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SPECIES COMPOSITION, LATITUDINAL AND ALTITUDINAL DISTRIBUTION OF CADDISFLIES IN HILL STREAMS OF SOUTHERN EASTERN GHATS

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ABSTRACT
A total of 789 individuals of aquatic insects were collected from six selected streams of Southern Eastern Ghats. The objective of the present study is to address the latitudinal and altitudinal distribution of larval Caddisflies in the different streams of Southern Eastern Ghats. High family and generic richness was recorded in 11°47′80" N which is considered as highest degree of latitude among the visited sites located in Yercaud hills which corresponds to the altitude of 1161m. The Altitudinal and Latitudinal gradient offers excellent opportunities to investigate factors which control the diversity, composition and abundance of Caddisflies in streams of Southern Eastern Ghats. The present study clearly reveals that maximum diversity is confined to higher altitudes among sampled locations. Due to reduction in rainfall and global warming the stream flow is restricted to higher elevations and harbors maximum diversity.

INTRODUCTION

Trichoptera is an order of holometabolous insects with aquatic immature stages that are integral components of almost all freshwater communities. Caddisflies are stream engineers and construct their houses made of small twigs, leaf fragments, sand grains etc. Any stream profile changes would alter the existence of Caddisflies. This world is under anthropogenic threat and the global warming is manmade. Thermal characteristics of stream change along the Latitudinal and Altitudinal profiles, thus giving rise to distinct patterns of Caddisflies distribution.

Current climate change scenarios indicate proportionally more detectable impacts at both high altitude and latitudes (Beniston *et al*., 1997). Freshwater habitats have received less attention than terrestrial and marine ecosystems, so we must not assume *a priori* that diversity patterns found in terrestrial or marine systems also apply to freshwater systems (Boyero, 2002). However, local studies in streams have failed to show clear latitudinal macroinvertebrate diversity patterns; (Vinson and Hawkins, 2003). Much more data is required, therefore, there is an urgent need to examine local and global patterns of Latitudinal and Altitudinal diversity for different species.

Studies on the ecology of macroinvertebrates of some major streams in Southern Western Ghats have been well documented already (Anbalagan and Dinakaran, 2006; Dinakaran and Anbalagan, 2007). The species composition and distribution of Caddisflies in Southern Eastern Ghats is very poorly studied. No studies have been performed in the Southern Eastern Ghats that examined factors affecting large scale distribution of Caddisflies. Hence the present study on Southern Eastern Ghats was selected for investigation. The Eastern Ghats are located between 11°31' and 22°N L and 76°50' and 86°30′ E L in a North-East to South-West strike. The study was conducted in six selected streams of Eastern Ghats namely Alagar hills, Pranmalai, Sirumalai, Karandhamalai, Kolli hills, Shervarayan hills. The goal of this study was to test the effect of the latitude and altitude on diversity and composition of Caddisflies in the selected streams of Southern Eastern Ghats.

MATERIALS AND METHODS

The larvae of Caddisflies were surveyed in six hill streams including Alagar hills, Kolli hills, shervarayan hills, Karandhamalai, Sirumalai, Piranmalai which are located in Southern Eastern Ghats. Water temperature was recorded in the field using thermometer; dissolved oxygen was estimated using Winkler's method, pH and conductivity were determined by pH and conductivity meters respectively. Altitude, Latitude and Longitude were taken from GPS (Global Positioning system - Garmin 12). The quantitative collections of samples were made using Kick net and Dipper net (Burton and Sivaramakrishnan, 1993). The larvae of Caddisflies were collected and stored in 70% ethanol. EPT taxa were identified with the help of Dudgeon (1999) and Wiggins (1996) and other available literature. The stream substrates were also recorded on-site.

The data regarding the distribution of genera of Caddisflies were considered for analysis. Shannon Weiner diversity accounts for both abundance and evenness of the species. Simpson index provides important information about rarity and commonness of the species in the community. Simpson and Shannon Weiner indices (Alpha diversity index) were used to measure the genetic diversity within the Latitudinal zones. The average air temperature, water temperature and pH are also considered for analysis.

RESULTS

789 of total aquatic insects belonging to 9 orders were collected from the 14 sites in 6 selected streams of Southern Eastern Ghats. The physico chemical parameters of the streams were recorded in the Table 1. Eight different genera of Caddisflies belonging to eight families were found. In the course of the investigation performed in six selected streams of Southern Eastern Ghats 50% of total aquatic insects were found to be Caddisflies.

More aquatic invertebrates' richness was found at an altitude of 800m and 387m. The Simpson and Shannon index were tabulated in the Table 1.

Others, even occurring throughout all gradients, presented higher abundance in certain altitude, such as *Hydropsyche* and *Wormaldia* species in the latitude of 78°14". *Anisocentropus* is the only species which is present only at the Altitude of 1097m which corresponds to its Latitude 11°19.053"N. Eight genera of Trichopteran larvae were extremely wide spread in Southern Eastern Ghats. From these sis genera were present in the streams which are higher elevated.

