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Integrated Surface Water Quality Assessment Using Benthic Macroinvertebrates

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***Abstract**: Biomonitoring of waterbody provides an integrated and cumulative assessment of its water quality over a particular time period. This paper presents a review of concepts and use of biomonitoring methods for water quality monitoring. The benthic macroinvertebrates are the most common indicators of biomonitoring, which can be used independently for water quality assessment. This paper reviews the various methods of benthic macroinvertebrates collection i.e. rapid monitoring and use of artificial substratum. The common biomonitoring parameters are classified as Biological Monitoring Working Party (BMWP) Score (Saprobic Score) and Sequential Comparison Index (Diversity Score) are discussed. The applications of biomonitoring are proposed to mainly include assessment of surface water quality and studies on the Biological diversity of surface water.*

Keywords – Water Quality, Biomonitoring, Benthic Macroinvertebrates, Saprobic score (BMWP), Diversity index, Surface Water

Introduction

Water is one of the most vital natural resource. Biologically and economically water is very precious. Man depends on water for production of food, disposal of domestic and industrial wastes, generation of energy, transportation, industrial production and recreation. To ensure that the water quality is being maintained or restored at accepted level, it is important that the monitoring is done on regular basis. In India, Central Pollution Control Board (CPCB) has derived primary water quality criteria (PWQC) as required in the designated best uses of surface water bodies to identify beneficial uses of water in terms primary water quality criteria parameters.

It is difficult to monitor water quality only by physicochemical methods. To overcome this difficulty, biomonitoring techniques are used with various physicochemical monitoring. Biomonitoring methods are used for research work and study because this method is fast, inexpensive; the equipment used is simple and easier in sampling.

Biomonitoring is a science of informing the ecological condition of rivers, lakes, canals, streams and wetland by examine the organism live there.

Benthic macroinvertebrates have been useful because they have been recognized as being particularly sensitive to pollution and to other changes in to the streams. They can be used to gauge unseen dangers in the aquatic environment.

Materials and Methods

This study involves the various methods for sampling of invertebrates i.e. rapid monitoring (kick net, dip net) and use of artificial substratum. Artificial substratum helps to colonize the Benthic invertebrates in the fabricated cage i.e. sampler, which is filled with natural pebbles and immersed in the stream for one month. There after retrieving it, the species of animals which are colonized on the substratum are collected and evaluated for water quality.

Location And Duration Of Monitoring

Bio monitoring needed to be done during the biologically mature period of the year. In Indian scenario, rainfall occurs for a limited period of time but with very high intensity. The entire aquatic biological system is disturbed because of rapid increased flows and flood conditions. After the monsoon the aquatic biological system start rehabitating and reestablishing. After Gradual succession, "mature" ecosystem establishes. This is the right time for biological sampling.

The sampling time for Biomonitoring is preferably selected in the early morning and/or before sunset because many of the species of macroinvertebrates avoid the extreme sun light and temperature.

Reference station for these studies should be fixed in the upstream where there is no human intervention (disturbances) or any anthropogenic pressure and sampling point should be downstream of each discharge point identified after the complete mixing.

Selection of Monitoring Parameters

This study involves the use of two known parameters i.e. Biological monitoring working - party (BMWP) Score or saprobic score and sequential comparison index or Diversity score.

Biological Monitoring Working Party (Bmwp) Score Or Saprobic Score

This scoring system was basically evolved for British rivers and it was tried with some minor modifications on River Yamuna during the pilot study under the indo-Dutch project by Central Pollution Control Board, the method was found quite suitable for Indian conditions The biological scores allocated to groups of organisms by Biological Monitoring Working Party (BMWP) Score is as shown bellow

Table 1 Biological Monitoring Working Party (BMWP) Score or Saprobic Score (by CPCB)

