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Diversity, trophic relationships and biomonitoring potential of Ephemeroptera, Plecoptera and Trichoptera communities in streams of southern Eastern Ghats

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ABSTRACT: A survey of Ephemeroptera, Plecoptera and Trichoptera (EPT) occupying streams in three hills of south portion of Eastern Ghats was conducted between October 2004 and May 2005. Three sites were selected on each stream and visited monthly throughout the sampling period. A total of 2,226 individuals belonging to 14 genera and 10 families of the three taxa were collected. Diversity indices showed higher values in stream of Sirumalai hill. High similarity was observed between Karanthamalai and Sirumalai and low similarity between Alagarmalai and Sirumalai. Collectors were predominant than other functional feeding groups. Sirumalai stream scored high BMWP values indicating good water quality.

KEYWORDS: species richness, water quality assessment, Eastern Ghats, Ephemeroptera, Plecoptera, Trichoptera

INTRODUCTION

A large number of major and minor rivers flow through the Eastern Ghats, which is an assemblage of a series of broken hills spreading over the states Orissa, Andhra Pradesh and Tamil Nadu in India. Several investigations on the aquatic insects of streams of Western Ghats have already been reported (Anbalagan *et al.*, 2004; Subramanian *et al.*, 2005; Anbalagan and Dinakaran, 2006; Dinakaran and Anbalagan, 2007). But no attempt has so far been made to study the fauna of these rivers of Eastern Ghats. The objective of the present study was to evaluate the species richness of Ephemeroptera, Plecoptera and Trichoptera (EPT) community in hill streams of Eastern Ghats, Tamil Nadu.

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MATERIALS AND METHODS

The Eastern Ghats are located between latitude 10° and 22° N and longitude 76° 50′ and 86° 30′ E. The Ghats cover an area of about 75,000 km^2, with an average width of 200 km in the North and 100 km in the South. They extend over a length of 1750 km. The region falls under tropical monsoon climate receiving rainfall from both southwest and northeast monsoon. Vegetation varies considerably with altitude and shows a distinct zonation of forest types. As a whole, the vegetation is typically deciduous type and scrub jungle in most places. For this investigation, streams from three hills namely, Karanthamalai (10° 17′ N and 78° 14′ E), Alagarmalai (10° 04′ N and 78°12′ E) and Sirumalai (9° 28′ N and 77° 22′ E) were chosen.

The study was conducted between October 2004 and May 2005. Three sites were selected in each stream and EPT taxa were quantitatively sampled every month using a 1m wide Kick-net (mesh size-1 mm). Riffle/run areas of stream were selected for sampling since such area is suitable for Kick-net sampling. EPT taxa were picked from the net surface and immediately preserved in 70% ethyl alcohol. Three samples were collected from each stream as three replicates in data. Genera/species of EPT taxa were identified in the laboratory. Mouth-part morphology and gut content were also examined for functional feeding group analysis (Cummins and Wilzbach, 1985; Dudgeon, 1999). Physico-chemical parameters were assessed following methods prescribed by American Public Health Association (1995).

Alpha diversity indices of Shannon-Weiner index and Simpson index were worked out. The Shannon index and Simpson index of diversity were calculated (Ludwig and Reynolds, 1988). Similarities in taxonomic composition were quantified using Jaccard's index (Sneath and Sokal, 1973) based on a presence-absence matrix for the insect fauna of each stream. A Bray-Curtis cluster analysis was performed using a flexible method ($\beta = -0.25$) using PAST Program (version 1.42). BMWP (Biological Monitoring Working Party) score was calculated by the procedure: list the families present, ascribe the score for each family, and then add the scores together to arrive at a site score. Score value for individual family reflects its pollution tolerance based on current knowledge of distribution and abundance (Armitage *et al.*, 1983).

RESULTS

A total of 2226 individuals of EPT complex belonging to 14 genera of 10 families were collected (Table 1). Diversity and abundance of EPT taxa were highest during October in Karanthamalai and Sirumalai streams and February in Alagarmalai stream. The lowest diversity of EPT taxa was observed in May in all the streams (Table 2).

