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Biomonitoring of Sirsa river in Baddi area of Himachal Pradesh

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ABSTRACT: The present paper deals with status of river Sirsa at three sites namely upstream Baddi (S_1), Jagatkhana near bridge (S_2) and Ghanauli near bridge (S_3) in borderline with Punjab in terms of saprobic index and sequential diversity index. This system of water quality indexing has been used in management of water resources. The macro invertebrate fauna exhibit a huge range of diversity in river bed and are highly sensitive or tolerant to changes in water quality. The presence, absence, frequency of appearance, disappearance and abundance of these organisms act as biomonitoring tool in pollution load assessment along with biochemical oxygen demand. The effluents discharged from Baddi industrial hub into river water contain both organic and inorganic pollutants. By reviewing this study, reliable management measures can be adopted for pollution abatement programs.

Keywords: Industrial effluents, BOD, saprobic index, sequential diversity index, benthic fauna

I. INTRODUCTION

The riverine ecosystem performs a wide range of functions with many intrinsic values or changes. These freshwater has become dumping sites to emanate pollutants. Biomonitoring is an integral part of sound water pollution studies to observe ecological disturbances and provide an indication of flow of pollutants at trophic level. The benthic macro invertebrate fauna of river is most suitable biological parameter for water quality evaluation in relation to biotic indices and diversity of species richness. An advantage of biological sampling over chemical sampling is that it looks at indicators of conditions which are present in the river over the period of time rather just at the moment when samples are collected so as to give it a water quality value (Kumari, 2006). The macro invertebrate populations in streams and rivers can assist in the assessment of overall health of stream (Carlisle *et al*., 2007). The ruthless discharge of industrial effluents into river water disrupts ecological balance in the long run, thereby endangering the aquatic biota. It appears to be evident that community diversity declines in the presence of pollution and the sensitive species are progressively replaced by more tolerant form as pollution increases. Benthic macro invertebrates act as barometer of overall biodiversity in aquatic ecosystems (Chatzinikolaou *et al.,* 2006). In present study, saprobic score and biodiversity score has been used to assess the benthic macro invertebrate communities i.e. observations on aquatic insects, crustaceans, molluscans, worms etc. are drastic to draw results on bioindicators reported.

II. MATERIAL AND METHODS

The method of biological water quality assessment includes sampling, collection, sorting, identification, counting and calculations of indices applied. Water samples were collected from August 2011 to July 2012 from three sampling sites: (S_1) upstream Baddi, (S_2) at Jagatkhana bridge and (S_3) at Ghanauli bridge based on dumping rate of industrial effluents directly or indirectly through various routes in and around river water. The macro invertebrates were collected by Ekman dredge and separated from sediment by sieving through a fine mesh size 0.3-0.5 as a screener. Then rinsed and preserved in 4 % formalin. The organisms preserved were analyzed and identified according to books: Ward and Whiple (1959), Pennak (1978), Tonapi (1980) and Adoni (1985). Therefore, the saprobic and diversity scores were calculated as per guidelines of CPCB 1999; Biochemical oxygen demand was also estimated as per method given in APHA (1998). Sirsa river is one of the major perennial tributary of river Sutlej and is liable to floods. It lies adjacent to Barotiwala-Baddi-Nalagarh Industrial hub and in between 30º 57′N; 76º22′E at 400 m above msl. Sirsa river originates near Kalka, enters Himachal Pradesh in district Solan near Baddi and flows through sub-shivalik hills before, it confluences with river Sutlej at Chak Dehra near Ghanauli.

At present, Baddi-Barotiwala industrial estate is spread over an area of 3,500 ha. The area houses about 50 large and medium scale units and more than 300 small and tiny units. Sirsa river is the ultimate recipient of all the industrial effluents as well as domestic waste.

III. RESULTS AND DISCUSSION

Biomonitoring along with physico-chemical analysis provided converging lines of evidences for evaluation of polluted habitats (Dubey, 2011). Pollution in an aquatic ecosystem affects the BOD of water directly and thus brings a negative effect on the diversity of species present in the ecosystem. The diversity indices drop after more sensitive species begin dying out (Spelberg, 1991). The industrial effluents may contain specific, toxic, transferable and non-biodegradable substances which are potent metabolic inhibitors of both terrestrial and aquatic organisms and leads to degradation of aquatic biota. The progressive and irreversible accumulation of these substances at trophic level causes marked effects on macro-invertebrates species present in the water body. Benthos has wide variations in response to pollutants so used as bioindicators of river to evaluate water quality (Hawkes, 1979; Sharma and Chowdhary, 2011). The information from bio-mapping helps in collection of baseline data on taxonomical distribution of benthic macro-invertebrates, which are natural indicator for water quality assessment of various rivers. Analysis of treated distillery effluents at Solan showed that all values reported to be within permissible limits of BIS and WHO while non- treated wastewater of commercial or residential area has slightly higher values of total solids, total dissolved solids and total volatile solids but has no impact on quality of drinking water (Ahlawat and Kumar, 2009).

It has been reported that pollution in most of the rivers in Northern Bihar is organic (Kumari *et al.*, 2006) and biomonitoring of wetlands of Punjab was also reported by (CPCB, 2005) with reference to biological quality of water. Since BOD is an index of organic pollution, in present study BOD of river at S_1 ranged between 5-7 mg/L; at S_2 between 6-9 mg/L and at S_3 it ranged 12-14 mg/L. It is interesting that saprobic index at S_1 was 4.5 with diversity index 0.80 where as saprobic index and diversity index at S_2 was 4.8 and 0.72 respectively. At S_3 the saprobic score was 5.0 with diversity score 0.22 as shown in Table 1.

Table 1: Biomonitoring of Sirsa river.

Sampling sites	Saprobic score	Diversity score	BOD mg/L	BWQC	Water quality
S_1	4.5	0.80	5-7	C	Moderately polluted
S_2	4.8	0.72	6-9	C	Moderately polluted
S_3	5.0	0.22	12-14	D	Highly polluted

Results from the present investigations clearly inferred that there was inverse relationship between saprobic score and diversity score calculated as sites S_1 and S_2 were moderately polluted due to slightly lotic terrain but at S_3 organic pollution load estimated was maximum may be due to mere 0.22 diversity score, high BOD content, plain substratum, muddy highly turbid water and directly pouring of human and animal wastes beside large volume of industrial wastewaters and this site S_3 was highly polluted.

IV. SIGNIFICANCE

Studies highlights data or information on environmental issue of river Sirsa related with restoration of its ecological status.

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