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DIVERSITY ASSESSMENT OF MACROINVERTEBRATES AND IMPACT OF HUMAN ACTIVITIES IN RIVER DIKHOW - A SOUTHERN TRIBUTARY OF RIVER BRAHMAPUTRA, ASSAM, INDIA

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ABSTRACT

Rivers reflect the status and quality of their landscape, river bio-assessment of river through biological monitoring has to have a connection between water quality and quantity, ground and surface water and the interdependence of aquatic biota on water and the landscape. Because, biology is the ultimate integrator of these interactions and biology provides the most direct and effective assessment of the status of the rivers. Biological criteria provide sensitive tracking of resource condition, particularly because the impairment of water is predominantly caused by non-toxic and non-chemical factors. Additional strength of biomonitoring include the ability to assess and characterize resource status, diagnose physical, chemical and biological impacts as well as their cumulative effects serve a broad range of regulatory as well as environmental program when integrated with chemical assessment and also provide a cost –effective approach to resource protection.

KEYWORDS :*Diversity Assessment Of Macroinvertebrates , Human Activities , biological monitoring .*

INTRODUCTION :

The benthal organisms ar related to a good style of substrata starting from organic vegetation (tree dust, macrophytes, algae, and detritus) to completely different sizes of inorganic particulates (silt, gravel, cobble, and stones). These substrata ar the foremost simply altered habitats once a watercourse is regulated. several genera or families of benthal animals are related to the most surround varieties [1],[2]. Besides substrate, several fresh invertebrates have precise needs for specific current velocities or flow ranges [3]. Certain taxa is also ideal indicators of prevailing flow conditions, qualitative responses to flow changes, website specific studies show that the majority taxa related to slow flow tend to extend in abundance as flows decline [4], whereas most species related to quicker flows exhibit the other response [5]. Various diversity indices are used to determine the distribution pattern of benthic macro invertebrates related to habitat quality. Diversity index is a statistical method which is planned to evaluate the variety of a data group consisting of different types of components. Features of a population such as number of existing species (Richness), distribution of individuals equally (Evenness) and total number of existing individuals underlie the basis of diversity indices [6],[7].

Keeping all these views in mind, a comprehensive study was done to portray a vivid picture of the river ecosystem by considering an important biotic community (Macro invertebrate) as a tool.

METHODOLOGY

Demarcation of the study area

The selected study area is the tailrace of Dikhow river of 65 km stretch which has been demarcated into five sectors as follows:

Table:1: Details of the sampling sites

Sampling site	Name	Locality	GPS position
I	Silghat	Nazira	(N-26º54'51.6" and E-94º44'14.6")
II	Kujibali	Hanhsora	(N-26º57'2.3" and E- 94º42'30.2").
III	Dikhow Bridge	Sivasagar	(N-26º58'35.1" and E-94º37'49.2")
IV	Baliaghat	Gaurisagar	(N-26º57'48.9" and E- 94º30'49.4");
V	Dikhowmukh	Dikhowmukh	(N- 26º59'58.5" and E-94º28' 03.9"

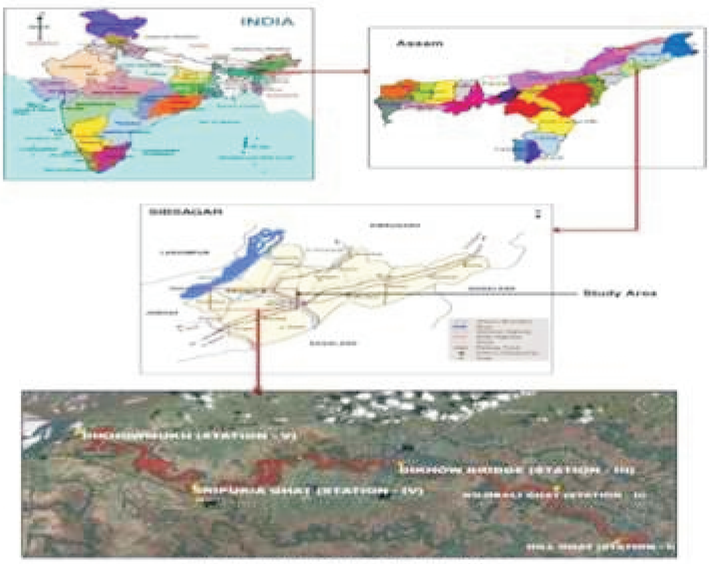


Fig. 1 : Location Map of the Study Area

Macroinvertebrate assessment: Benthic macroinvertebrates were collected from each sampling sectors using drag nets and preserved on sites in 70% ethyl alcohol and identified as suggested by Edmondson [8].