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Group	Families	Score
Mayflies, Stoneflies, Riverbug, Caddisflies or Sedgeflies	Siphlonuridae, Heptageniidae, Leptophlebiidae, Ephemerellidae, Potamanthidae, Ephemeridae, Taeniopterygidae, Leuctridae, Capniidae, Perlodidae, Perlidae, Chloroperlidae, Aphelocheridae, Phryganeidae, Molannidae, Beraeidae, Odontoceridae, Leptoceridae, Goeridae, Lepidostomatidae, Brachycentridae, Sericostomatidae	10
Crayfish, Dragonflies	Astacidae, Lestidae, Agriidae, Gomphidae, Cordulegasteridae, Aeshnidae, Corduliidae, Libellulidae	8
Mayflies, Stoneflies, Caddisflies or Sedge flies	Caenidae, Nemouridae, Rhyacophilidae, Polycentropodidae, Limnephilidae	7
Snails, Caddisflies or Sedge flies, Mussels, Gammarids, Dragonflies	Neritidae, Viviparidae, Ancylidae, Hydroptilidae, Unionidae, Corophiidae, Gammaridae, Platycnemididae, Coenagrionidae	6
Bugs, Beetles, Caddisflies or Sedgeflies, Craneflies/Black flies, Flatworms	Mesoveliidae, Hydrometridae, Gerridae, Nepidae, Naucoridae, Notonectidae, Pleidae, Corixidae, Haliplidae, Hygrobiidae, Dytiscidae, Gyrinidae, Hydrophilidae, Clambidae, Helodidae, Dryopidae, Elmidae, Chrysomelidae, Curculionidae, Hydropsychidae, Tipulidae, Simuliidae, Planariidae, Dendrocoelida	5
Mayflies, Alderflies, Leeches	Baetidae, Sialidae, Piscicolidae	4
Snails, Cockles, Leeches, Hog louse	Valvatidae, Hydrobiidae, Lymnaeidae, Physidae, Planorbidae, Sphaeriidae, Glossiphoniidae, Hirudidae, Erpobdellidae, Asellidae	3
Midges	Chironomidae	2
Worms	Oligochaeta (whole class)	1

(Source: CPCB)

Macroinvertebrates are collected from the different surroundings of different water bodies at representative locations of water bodies and analysed their score from the given table for each particular species.

Total BMWP site score or Average score per taxon (ASPT)

Sequential Comparison Index Or Diversity Score

The methodology involves pair wise comparison of sequentially encountered individuals and difference of two benthic animals can be observed up to the species level, where no taxonomic skill is required. The diversity is the ratio of the total number of different animals (runs) and the total no of organisms encountered. The ratio of diversity has a value between 0 and 1. High diversity of macroinvertebrates always supports good water quality.

DIVERSITY INDEX

These parameters are included in Biological Water Quality Criteria (BWQC), which is reference value given by Central Pollution Control Board (CPCB) for water quality measurement (assessment), which gives water quality characteristics i.e. pollution level, water quality classes and its best designated use. We can also compare the results of both Primary Water Quality Criteria (PWQC) and Biological water quality criteria (BMQC)

Table 2 Biological Water Quality Criteria (BWQC)

Sr No	Range of Saprobic Score	Range of Diversity Score	Water Quality	Water Quality Class	Indicator Colour
1	7 and	0.2-1.0	Clean	A	blue
2	6-7	0.5-1.0	Slight Pollution	B	Light
3	3-6	0.3-0.9	Moderate	C	Green
4	2-5	0.4- less	Heavy	D	Orange
5	0-2	0-0.2	Severe	E	Red

(Source: CPCB)

Conclusion

Some Macroinvertebrates cannot survive in the polluted water and other can survive in polluted water. In an unhealthy stream, there may be only a few types of non- sensitive to pollution invertebrates are present. In a healthy stream, verity of pollution sensitive species as well as non- sensitive to pollution invertebrates are present.

Their taxonomical analysis as described in this study can reveal state of water quality. It can be used for the bio assessment of water quality at raw water intake points for drinking purpose, canal waters, lakes and also for river. With this information, appropriate policies and preventive measures can be implemented.

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