Among alpha diversity indices, Shannon-Weiner index and Simpson's index were calculated for all the sampling stations. Shannon-Weiner index and Simpson's index showed the higher values (2.232; 0.8698) and species richness was higher in Sirumalai stream than Karanthamalai and Alagarmalai streams. Similarity matrix showed that there was a higher similarity in EPT richness between Sirumalai and Alagarmalai and low between Karanthamalai and Sirumalai. The Similarities between three hill streams among EPT taxa are depicted as dendrogram (Fig. 1).

TABLE 1. EPT taxa in the streams originating from three hills of Eastern Ghats in Tamil Nadu

Order	Family	Genus/species	Presence/absence		
			Karantha-malai	Alagar-malai	Sirumalai Sirumalai
Ephemeroptera	Baetidae	*Baetis* sp.	+	+	+
	Heptageniidae	*Cinygmina kumbakkariensis*	−	−	+
		Thalerosphyrus flowersi	+	−	+
	Leptophlebiidae	*Choroterpes alagarensis*	+	+	+
	Teloganodidae	*Teloganodes* sp.	+	+	+
	Caenidae	*Caenis* sp.	−	−	+
Plecoptera	Perlidae	*Neoperla biseriata*	+	−	+
Trichoptera	Hydropsychidae	*Potamyia* sp.	+	−	+
		Parapsyche sp.	−	−	+
		Hydropsyche sp.	+	+	+
		Cheumatopsyche sp.	−	−	+
	Polycentropodidae	*Polycentropus* sp.	−	−	+
	Calamoceratidae	*Anisocentropus*	−	−	+
	Lepidostomatidae	*Goerodes* sp.	−	+	+

+ present , − absent

TABLE 2. Abundance and number of EPT taxa in three streams of Eastern Ghats during October, February and May of 2004–2005

Stream	October		February		May	
	Abun-dance	No. of taxa	Abun-dance	No. of taxa	Abun-dance	No. of taxa
Karanthamalai	301	7	255	7	154	6
Alagarmalai	110	5	125	5	54	5
Sirumalai	927	13	270	9	30	5

Collectors was the predominant group among the functional feeding groups in all the streams sampled. In Sirumalai stream collectors dominated (55%) followed by filter-feeders (18%), predators (14%), scrapers (9%) and shredders (4%). In Karanthamalai collectors dominated (45%) followed by predators (26%), filter-feeders (23%), scrapers (4%) and shredders (2%). In Alagarmalai, collectors (67%) were predominant followed by shredders (24%); while scrapers (6%) and predators (3%) were the less occupied group. Filter-feeders were conspicuous by their absence. In

