

Full Length Research Paper

Benthic macroinvertebrate community of a fourth order stream in Kashmir Himalaya, India

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The study was conducted in order to determine the abundance of benthic macroinvertebrates in Doodhganga stream passing through Brenwar forest (Yousmarg) Kashmir. Altogether 6 orders under 2 phyla namely: Arthropoda and Annelida were recorded from the stream. In spite of the torrential flow of the stream, the hard substrata like boulders and cobbles provided a stable habitat for diverse number of macroinvertebrates. The diversity of benthic community helped to assess the health of the stream. On the basis of Hilsenhoff biotic index the study area was found pristine with negligible organic pollution. The seasonal dynamics showed greater diversity and density in summers than in winters.

Key words: Benthic, diversity, pollution, stream.

INTRODUCTION

Benthic macroinvertebrates are by far the most common groups used in the assessment of water quality (Williams and Felton, 1992; Rosenberg and Resh, 1993; Lin and Yo, 2008; Martins et al., 2008). These animals of size 200-500 µm (Rosenberg and Resh, 1993) inhabit the bottom substrate of fresh water, estuarine and marine ecosystem (A.P.H.A, 1998). The distribution of benthic macro invertebrate species and communities is controlled by a variety of environmental factors such as habitat characteristics (Peeters and Gardeniers, 1998), water quality (Hellawell, 1986), sediment quality (Chapman, 2001), sediment grain size (Tolkamp, 1980), contaminants (Phipps et al., 1995) and by biological factors such as competition and predation (Macneil et al., 1999).

The benthic community shows a range of taxa-specific

responses to environmental stressors, these may be with respect to alteration in the food webs (Goedkoop and Johnson, 1996; Lodge et al., 1998; Stockley et al., 1998) or due to floods or drought (Covich, 1993; Power, 1995; Johnson et al., 1998), that alter the species composition of the benthic macrofauna.

This paper provides useful information pertaining to the type of invertebrates inhabiting the bottom substrate, thereby reflecting the pollution level in the stream.

MATERIALS AND METHODS

Study area

Doodhganga stream is the principal left bank tributary of the River

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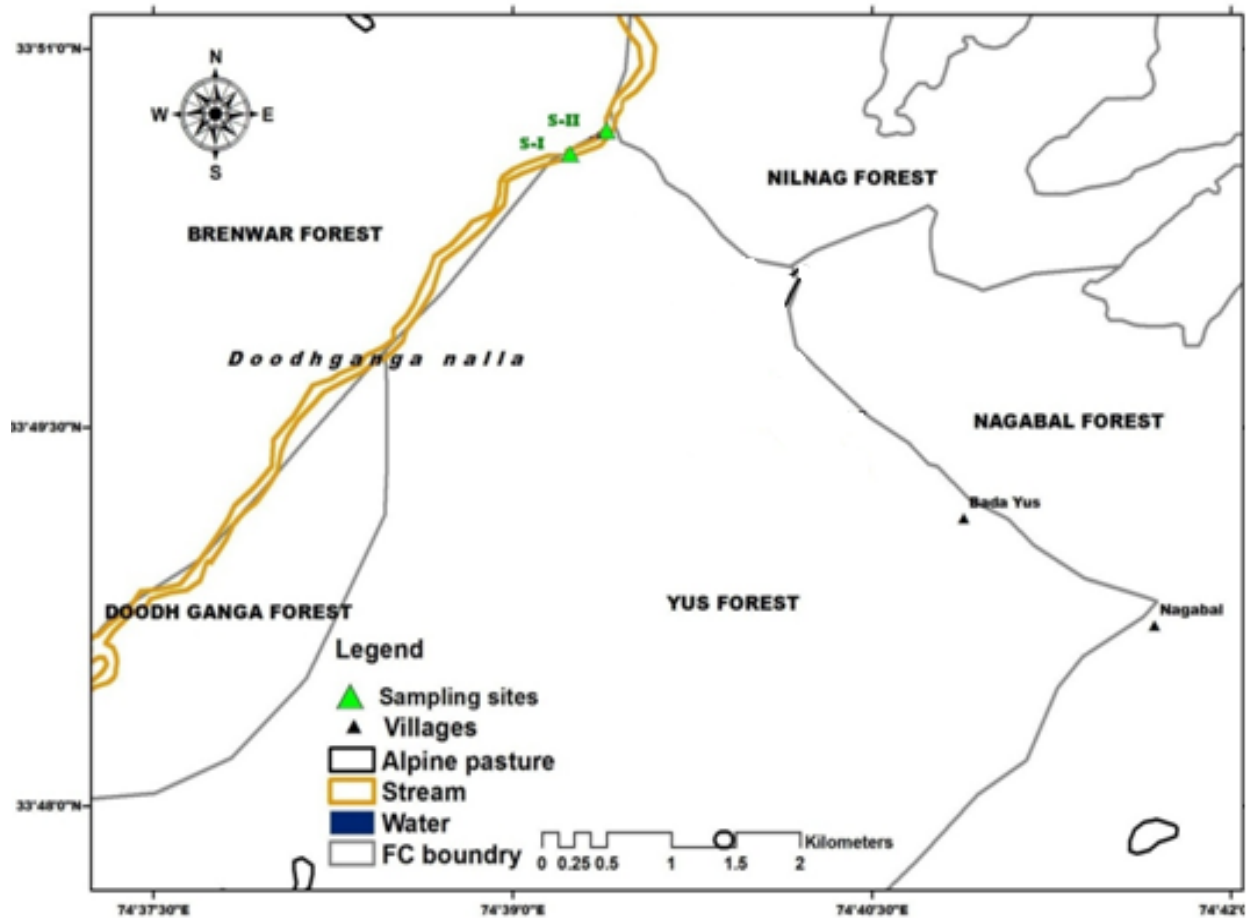


