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A Case Study on Aquatic Macroinvertebrate Assemblage And Their Suitability To Different Substrata: First Record on Aquatic Insect Diversity of Gujarat State

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Abstract:*Aquatic macroinvertebrate assemblage at Thol Bird Sanctuary corresponding to different habitats was assessed. The habitat was sub-divided into, two sites S1 (a macro habitat selected with vegetated association with minimal human intervention) located with tree cover. Other sampling stations S2 (fringe area sediments with high human intervention) was impacted in various ways. A total no. of 414 specimens was collected from both the sites. Diversity indices observed for S1 was H=5.53 and for S2 was H=5.07 and Simpson's index for S1 was D=0.94 and S2 was D=0.93. There was no significant difference between both the sites ($p<0.05$).*
Keywords: *Aquatic macroinvertebrates, Thol, Diversity*

I. Introduction

Invertebrate communities change in response to changes in physicochemical factors and available habitats. The biotic structure and water quality of streams and rivers reflect an integration of the physical, chemical and anthropogenic processes occurring in a catchment area, leading to the concept of ecological integrity **[1].**Human induced physical perturbations, changes in LULC patterns and discharge of pollutants through point and non-point sources are responsible for a broad-scale deterioration of freshwater ecosystems **[2].** Wetland ecologists have tacitly assumed that water chemistry is an important influence on wetland invertebrates **[3].**The hydrology and water chemistry of wetlands both are governed by landscape features, hence a change in biotic communities varying with changes in landscape characteristics, such as landform or soil type is seen **[4].**Aquaticmacroinvertebrates are ubiquitous and diverse group of long lived species that are strongly affected and have predictable response towards human influences in aquatic ecosystem. In addition to this they are sedentary, therefore body burdens reflects local conditions, allowing detection of a variety of perturbations in a range of aquatic habitats **[5].**However studies of associations between water quality and invertebrates from natural habitats with more moderate chemistries appear to be lacking **[6].**Live organisms offer valuable information regarding their surrounding conditions and can be used to evaluate the physical, chemical and biological impact and their cumulative effects **[7].**

The physical dimensions of ecologically relevant microhabitats regulating the distributions of particular species having a specific interrelation during biological process are virtually unknown.Realising the importance of such study on relation between the physical and chemical attributions associated with particular habitat type and the invertebrate fauna associated with them, several of such studies have been undertaken by ecologists and biologists.Investigation of influence of water chemistry specifically effect of temperature on the biota have been undertaken since time and again **[8] [9] [10].**

The influence of physico-chemical attributes on the structure and composition of invertebrate communities has been a dominant theme in aquatic ecology **[11].**Water quality is an important factor influencing the distribution and abundance of invertebrates, ecologists all over the world are using invertebrates to give an early warning to possible harm of the water resources **[12].**In present study the author has evaluated the influence of habitat and microhabitat factors on spatial variation of the macroinvertebrate assemblages within two different macro habitat types differing in hydro-period, water chemistry, and dominant vegetation.

II. Materials And Methodology

1. Study area

Freshwater wetland was selected to undertake this pilot study of a prolonged ecological characterisation of wetland ecosystem. Thol Bird Sanctuary was selected, keeping in mind the basic pattern of hydro-period and its subjectivity towards the change in physical and chemical nature of the micro habitats.The Land Use Land Cover (LULC) patterns in the basin broadly ranges from small scale lumbering and farming to large-scale mechanised agriculture. Two sub-stations for sampling were selected S1 (a macro habitat selected with vegetated association with minimal human intervention) located with tree cover. Other sampling stations S2 (fringe area sediments with high human intervention) was impacted in various ways.

2. Sampling design

Triplicate samples of water to assess physico chemical parameters and macroinvertebrate assemblage were collected from designated sampling stations on a monthly basis from month of February to July 2015 covering part of dry season and a part of wet season.

2.1 Physical-chemical parameters

On each sampling visit, physical and chemical parameters were measured before macroinvertebrates were sampled. Electrical conductivity was measured using a conductivity meter (HANNA, Model HI96304 EC-4), temperature and pH were measured in situ by a combined pH/temperature-meter (HANNA, Model pH/°C METER). Dissolved oxygen (DO) was measured using digital meter (HANNA, Model DO METER). Monthly variation of the physical-chemical parameters was measured from months of February to July 2015.

2.2 Macroinvertebrate sampling

The wetland was sub divided into two micro habitats on the basis of the hydro periodicity and differences in physical-chemical attributions. Macroinvertebrates were collected from microhabitats; aquatic macrophytes associations (S1) and fringe sediments (S2).To avoid bias dueto spatial variations or patchiness, simple random samplingwas done and insects werecollected from each of the two habitats byestablishing a transect at each sampling reach. This procedure was replicated three times for each microhabitat, making nine samples per reach. Sampling was done using an insect net 500 µm mesh size and samples were pooled to make one composite sample per habitat per station. The samples were preserved in 80% ethyl alcohol solution prior to transportation to the laboratory for sorting as described by Karr, 1999.

2.3 Laboratory processing

In the laboratory, samples were washed with distilled water, sorted, and counted using a stereomicroscope. They were identified to the family level possible, using available literature on identification of aquatic macroinvertebrate fauna.
Relative abundance and species richness for major taxonomic groups was calculated to assess the compositional difference amongst sites.

2.4 Statistical analysis

One-way analysis of variance was used to test differences between stations. Comparisons of means were done post hoc using ANNOVAto analyse difference between the habitats that differed significantly. To gauge the abundance of specific community, certain important biotic indices such as Shannon-Wiener (Shannon-wiener, 1949) and Simpson's index (d_{simp}) (Simpson, 1949) were calculated.