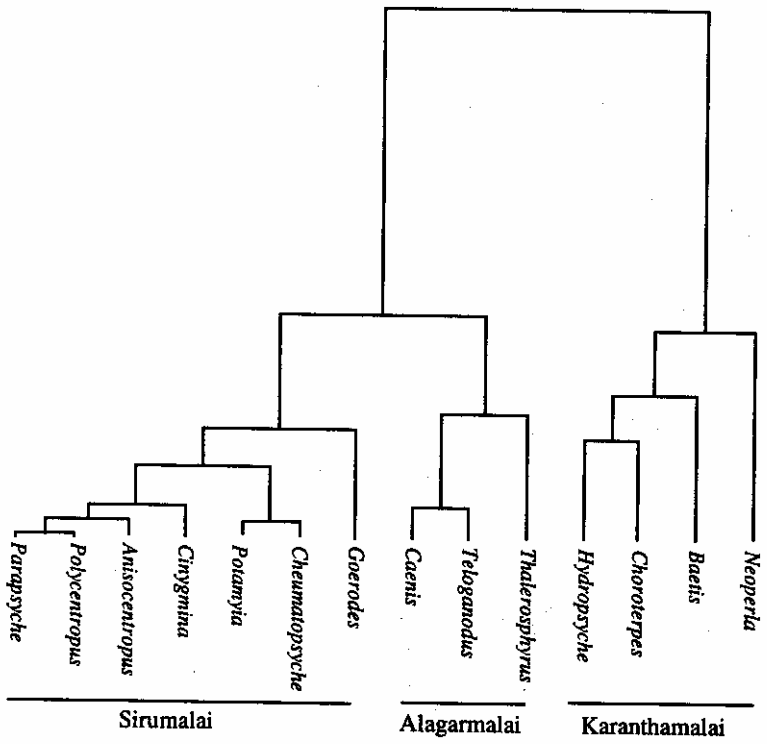

FIGURE 1. Dendrogram showing the similarity matrix for genera in streams of three hills

TABLE 3. Relative abundance of functional feeding groups in the streams of three hills of Eastern Ghats

Feeding groups	Percentage of different feeders		
	Karanthamalai	Alagarmalai	Sirumalai
Predator	26.3	2.9	14.0
Scraper	4.2	6.2	9.2
Filter-feeder	22.8	0	18.1
Collector	44.6	67.3	55.2
Shredder	1.9	23.6	3.6
Total	100	100	100

terms of abundance of functional feeding groups, collectors were most abundant (Table 3).

Assemblages of EPT taxa were compared between sampling sites. The results clearly explained the variations existing between the sampling stations. BMWP

TABLE 4. BMWP scores for families of EPT taxa in the streams of three hills of Eastern Ghats

Family	Karanthamalai	Alagarmalai	Sirumalai
Leptophlebiidae	10	10	10
Heptageniidae	0	10	10
Baetidae	4	4	4
Teloganodidae	10	10	10
Caenidae	0	0	7
Perlidae	10	0	10
Polycentropodidae	10	10	10
Hydropsychidae	0	0	5
Lepidostomatidae	0	5	10
Calamoceratidae	0	0	10
Total	44	49	86

analysis showed the prisitnity of streams. Sirumalai secured greater score (86) than Alagarmalai (49) and Karanthamalai (44) (Table 4).

DISCUSSION

Diversity analyses indicated that higher diversity values for EPT taxa were observed in stream of Siurmalai hills during October. Many factors were probably responsible for this, especially influence of monsoon, where southern Eastern Ghats receives maximum rainfall during Northeast monsoon (October). Lewis and Harrel (1978) found higher species diversity values during the periods of high discharge, which was attributed to many taxa being carried into the main stream from tributaries. Another factor related to discharge is the amount of plant debris washed into the river from either runoff or increased water levels and they provided habitat and nutrients for aquatic insect community.

Invariably all the sampling sites were dominated by collectors followed by filter feeders, predators, scrapers and shredders. The functional feeding group analyses agreed with the River Continuum Concept (Vannote *et al.*, 1980). Dominance of collector species might be due to fine particulate organic matter from upstream reaches and decomposing activities by microbial communities inhabiting the sampling sites. Previous studies suggest that consumers selectively assimilate a small fraction of natural detritus and that the rest is in fact passed rather quickly through the gut (Schindler, 1968; Bell and Ward, 1970; Hargrave, 1970).

Low BMWP scores from Karanthamalai may be due to anthropogenic disturbances by tourists and pilgrims. Water quality at this site should be monitored closely in coming years. Under natural conditions EPT diversity is directly correlated with habitat variety and therefore modified 'Species-Deficit-Concept' (Kothe, 1962) should effectively reflect the state of overall ecological integrity for a defined sampling area. The greatest impediment for practical application is the insufficient knowledge of the

species inventory for different sampling stations due to unknown distribution models and, subsequently, data incomparability. The outstanding importance of reliable faunistic baseline data and their value for future conservation projects is amply documented from long-term studies (Landa *et al.*, 1997; Sartori and Landolt, 1998). In Eastern Ghats at least, these difficulties must be overcome with regard to EPT community.

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