Figure 1. Doodhganga stream through Brenwar forest, Yousmarg and identification of two sampling sites.

Jehlum. The sampling sites (Figure 1) were located in the stream passing through the Brenwar forest of Yousmarg at an altitude of 2,304 m a.m.s.l. The coordinates for the two sites (I & II) were 33° 50' 34.4" N and 74° 39' 12.4" E and 33° 50' 41.2" N and 74° 39' 24.7" E, respectively. The study area belonged to stream order four (Hussain and Pandit, 2011) according to Rosgen classification. Sampling was carried in two different sites and the results obtained were averaged to provide a holistic information about the stream.

Methodology

Quantitative sampling was done during May, June, November and December (2010) via following the protocol for hard-bottomed streams (Hoffsten and Malmqvist, 2000; Stark et al., 2001; Ilmonen and Paasivirta, 2005). Fifteen replicates were taken from each site per month.

Samples collected were preserved in 4% formalin (for specimen with exoskeleton) and soft bodied organisms were preserved in 70% ethanol (Borror et al., 1976). The identification was done upto genus level with the help of standard works of McCafferty and Provonsha (1998), Wetzel and Likens (2000), and Ward (1992).

The population density was determined by calculating the number of individuals recorded per meter square. Biotic indices like

Shannon diversity index (Shannon and Weaver, 1976), Simpson index (Simpson, 1949), evenness index (Pielou, 1966) and Hilsenhoff Biotic Index (Hilsenhoff, 1977, 1982, 1987) were also determined.

RESULTS AND DISCUSSION

The general characteristics of the stream are given in Table 1. During the period of investigation, 22 species of macrozoobenthos were recorded (Table 2). Arthropoda was found to be the most dominant group, comprising of 21 species followed by Annelida with 1 species. The former was represented by class Insecta (5 order) and Crustacea (1 order).

Highest relative density (94.5%) was recorded for phylum Arthropoda. The hard bottomed stream provided a stable habitat (Williams and Feltmate, 1992; Emere and Nasiru, 2007; Arimoro et al., 2007) to the macroinvertebrates against the increased water flow rate. The other phyla Annelida was represented by only *Erpobdella octoculata*. Here their contribution to the total invertebrate

Table 1. General characteristics of the study area.

Parameter	Average values
Depth (m)	1.23
Dissolved oxygen (mg/l)	6.52
Water flow rate (m ³ /s)	2.06
Substrate type	Hard-bottomed stream (leaf litter from adjoining forest)

Table 2. Community structure of macrozoobenthos species in Doodhganga stream

Phylum	Order	Family	Taxa/Species
		Athericidae	<i>Atherix</i> sp.
		Blephariceridae	<i>Bibiocephala</i> sp.
		Chironomidae	<i>Diamessinae</i> sp. <i>Glyptotendipes</i> sp.
		Empididae	<i>Clinocera</i> sp.
	Diptera	Tabanidae	<i>Tabanus</i> sp. <i>Chrysops</i> sp.
		Tipulidae	<i>Hexatoma</i> sp. <i>Tipula</i> sp.
		Simuliidae	<i>Simulium</i> sp.
Arthropoda		Glossosomatidae	<i>Glossosoma</i> sp.
		Hydropsychidae	<i>Hydropsyche</i> sp.
	Trichoptera	Limnephilidae	<i>Limnephilus</i> sp.
		Rhyacophilidae	<i>Rhyacophila</i> sp.
		Brachycentridae	<i>Brachycentrus</i> sp.
	Plecoptera	Capniidae	<i>Allocapnia</i> sp.
		Chloroperlidae	<i>Xanthoperla</i> sp.
	Ephemeroptera	Baetidae	<i>Alainites</i> sp.
		Heptageniidae	<i>Epeorus</i> sp.
	Coleoptera	Chrysomelidae	Unidentified
	Amphipoda	Gammaridae	<i>Gammarus pulex</i>
Annelida	Pharyngobdellida	Erpobdellidae	<i>Erpobdella octoculata</i>

community was little, as the annelids have been observed to thrive better in soft depositing substrates which were not the present case.