Aathuppalam is the only place of Southern Eastern Ghats where the Caddisfly species *Rhycophila* and micro Caddisfly *Limnephilid* were recorded. Totally 15 species of aquatic insects were recorded in Shervarayan hills (11°47'799"N to 11°47'802"). From these 5 species were found to be Caddisfly larva.

The results presented here showed that despite the limited Altitudinal range of Southern Eastern Ghats, there is a distinct modification in the faunal community in relation to composition and abundance along this gradient pointed out by Illies (1964, 1969). The altitudinal distribution of Caddisflies was depicted in Table 2.

The higher Caddisfly diversity is seen at an altitude of 1175m which is mostly nearer to the higher elevation of the Southern Eastern Ghats. The species richness is more and abundance is less in higher altitudes. Many species have collected repeatedly at certain elevation but have never been taken at others where frequent and careful collections have been made. From the

Table 1: Physico chemical parameters of selected streams of Southern Eastern Ghats and the diversity of Caddisflies

S.No	Streams	Sites	Latitude(N)	Longitude (E)	Altitude (m)	Stream depth(cm)	Temperature (C)	pH	Simpson	Shannon
1	Alagar hills	Nuburagangai	10°04"	78°12"	235	18	25.9	9.27	0.07986	0.1732
2	Kolli Hills	Karavalli	11°19'52"	78°19.65"	312	10	19.4	6.30	0.4308	0.727
3		Naachiamman Odai	11°19'05"	78°21.26"	1097	5	28.5	7.70	0.4082	0.5983
4		Solaikkadu	11°17'49"	78°21.92"	1176	8	28.5	7.67	0.4628	0.6555
5		Agayagangai	11°1745"	78°21.90"	1175	20	21.1	8.10	0.4875	0.6806
6	Yercaud	Kiliyur	11°47'79"	78°12.03"	1168	10	18	7.90	0.1884	0.3365
7		Aathuppalam	11°47'80"	78°12.03	1167	10	21.8	8.10	0.2572	0.5217
8	Sirumalai	Site1	10°15'78"	77°59.73"	833	5	21.8	7.77	0.4688	0.6616
9		N.M.Turning	10°15'60"	77°59.58"	800	20	23.3	8.03	0.6145	1.009
10		Aathumedu Odai	10°14'16"	77°58.56"	1115	10	21.6	6.52	0.4861	0.824
11		Agasthipuram Ashram	10°13'25"	77°13.25	1121	15	23.1	5.74	0.449	0.7963
12	Karandhamalai	Ayyan Odai	10°17'82"	78°04.25	883	10	26.9	7.45	0.5465	0.9289
13		Ayyanar Aruvi	10°17'82"	78°04"	374	10	23.2	8.04	0	0
14	Pranmalai	_	10°14'52"	78°27'26"	174	5	27	7.50	0.5	0.8676

Table 2: Altitudinal distribution of Caddisflies in Southern Eastern Ghats

S. No.	Taxon	Altitude (m)										
		175	250	325	375	400	800	850	1100	1125	1150	1175
1	*Hydropsyche* sp.											
2	*Wormldia* sp.											
3	*Lepidostoma* sp.											
4	*Psychomylia* sp.											
5	*Rhyacophilia* sp.											
6	*Stenopsyche* sp.											
7	*Anisocentropus* sp.											
8	*Moselyna* sp.											

Table 3: Latitudinal distribution of Caddisflies in Southern Eastern Ghats

S. No.	Taxon	Altitude (m)										
		10°04″	10°13′5″	10°14′16″	10°14′52″	10°15′60″	10°15′78″	10°17′82″	11°17″49″	11°19′	11°19′52″	11°47′80″
1	*Hydropsyche* sp.											
2	*Wormldia* sp.											
3	*Lepidostoma* sp.											
4	*Psychomylia* sp.											
5	*Rhyacophilia* sp.											
6	*Stenopsyche* sp.											
7	*Anisocentropus* sp.											
8	*Moselyna* sp.											

above description we ultimately learn that there is a drastic change in the diversity of Caddisflies in Southern Eastern Ghats which shows that there is a great relationship between the diversity of species and global climate change.

Invariably all the sampling sites were dominated by *Hydropsyche* species. 90% of the total collected areas were distributed with the species *Hydropsyche* hence it is cosmopolitan in distribution. *Hydropsyche* is one of the most diverse and abundant families' world wide. The present analysis revealed that the studied biogeographical groups of Caddisflies have distinctly different altitudinal distribution over the streams of Southern Eastern Ghats.

The latitudinal gradient in diversity is one of the most pervasive patterns characterizing life on earth (Hawkins 2001, Willig 2001), with tropical regions, especially those in the New World, harboring the most species-rich biota. The higher Caddisfly diversity is seen at latitude 11°1745" N. The latitudinal diversity of Caddisflies were recorded in the Table 3. According to the present study the species richness is present at the higher altitudes and species abundance is found at the lower altitudes.