Statistical Analysis

Macro invertebrate species diversity was subjected to diversity analysis using different indices like Shannon – Weiner index (H)[9] ; Simpson index of diversity (1-D) [10]; Margalef's diversity index [11]; Pielou Evenness Index; Pielou diversity index [12], McIntosh diversity index and McIntosh evenness index[13] .

Shannon-Weiner Diversity Index "H"
Shannon-Weiner index is the most preferred index among the diversity indices used in biological science. It is calculated as follows
H = -" [(ni / N) x (ln ni / N)]
H: Shannon Diversity Index
ni: Number of individuals belonging to i species
N: Total number of individuals
Pielou Evenness Index "J"

It was derived from Shannon index by Pielou in 1966. The ratio of the observed value of Shannon index to the maximum value gives the Pielou Evenness Index result. It is expressed as:-

J = H / Hmax
J: Pielou evenness index
H: The observed value of Shannon index
Hmax : lnS
S: Total number of species

Simpson Diversity Index"D"

In ecology, Simpson index (D) is often used to quantify the biodiversity of a habitat. It takes into account the number of species present, as well as the abundance of each species.

Simpson's index of diversity:

D = 1 – S ni (ni-1)/N (N-1)

Where, ni = the total number of individuals of a particular species. N = the total number of individuals of all species.

Margalef Diversity Index "Ma"

It has no limit value and it shows a variation depending upon the number of species. Thus, it's used for comparison the sites

Ma= (S-1) / ln N
Ma: Margalef Diversity Index
S: Total number of species
N: Total number of individuals
McIntosh Diversity Index “Mc”

It was suggested by McIntosh in 1967. The values are between 0 – 1. When the value is getting closer to 1, it means that the organisms in a community are homogeneously distributed 26

Mc = [N - √ ni2?)] / [N - √N]
Mc: McIntosh Diversity Index
ni : Number of individuals belonging to i species
N: Total number of individuals
McIntosh Evenness Index “McE”

It was derived from McIntosh index. The values are between 0 – 1. When the value is getting closer to 1, it means that the individuals are distributed equally 30.

Mc E = [N - √ ni2?)] / [N – (N /√S)]
Mc E: McIntosh evenness index
ni : Number of individuals belonging to i species
S: Total number of species
N: Total number of individuals

RESULT AND DISCUSSION:

Table:2 List of macroinvertebrates with their tolerance level as recorded from Dikhow River during the study period

TAXA	TOLERANCE	REFERANCE
ANNELIDA Hirudenea Hirudinideae. *Rhynchobdella sp*	10	Barbour *et al,* 1999
MOLLUSCA Gastropoda Physidae *Physella* sp.	8	Bode *et al.*1996
MOLLUSCA Bivalvia Margaritiferideae *Margaritifera* sp.	8	Barbour *et al,*1999
ARTHROPODA Crustacea Gammarideae *Gammarus* sp.	6	Bode *et al,*1996

ARTHROPODA Crustacea Pennideae *Fenneropenaeus indicus*	8	Barbour *et al*,1999
ARTHROPODA Insecta Isotomidea *Isotomurus* sp	5	Bode *et al*,1996
ARTHROPODA Insecta Caenidae *Caenius* sp.	7	Hauer and Lamberti, 1996
ARTHROPODA Insecta Gomphidae *Gomphus* sp.	5	Bode *et al*,1996
ARTHROPODA Insecta Belostometidae *Lethocerus* sp.	5	Barbour *et al*,1999
ARTHROPODA Insecta Hemiptera Nepidae ------------	--	----
ARTHROPODA Insecta Hydrophilidae *Hydrophyllus* sp.	5	Bode *et al*,2002
ARTHROPODA Insecta Chaoboridae *Chaoborus* sp.	8	Bode *et al*,1996
ARTHROPODA Insecta Chironomidae *Chironomus* sp.	8	Hauer and Lamberti, 1996