The total number of individuals varied 632 ind.m² (May) to 185 ind.m² (December). During the individual sampling months (Figure 2) more or less constant trend of trichoptera and diptera dominating over other orders was

reported. The macroinvertebrates belonging to these two orders are known to have a wide range of feeding behavior ranging from shredders, collectors to predators (Hutchinson, 1993) thereby occupy every possible trophic level (Williams and Feltmate, 1994; Mackie, 2001).

The benthic fauna showed a seasonal variation in density and diversity as is seen in the Figure 2. The

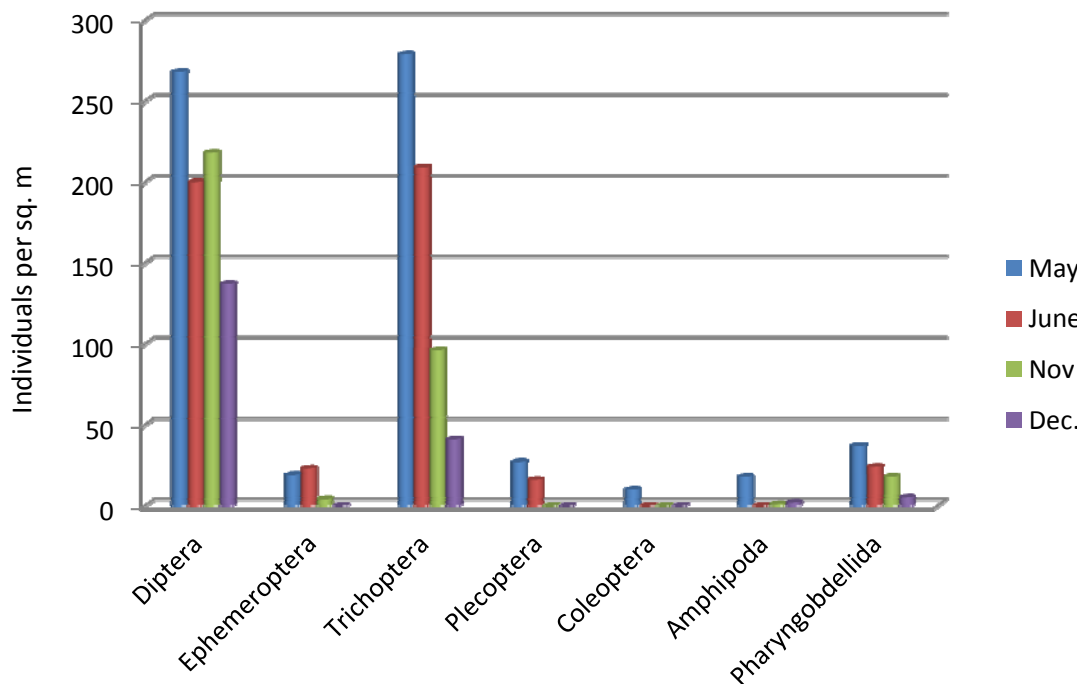


Figure 2. Population densities (number of individuals per sq. m.).

abundance was found to be highest during summer as compared to winters (Bruce et al., 2003; Lamp and Haube, 2004). The freezing temperature in winter in this high altitude temperate stream limits the density and species richness however warmer conditions in summers favors establishment of diverse fauna (Gupta and Michael, 1983; Allan, 1995; Cowell et al., 1997; Stark and Armitage, , 2004). The mean values of Shannon-, Simpson- and equitability indices were found to be 2.18, 0.16 and 0.85 respectively. The Hilsenhoff Biotic Index (3.6) indicated no apparent organic pollution in Doodhganga stream has apparently no organic pollution.

Conclusions

The study shows that the substrate type has an effect on the distribution of benthic organisms. A seasonal variation in the abundance of individuals indicates that temperature and its factors have a pronounced influence on the life cycle of invertebrates. The diversity indices and biotic index shows high abundance, richness and diversity with no organic pollution in the study area hence indicating good stream health.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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