ABUNDANCE, ALTITUDINAL DISTRIBUTION AND SWARMING OF EPHEMEROPTERA IN PALNI HILLS, SOUTH INDIA

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ABSTRACT

The nymphs of 17 genera of Ephemeroptera representing seven families were collected during a survey of mayflies at different altitudes in Palni hills. Densities ranged between 5–80 nymphs m^{-2} at the sites investigated. Species richness of most mayfly assemblages was high whilst the abundance of individual species was low. Leptophlebiidae and Heptageniidae dominated larger streams at different altitudes whereas Baetidae and Caenidae exhibited overlapping distribution patterns. Historical immigration, assured perennial flow of a stream and its pollution-free nature appear to be the factors mainly influencing the distribution of a few biogeographically significant genera of Leptophlebiidae. Noon swarming of leptophlebiid and baetid mayflies was observed at a few sites at higher altitudes.

INTRODUCTION

The Palni hills portion of the Western Ghats of peninsular India contains a larger number of hill streams dominated by mayfly fauna. The peaks rise over 2,500 m above sea level (a.s.l.). The altitudinal gradient as well as the presence of numerous perennial streams offer excellent opportunities to investigate factors which control the diversity, composition and abundance of stream organisms. There is little information on the influence of altitude on the abundance and distribution of Ephemeroptera with the only studies being those of Kamler (1967) in the Carpathian mountains of Poland, Ward and Berner (1980) in cordilleran chain of Colorado, U.S.A. and of Hubbard and Peters (1984) in Sri Lanka. The present observations on the occurrence and swarming of Ephemeroptera in relation to altitude are based on materials collected from ten sites in the Palni hills, where stream flow depends on the southwest and northeast monsoons.

DESCRIPTION OF STATIONS AND THEIR ECOLOGY

Collection sites (Fig. 1) were selected based on differences in altitude, ranging from 400 to

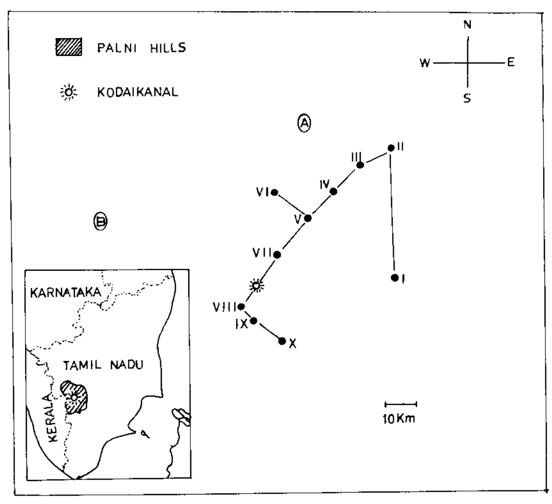

Fig. 1. Map showing the location of the study sites.

I.C. Campbell (ed.) Mayflies and Stoneflies, 209–213.

Table 1. Physico-chemical features, water quality parameters, and mayfly species richness and abundance at the sampling sites

Site	Altitude m.a.s.l.	pH	D.O. ($mg\,l^{-1}$)	Temp. (°C)	Current speed ($sec\,m^{-1}$)	Width (m)	Substrate type	Riparian vegetation	Total species	Range[1] of $\bar{x}$	Mean[2] density
I	400	6.9	4.9	19	4	10	bedrock with pebbles 20–40 cm diameter	*Cyperus* sp., *Scirpus* sp., *Blumea* sp., *Scoparia dulcis, Bacopa moneri*	13	1–8	20
II	850	7.2	4.8	19	8	1–3	sandy	*Ipomea* sp., *Ficus ispida, Brugmansia suaveolens*	3	1–3	5
III	1050	6.75	4.8	20	8	3–5	bedrock with pebbles 10–20 cm diameter	*Brugmansia suaveolens, Passiflora edulis, Cipadessa baccifera*	3	2–10	15
IV	1300	6.9	4.8	18.5	11	8–10	bedrock with boulders and pebbles	Manderin orange and coffee plantations	7	1–18	33
V	1400	6.95	4.8	17.5	11	2–3	sand and rock, pebbles encrusted with cyanobacteria	*Ligustrum perrottetii, Trema orientalis, Pinus* plantations	9	3–10	40
VI	1600	7.25	4.0	16	5	2–3	rock and sand mixed with silt	*Polygonum chinense, Todalia asiatica, Piper* sp.	6	1–7	19
VII	1700	7.25	4.0	15.5	3	5–10	bedrock, large boulders and pebbles	*Brugmansia suaveolens, Rubus ellipticus, Mussaenda hirsutissima*	7	3–55	80
VIII	2200	7.35	4.0	13	4	4–6	sand and rock	*Pinus* plantation	6	2–5	22
IX	2250	7.35	4.0	15	6	0.5–1	algal encrusted pebbles, organic debris	*Acacia dealbata, A. decurrens, A. melanoxylon*	3	2–20	24
X	2360	7.1	4.0	12	4	0.25–0.5	sand	*Scleria* sp.	2	5–10	15