III. Results

The biotic scores calculated and statistical analyses performed helped to assign distinct catchment and anthropogenic impacts to the benthic macroinvertebrate assemblages along the two selected sites in the described wetland, when pollution and hydrological impacts were most evident. Considerable seasonal variations in respect of certain physico-chemical parameters and macro benthic invertebrate population were observed (Tables 1 and 2). During the period of present investigations, for S1 the water temperature of the wetland was observed to fluctuate from a minimum of 18°C in February to a maximum of 32°C in the month of May 2015. Mean depth of ranged from a minimum of 0.2 m in the month of April to a maximum of 0.4m in the month of July 2015. Similarly for S2, water temperature was a minimum of 20°C in February to a maximum of 30°C in the month of May 2015. Mean depth ranged from a minimum of 0.3 m in the month of April to a maximum of 0.5m in the month of June 2015. pH of water showed a wide variation ranging from 6.8 to 7.5 for S1 and from 6.8 to 8.1 for S2. The concentration of DO recorded a seasonal variation from a minimum of 5.7 mg/l in the month of March 2015 to a maximum of 7.2 mg/l in the month of April 2015 for S1, whereas DO ranged between 5.6 and 6.8 for S2. EC for S1 and S2 ranged between a min. of 12 µS/cm to max. of 18µS/cm for S1 and S2.

Altogether 10 taxa were observed during the entire study period constituting of 30 families. For S1 max. no of individual taxa were of Odonata (n=83), followed by Mollusca (n=64), then Diptera (n=30), Ephemeroptera (n=24), Hemiptera (n=20), Plecoptera (n=19), Amphipoda (n=9), Coleoptera (n=3) Megaloptera and Isopoda (n=1). For S2, max. no. of individual taxa were of Mollusca (n=64), followed by Odonata (n=45), Diptera (n=19), Ephemeroptera (n=13), Plecoptera (n=9), Hemiptera (n=7). If we take into account total no. of taxa in S1 and S2, then S1 catered more number of taxa (n=254) then S2 (n=160).

The macrobenthic invertebrate fauna was analyzed for species diversity, species richness, andevenness. The values of species diversity of macrobenthic fauna thus obtained varied considerably during the months of sampling. The index ranged between H' = 3.07to H' = 2.96 (for S1 and S2 res.). The range of variations of Simpson's index ranged from d_{sim} = 0.94 to d=0.93 (S1 and S2 res.). The evenness value observed were P i = 0.55 and P = 0.58, respectively.Post hoc analysis using ANNOVA was carried out to gauge the exact difference between the two sites, but no significance difference was seen ($p<0.05$).One can conclude form the study that though no significance difference was seen between the selected sites S1 showed high number of diversity of the aquatic insects then S2 (254>160), this was due to the conducive habitat given by vegetative growth around the site.

IV. Discussions

Fresh water wetland was selected to investigate the aquatic macroinvertebrate community. The area was divided into two sites S1 and S2, wherein S1 had vegetative cover and S2 comprised of sand beds. Physical-chemical parameters for both the sites were studied to gauge the environmental impairment due to human presence. It was seen from the results that S2 was more environmentally degraded then S1 and this was shown by both the phsico-chemical parameters (Table 1) and the presence of aquatic macroinvertebrates (Table 2). S1 had higher number of pollution intolerant species then S2.The present study concludes that the presence of some pollution indicator species such as Diptera and Molluca**[13] [14] [15]**directly points to the shifting status of the site from non-polluted to polluted.

V. Conclusion

The study concluded that sites which were selected according to human intervention showed environmental impairment at the site wherein the rich was near. Presence absence of aquatic macroinvertebrates could very well depict the present condition of the habitat thus catering to the needs of biomonitoring.

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Table 1 Aquatic macroinvertebrates encountered at Thol Bird Sanctuary

Order	FAMILY
Plecoptera	
	Capniidae
	perlidae
	Nemouridae
Ephemeroptera	
	Baetidae
	Caenidae
	Ephemerellidae

	Ephemeridae
	Heptageniidae
Hemiptera	
	Corixidae
odonata	
	Aeshnidae
	Libellulidae
	Coenagrionidae
	Macromiidae
	Gomphidae
	Lestidae
Megaloptera	
	Sialidae
Coleoptera	
	Elmidae
Diptera	
	Blood-red Chironomidae
	Pink Chironomidae
Amphipoda	
	Gammaridae
	Hyalellidae
Isopoda	
	Asellidae
Mollusca	
	Lymnaeidae
	Physidae
	Planorbidae
	Viviparidae
	Pleuroceridae
	Bithyniidae
	Hydrobiidae
	Valvatidae

Table 2 Physical –Chemical Parameters at Sites S1 and S2

	S1	S2
Physical parameters		
Water Temperature (°C)	18 ± 1.4	20 ± 1.8
Water Depth (m)	0.3 ± 0.1	0.2 ± 1.5
Width(m)	1.8 ± 0.8	2.3 ± 0.19
Chemical parameters		
pH	6.8 ± 0.3	8.1 ± 1.3
Dissolved oxygen(mg/lt)	6.5 ± 0.15	5.6 ± 1.4
DO % saturation	75 ± 0.6	52 ± 2.1
Electrical coonductivity(μS/cm)	16 ± 1.8	16 ± 0.5

Fig 1 variation in physical-chemical parameters at Thol Bird Sanctuary