Checklist of benthic macroinvertebrate communities of stream Rawasan in Garhwal region (Central Himalaya), Uttarakhand (India)

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Abstract: The benthic macroinvertebrates are indicators of water quality and ecosystem health. The present study investigated the benthic macroinvertebrate communities at five different sites (August 2015 to July 2016) of stream Rawasan of Garhwal region (Central Himalaya), Uttarakhand (India). 21 benthic macroinvertebrates taxa mainly belonged to 6 orders were recorded at different sites. Majorities were nymphs and larvae of Ephemeroptera, Plecoptera, Trichoptera, Coleoptera, Lepidoptera, and Turbelleria. Significant changes in the benthic fauna were due to the fluctuation in abiotic and biotic variables, geology, land use, altitudinal variation and riparian vegetation.

Keywords: Aquatic insects • checklist • altitudinal variation • Garhwal region

Introduction

The benthic macroinvertebrates are live in the bottom of water body. They act as good indicators of water quality (Rosenberg and Resh, 1993) and ecosystem health (Norris and Hawkins, 2000). Benthic macroinvertebrates are the most popular choice for bioassessment measure (Hellawell, 1977). These communities have been extensively studied in Himalayan River and streams by several authors (e.g., Sunder and Subla, 1986; Jhingran et al., 1989; Dobriyal et al., 1992; Suren 1994; Ormerod et al., 1994; Brewin et al., 1995; Kumar et al., 1998; Singh et al., 2010; Negi and Mamgain, 2013; Balodi and Koshal, 2015; Rana et al., 2017).

Biodiversity in the Himalayan Mountains is globally significant due to pronounced endemism, habitat heterogeneity and biogeographic location (Myers, 1990). In tropical Asian countries, catchment deforestation and agricultural expansion are important factors for deterioration of the riverine ecosystem (Dudgeon, 1992). However these communities also depend upon the local and seasonal fluctuation in abiotic and biotic variables, geology, land use, altitudinal variation and vegetation. Soil erosion, floods and types of substratum may affect the distribution of aquatic fauna (Khan, 1983).

In Garhwal region of Uttarakhand state the successive variation in the aquatic habitat influence the biotic communities. The present study investigated the macroinvertebrate communities in the stream Rawasan of Garhwal region which provides information on biodiversity as a checklist of benthic macroinvertebrate communities with reference to different altitudinal variation among sites.

Materials and Methods

Study area

The present study was carried out in the stream Rawasan of Pauri Garhwal in the Central Himalayan region of Uttarakhand. The Rawasan stream is an important tributary of River Ganga and geographically, is bounded by 29º56'33.82"N and 78º26'42.41"E.

Table 1 GPS coordinates of selected sampling sites at Rawasan stream.

S. No.	Sites	Locality	Altitude (m asl)	GPS Coordinates
1.	Narikatal	Yemkeshwer block	830	29º56'7"N–78º25'51"E
2.	Jarpani	Yemkeshwer block	810	29º55'15"N–78º25'53"E
3.	Seela	Yemkeshwer block	790	29º55'23"N–78º25'54"E
4.	Pupaldanga	Yemkeshwer block	700	29º53'38"N–78º25'09"E
5.	Madhan	Yemkeshwer block	510	29º51'37"N–78º22'43"E

Benthic macroinvertebrates collection and identification

Sampling to obtain data on benthic macroinvertebrates was undertaken monthly at 5 sampling sites during August 2015 to July 2016. Benthic macroinvertebrates were collected from all the selected sampling sites following random sampling (Cummins, 1962) using modified Surber square foot sampler (Welch, 1952). Each of the sites investigated included on average a 200 m stretch of rivers and streams, comprising 4–8 samples in one square foot area reflecting the different habitats (i.e., riffle and pool). Identification was carried out to the lowest recognizable level usually genera, in the laboratory with the help of keys specified by Usinger (1956); Ward and Whipple (1959); Needham and Needham (1962); Usinger (1971); Macan (1979); Tonapi (1980) and Edington and Hildrew (1995).

Results and Discussion

During the present study a total of 21 benthic macroinvertebrates taxa belong to 6 orders i.e., Ephemeroptera, Trichoptera, Plecoptera, Coleoptera, Lepidoptera and Turbelleria (Table 2). The highest benthic taxa (21) were recorded at S1 site followed by S5 (16), S2 (15) and S3 (14). At S1 site habitat conditions such as moderately low velocity with

intermittent pools may influence the benthic communities. The flow conditions are important to ecosystem processes through the delivery of nutrients and gases and removal of wastes, and possibly by influencing which species occur at a site (Allan and Castillo, 2007). The dense forest in the riparian zone serves as food for the benthic taxa and also less disturbance at the site provides suitable habitat conditions for benthic communities. The aggregations of leaves on the streambed provide both food and habitat and typically support a high abundance and diversity of invertebrates (Mackay and Kalff, 1969).

The lowest (13) benthic macroinvertebrates taxa were observed at S4 site. This may be due to the disturbance by frequent anthropogenic activities by the local people of nearby villages. Fresh waters can vary widely in acidity and alkalinity due to natural causes as well as anthropogenic inputs and very acid and very alkaline waters are harmful to most organisms like benthic taxa (Allan and Castillo, 2007). The stream at was shallow and found polluted due to domestic activities of people which may declines in pH. Construction of road was going on at this site which disturbed the flow of water and altered the natural habitat of aquatic animals. The consequences of human disturbance: anthropogenic degradation and homogenization of habitat will lead

to biodiversity decline with unpredictable consequences for ecosystem function.

Among the 21 benthic macroinvertebrates taxa recorded *Caenis, Cinygma, Rhyacophila, Chimarra, Leptocella, Nymphula* and *Polycelis* were observed at all sites. These benthic taxa mostly preferred the clean and unpolluted water (Wells, 1991). However, *Perla* was observed at S1 site which prefer high oxygenated and low water temperature. Although, rivers and streams are characterized by variation in the physico-chemical parameters along different stretches due to the variation in ecological conditions of the stream. Any change either through natural or anthropogenic sources influences water quality as well as the biotic interactions (Thoker et al., 2015). Sites of the upper course of the river was characterized by fast flowing waters which decreases as we move downwards and is related to the gradient as the river slope decreases in downward direction and the concentration.

Table 2 Check list and occurrence of benthic macroinvertebrates taxa along different sites of stream Rawasan during August 2015 to July 2016.

Phylum	Order	Genera	S1	S2	S3	S4	S5
Arthropoda	Ephemeroptera	*Caenis*	+	+	+	+	+
		Cinygma	+	+	+	+	+
		Cinygmula	+	−	−	+	+
		Ephemerella	+	−	+	+	−
		Ecdyonurus	+	+	+	−	+
		Baetis	+	+	−	+	+
	Trichoptera	*Rhyacophila*	+	+	+	+	+
		Agapetus	+	−	+	+	+
		Hydropsyche	+	+	−	−	+
		Chimarra	+	+	+	+	+
		Glossosoma	+	+	+	−	+
		Leptocella	+	+	+	+	+
		Philiopotamus	+	−	+	+	+
	Plecoptera	*Neoperla*	+	+	−	−	+
		Perla	+	−	−	−	−
	Coleoptera	*Potamonectus*	+	+	+	−	−
		Psephenus	+	−	+	+	+
		Hydroporus	+	+	−	−	−
		Hydrophilus	+	+	−	−	−
	Lepidoptera	*Nymphula*	+	+	+	+	+
	Turbellaria	*Polycelis*	+	+	+	+	+

+, indicate presence; −, indicate absence of benthic taxa

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