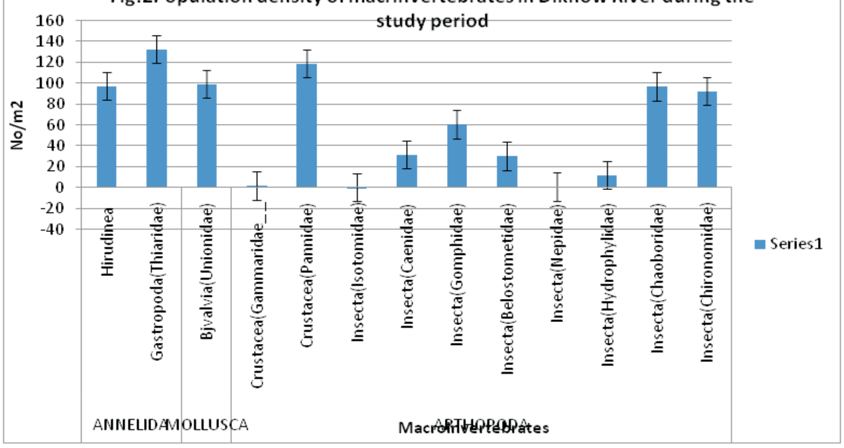
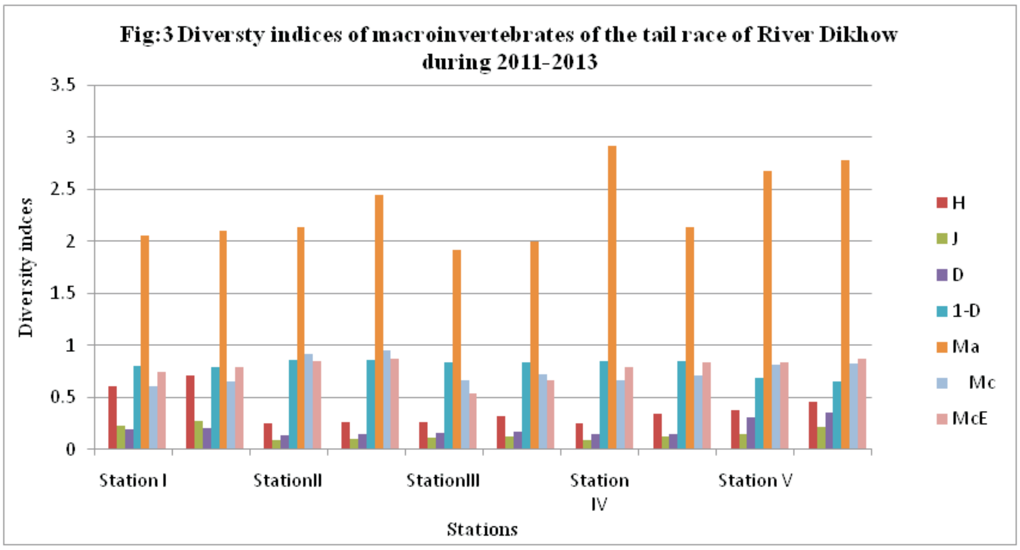


Fig:2Population density of macrinvertebrates in Dikhow River during the study period



13 species (Rhyncobdella sp, Physella sp, margaritifera margaritifera, Gammarus sp, Fenneropeneaus indicus, Isotomurus sp, caenius sp, Gomphus sp, Lithoserous sp, Hydrophylus sp, Chaoborus sp, Chironomus sp) of macroinvertebrates belonging to 13 families,(Hirudinidae, Physidae, Margaritiferidae, Gamaridae, Paenidae, Isotomidae,Caenidae, Gomphidae, Belostometidae, Nepidae, Hydrophilidae, Chaoboridae, Chironomidae), 5 classess (Hirudinea, Gastropoda, Bivalvia, Ceustacea and Insecta) and 3 phyla (Annelida, Mollusca, Arthropoda) have been recorded from the tail race of Dikhow river(Table: 2) during the study period.

The highest population of macroinvertebrates is contributed by Physidae family of class Gastropoda of Phylum Mollusca (Fig:2), followed by family Pannidae of class Crustacea. Pannidae is followed by family Margaretiferidae (Fig:2) of class Bivalvia , followed by population of family Hirudinidae of class Hirudinea.(Fig:2).Family Chaoboridae of class Insecta followed Hirudinidae . Chaoboridae is followed by family Chironomidae of class Insecta(Fig:2). Family Gomphidae, Belostometidae and Caennidae of class insect contributed with very low population compared to above mentioned families. Family Gammaridae of class Crustacea, Nepidae and Isotomidae of class Insecta showed lowest population during the study period.(Fig:2). Family Margaretiferidae of class Bivalvia belonging to phylum Mollusca showed comparatively higher population in station: 5(S5) during the study period (Table:2).