[1] The range of the mean number of individuals per species per m^2.
[2] The total mean density per m^2 of all mayflies.

2,360 m.a.s.l. The average rainfall ranges from 175 to 250 cm yr^{-1}. Details of water quality and the physical nature of the sites were recorded (Table 1). Each site was visited at the end of south-west monsoon (22–23 August 1986) and again at the end of north-east monsoon (20–21 December 1986). Sampling methods followed those suggested by Brittain (1974). Imagos were collected while swarming using long-handled net. The total number of species collected in the two trips were recorded, together with the mean abundance of mayflies as a whole and the range of mean abundance for each species.

RESULTS AND DISCUSSION

Nymphs of 20 species belonging to 17 genera from seven families of Ephemeroptera were collected (Fig. 2). The number of species exhibited a general decrease at higher elevations. Only two species were found at site X (2,360 m) whereas 13 species were collected at site I (400 m). A similar pattern of altitudinal distribution was noted by Ward and Berner (1980) in a rocky mountain stream in Colorado, U.S.A.

The relative contribution of each family to the total mayfly fauna did not vary as a function of altitude, a result similar to that found in Sri Lanka by Hubbard and Peters (1984). However, in St. Vrain Creek Colorado, Ward and Berner (1980) found that Heptageniidae exhibited a progressive decrease downstream and Baetidae, a progressive increase downstream in abundance whereas leptophlebiids were collected only at the lower sampling sites.

The mean density of mayflies collected at the end of two monsoons ranged between 5–80

