, 2010). The Mollusca fauna of the Bagmati River was presented with 6 families in 3 important orders Mesogastropoda, Basommatophora, Schizodonta covers 56.99% of the total population of aquatic fauna in which Mesogastropoda + Basommatophora= class-Gastropoda (snails=48.54%) and Schizodonta=class-Pelecypoda (mussels) = 8.45% were recorded (figure1). Family Thiaridae dominated the whole population of Gastropoda. Gastropoda (snail) acts as pollution tolerant benthos while Pelecypoda (mussels) acts as pollution sensitive benthos among Mollusca. Ephemeroptera (mayfly), Plecoptera (sandfly) and Tricoptera (caddish fly) were dominant at Site 1-Ratanpurghat, Site 2- Rasulpurghat, Site 4-Manikaulighat, and Site 7-Morwaraghat. This Pollution sensitive benthos was found positive correlation with transparency, and dissolved oxygen (Sharma, 1986). Family Baetidae with 154 individuals and Family Chimarrinae were dominant among order Ephemeroptera and Trichoptera respectively (Fig. 2-4).

Moderately tolerant benthos Odonata (dragonfly and damselfly), and Hemiptera (aquatic bugs) were dominant at most of the sites. Pollution tolerant benthos Simulidae (black flies), Chironomidae (midge flies) in order Diptera were dominant at site 3, 5, 6 and 8. They were found positive correlation with conductivity, total dissolved solid, dissolved organic material carbonate alkalinity, total hardness and. They are associated with poor water quality as they are more resistant to pollution have different mechanisms to deal with adverse environmental conditions and have hemoglobin as a physiological adaptation that favour a greater absorption and transpiration in little oxygen and serve to enhance the absorption of the dissolve oxygen. Pollution tolerant benthos leeches, worms were dominant at site 3,5,6,8. This was probably due to maximum amount of high organic nutrients present at these sites (Mandaville, 1999).

CONCLUSION

The low benthic macro-invertebrate community abundance, composition and diversity may have been greatly affected by stress imposed by pollutants. Most of the benthic macro-invertebrates community as a whole in the river has been found to have significant positive correlation with the total hardness, total alkalinity and only some benthos *i.e.*, Ephemeroptera

(mayfly), Plecoptera (sandfly) and Tricoptera (caddishfly) was found positive correlation with transparency. The loss in biodiversity will disrupt aquatic food chains and food webs of the ecosystem.

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