Tolerance is a listing of tolerance values for each taxon used in the calculation of the Hilsenhoff species-level Biotic Index and the Family Biotic Index. Tolerance values range from 0 for organisms very intolerant of organic wastes to 10 for organisms very tolerant of organic wastes. Most of these values were taken from Hilsenhoff [14], Bode et al [15],,Barbour et al [16] and Hauer and Lamberti [17]. While compared the tolerance level of the macroinvertebrate texa recorded from the Dikhow river, it has been noticed that, Chironomus sp and Chaoborus sp belonging to class insecta of phylum arthropoda with tolerance level 8 (Table;2 Fig:2), Fenneropenaeus indicus,belonging to insecta of Arthropoda, with tolerance level 8(Table;2 Fig:2), Margaretifera margaretifera under class Bivalvia and Physela sp under class Gastropoda belonging to phylum Mollusca with tolerance level 8(Fig:1) and Rhyncobdella sp. Belonging to class Hirudinea of phylum Annelida with tolerance level 10 (Table;2 Fig:2) recorded with maximum no. from the stations during the study period. Among them Bivalvia was found to be highest in no. particularly in station :V (Fig:2) during the study period. But, compared to them other classes with tolerance level 5 and 6 recorded to be less in no. from the stations(Fig:2). It indicates the water quality of Dikhow River likely to be polluted or introduction of organic pollutants [18],[19].

Shannon – Weiner index "H" which depends on both the number of species present and the abundance of each species. The index values are between 0.0 – 5.0. The values above 3.0 indicate that the structure of habitat is stable and balanced; the values under 1.0 indicate that there are pollution and degradation of habitat structure.The value of Shannon Diversity Index in all the station was found to be between 0.008985 to 0. 010114 (Fig: 3) ; i,e the value was below 1 which indicate there is pollution and degradation of habitat structure. Station wise Shannon diversity index of macroinvertebrate was highest in station I (0. 010114) and lowest in station II (0.008024). Pielou Evenness Index value was between 0.002 to 0.0024 and values was approximately similar in all stations (Fig: 3). The values are between 0 – 1.When the value is getting closer to 1, it means that the individuals are distributed equally. Simpson diversity index was derived by Simpson in 1949. Simpson index values (D) are between 0 – 1. But while calculating, final result is subtracted from 1 to correct the inverse proportion. Simpson's diversity index is a measure of diversity. Simpson Diversity index value ranged between 0.745 to 0. 877(Fig: 3). Simpson Diversity Index was highest in station II (0.877) and lowest in station III (0.745). Thus the diversity index values in all the station s indicate introduction of organic pollutants to the river . The stations are mainly human populated areas. As Margalef's index value greater than 3 indicate clean conditions, so it can be said from recorded values of Margalef diversity index (smaller than 3), that the tail race of Dikhow river is polluted . Low variability of population observed during the investigation period can be explained by a number of causes like degradation of habitat structure as a result of various anthropogenic activities or industrial out flow to the river. Simpson diversity index showed poor macroinvertebrate diversity in Station I,II,III and IV but higher in Station V (Fig: 3). McIntosh diversity index (Mc) was found to be closer to 1 in Station II and V but in rest Stations it was far below 1. Thus it can be considered that the organisms are homogeneously distributed in Station II and V (McIntosh, 1967). In Station II IV and V, the McIntosh evenness indices were found to be closed to 1 (Fig: 3) . Therefore it can be considered that the individuals are equally distributed. But, in Station III, particularly in wet season, the McIntosh evenness index was found to be far below 1 (Fig: 3) which indicated poor water quality (McIntosh,1967).

Station I and III are industrial areas. Disposal of organic pollutants must be reduced in these areas. Organic pollutants originate from domestic sewage (raw or treated), urban run-off, industrial (trade) effluents and farm wastes. Unplanned and unusual fishing must be stopped. River should be protected from fish poachers. Unplanned construction of hatcheries should be avoided. Catching of fish during their breeding season must be stopped.

ROLES TO BE PLAYED TO PREVENT FURTHER POLLUTION:

Effluents must be treated to acceptable levels and standardize before discharging them in river. Details of all effluents generated each industry or urban runoff must be mainained as database in the State water resource Information System, The State Pollution Control Board and local administration and must be made available to local people. scientific fishing should be practiced. Important information on scientific procedures for fishing must be published in local Assamese newspapers and magazines. Government or any other appropriate agencies must take initiatives in this.

Above all, we must not forget to play our individual roles starting from our own homes to save this diminishing commodity, our precious water. There are many easy ways to save water from wastage. Never let used water to go down the drain when there may be another use for it such as recycling it by watering the plants or washing the cars. Verify that your home is leak-free, because many homes have hidden water leaks. Read your water meter before and after a two-hour period when no water is being used. If the sunnecessarily. Dispose tissues, insects and other such wastes in the trash rather than the toilets. Take shorter showers. Replace your showerhead with an ultra-low-flow version.

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