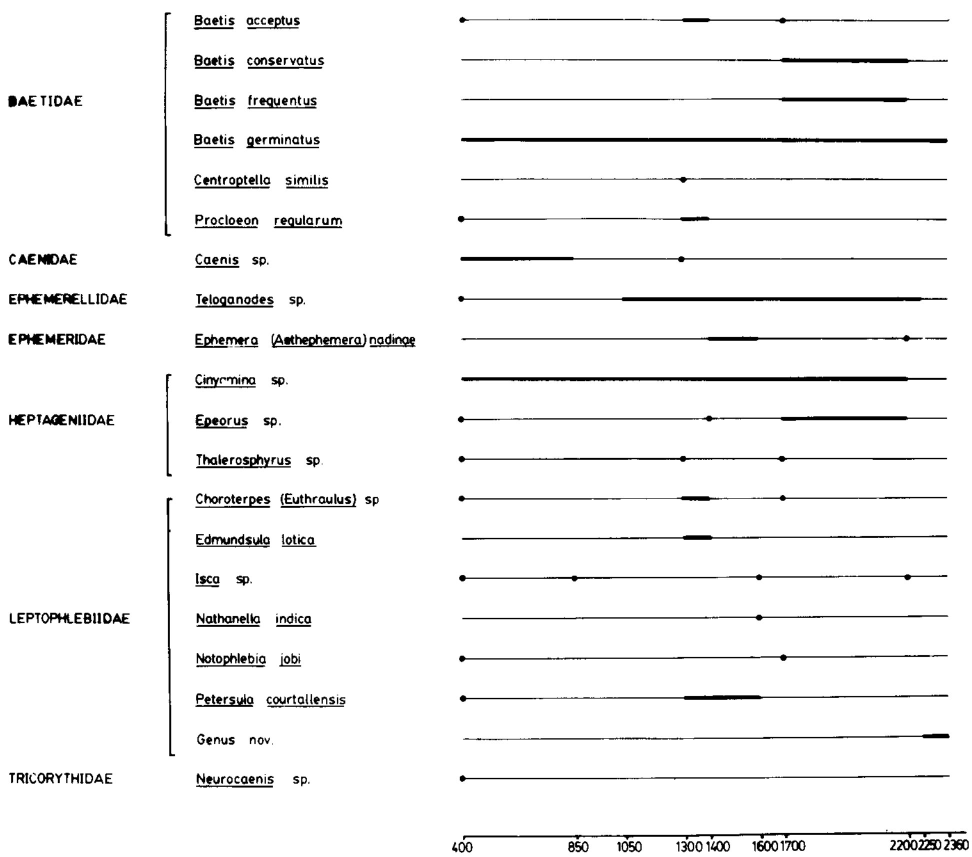

Fig. 2. The altitudinal distribution (dark horizontal lines and solid circles) of mayflies collected at sites I-X, in the Palni Hills, southern India.

nymphs m^{-2} (Table 1). Species richness of most families of mayflies was high and the population density of any particular species was low. Similar results have been found in hill streams of the Courtallam area of Western Ghats of South India (Sivaramakrishnan and Job 1981) and in Malaysa (Bishop 1973).

Although many genera of the Leptophlebiidae are distributed irrespective of altitudinal gradient, two genera viz. genus nov. and *Nathanella* are apparently restricted to higher altitudes (Fig. 2). These and a few other biogeographically significant genera (e.g. *Edmundsula)* are found in pollution-free streams which have an assured perennial flow in localised areas where the original forest cover has not yet been completely destroyed. Historical immigration appears to determine their distribution. Aquatic dispersal in the immature stages is the most likely factor explaining their present distribution and the present day watersheds do represent effective barriers to further migration of many aquatic species (Flannagan and Flannagan 1982). Furthermore, there is almost complete absence of speciation among these phylogenetic and geographical relics now found isolated in the refugial pockets in the high mountain areas, and representing the impoverished remnants of a vanished fauna (Mani 1974).

The altitudinal distribution of the species of Baetidae in Palni hills broadly resembles that in the hills of Sri Lanka. For instance, *Baetis conservatus* is found only above 1,500 m in the Palni hills as it is in Sri Lanka (Müller-Liebenau and Hubbard 1985) whereas the distribution patterns of *Baetis germinatus* and *Baetis acceptus* overlap. The pannote families Ephemerellidae, Caenidae and Tricorythidae are each represented by a single genus. Whereas the former two show overlapping distribution patterns, the latter is recorded only at the foothill site, Kumbakkarai (site I). The Lauratian family, Heptageniidae though represented in Palni hills by just three genera, each with a single species, dominates at virtually all elevations along with Leptophlebiidae, especially in larger streams with a comparatively rapid flow. *Ephemera (Aethephemera) nadinae,* the only ephemerid recorded, has an extended altitudinal range but is restricted to quiet areas of streams with slower current and sandy bottom with an admixture of silt.

Generally, the distribution of mayflies of Palni hills in southern India seems to be influenced by such factors as historical immigration, presence of pollution-free streams with assured perennial flow amidst undisturbed sholas rather than by altitudinal variations in the observed range. More locally, distribution appears to be associated with factors such as the current velocity, nature of the substratum, the amount of allochthonous organic matter, the temperature and shade.

Swarming was observed of genus nov., a leptophlebiid, 2 metres above water surface from 12.00 to 13.30 hrs. at Site IX on 22-8-86 and of *Baetis* sp., 5 metres above water surface from 9.00 to 10.30 hrs. in Site VII on 21-12-86. Mass emergences resulting in predator satiation obviate the streamside predation problem and it appears that all mass emergent species swarm over rivers, (e.g. *Ephoron, Lachlania)* or river banks (e.g. *Traverella)* (Edmunds and Edmunds 1980). This explanation appears to hold for our sporadic observations of swarming over streams. Whereas dusk is the most common time of day for swarming in temperate areas (Brittain 1982), swarming takes place from before dawn through the morning hours in tropical species. In temperate mayflies, it is a combination of light and temperature that controls swarming time; in the lowland tropics, temperature would appear to be less restrictive and light intensity may be the prime environmental cue (Edmunds and Edmunds, 1980). Apparently it is the temperature that plays a crucial role in controlling swarming time of species inhabiting tropical highland areas.

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