The observed patterns in species richness might be caused by a variation in the sampling effort among regions (Bardgett *et al*., 2005; Moerman and Estabrook, 2006). There is a positive correlation found between the altitude and species richness. Comparative studies of faunal assemblages and richness in similar streams located at different latitudes and altitudes are rare. Although described at a relatively high taxonomic level and based upon a limited set of streams, the observed latitudinal pattern allowed the distinction of geographical regions with taxon richness increasing at lower latitudes.

DISCUSSION

The present study demonstrates that in the Eastern Ghats, aquatic insect diversity within a habitat is determined by the interplay of intrinsic habitat and extrinsic environmental parameters. At the scale of habitat, taxa vary in abundance and diversity. Examination of the response curves for taxonomic richness and individual taxa confirm to existing knowledge about the ecology of the organisms.

Recent studies carried out in Southern Eastern Ghats shows that the abundance of *Potamia* sp, *Polycerntropus* species and *Chematopsyche* sp were recorded. But in our visit there is no evidence of such species present in those streams. Those species might be disappeared due to climate change, global warming or some other anthropogenical disturbances and dispersed to suitable physical habitats.

Latitudinal and altitudinal gradients of species richness are important for understanding the processes that generate and maintain biodiversity composition of the Caddisfly assemblages in terms of Biogeographical groups consistently changed along the altitudinal gradient.

Our results indicated that the altitudinal gradient is important not only to rivers of high mountains but also for different latitudinal and altitudinal wetlands. Palmer *et al*. (1994) found significant changes in composition and species richness in the Buffalo River (Africa) even in a small altitudinal range (600-1120m). Streams in lower altitude mountains may present important altitudinal distribution gradients of Caddisfly fauna.

According to the river continuum concept, the diversity must be rich in the lower altitudes and less in higher altitudes. But the concept become varies in recent studies. The species richness is found more in higher altitudes and less in lower altitudes. Species abundance is found lower in higher altitudes and less in lower altitudes. There is the total disturbance in the biodiversity. That is dependent on the dominant climatic processes in each stream. We also recorded changes *i.e.,* decrease in the abundance of specimens in the rainy period. There was neither a temporal replacement of the some species nor a significant difference in richness in all the observed streams. The replacement points out temporal stability in the assemblage composition, as well as a high degree of resistance and retrival from environmental stress.

Many previous works have reported a marked reduction in the abundance of the aquatic fauna during rainfall periods, which agrees with our results. There is a distinct temporal variation in the abundance of aquatic invertebrate assemblages between dry and rainy periods, with great reduction in the abundance of invertebrates during periods of increased rainfall in Andean rivers (Arunachalam *et al*., 1991)

Globally, the Caddisfly distribution varies between the north, center and south, being widely diverse toward high latitude. The older records were centered in central-southern Chile, principally between 36ºS and 41ºS. This reflected the location of the specialists (*e.g.* Illies in the Valdivian region, 39ºS) and not a restriction of the species produced by the latitudinal environmental gradient (e.g. riparian structure, substrate diversity). Thus, now there is an increased distribution of *Claudioperla tigrina* (23- 19ºS) and *Limnoperla jaffueli* (30-17ºS), the most northerly distributed species of the country. Unfortunately, our understanding of how taxonomic richness

of stream invertebrates is related to non aquatic environmental gradients, including latitude (Boyero 2002), is poor.

Jacobsen *et al*. (2004) indicated differences in the number of families and general diversity in tropical as compared to temperate zones, with higher richness and diversity in the tropics than in the temperate zones. Boyero (2002) found a similar pattern for Ephemeroptera and Odonata. Vinson and Hawkins (2003) reported slightly higher Trichoptera richness near the equator, a tendency for less variability across latitudes than Plecoptera or Ephemeroptera and more richness in temperate zones.

With our study, we underline that to understand differences in the spatial variation of biological diversity among taxa one has to consider the history of regions and lineages (Svenning and Skov, 2007) as well as the ecological traits of species (Hof *et al*., 2006;). The present study supports previous studies which document the various groups of Caddisflies are not in equilibrium with current climate. The relative importance of factors responsible for the increasing taxa richness towards lower latitudes is still a matter of debate (Chown and Gaston, 2000), although biogeographical factor such as isolation certainly play a role.

Previous studies have stated that lateral interactions between streams and geographical distribution may play a major role in stream ecosystem. Our study suggests that latitudinal transport can also influence the tropic structure of Caddisflies communities in streams of Southern Eastern Ghats. Nevertheless, altitude appears as an important factor affecting the structure of Caddisflies communities in streams. We state that the use of stream width or distance from source such as longitudinal gradient is not sufficient to accurately predict the diversity in different regions and that the influence of other environmental factors, such as altitude or latitude related to the temperature and hence to vegetation changes, leaf litter decomposition also should be accounted.

The present study indicates the changes regarding the diversity of Caddisfly in the streams. The indication may be the question for the future research that will determine how ecologically important process at the reach levels can be purposefully aggregated to global scale responses. The future challenge is to integrate the different latitudinal and altitudinal scales among certain disciplines such as Ecologist, Geomorphologist, Biogeochemist, etc.

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