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Litter ants: diversity and composition in Megamalai, Western Ghats

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Abstract

Diversity and composition of litter ants in Megamalai, Western Ghats was investigated in the present study. The study reveals that, tropical evergreen forest has more number of individuals compared to openrock with grassland, tropical moist deciduous forest and tropical dry deciduous forest. The diversity analysis reveals that, the simpson and Shannon diversity indices was higher during November and October in tropical evergreen forest as well as open rock with grassland accordingly. In the case of tropical dry and moist deciduous forests, it was in the month of February and December respectively. Among the study months, the species distribution was found even in the month of February followed by August in tropical evergreen forest, while it was dry deciduous forest, it was in the month of January (0.7622). Thus, the study reveals higher species abundance and diversity in tropical evergreen forest than other study sites.

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Introduction

In the recent decades, the anthropogenic impact over all terrestrial as well forest lands were highly destructive. During the last century, almost one half of the rainforests on earth have been destroyed. Due to the tremendous concentration of species in the tropics and their often narrow geographic ranges, biologists estimate that tropical deforestation will result in the loss of half or more of the existing species on earth during the next 75 years. As biological systems are of important for the survival of human activity, an increasing interest is being expressed worldwide in environmental studies.

With the numerous individuals, dominant animal biomass, genetic variety and successful biotic species interactors in terrestrial ecosystems, insects are the most prominent bioindicators in the lineup of indicator species. Among them, arthropod belongs to formicidae family of Hymenoptera are ecological dominant in most terrestrial ecosystem. Its susceptibility to environmental fluctuations (Kaspari and Majer, 2000) and manageable diversity compared to other insect group unveils them as potential bioindicators. In a recent analysis of various insect groups as potential bioindicators, ants scored highest (Brown, 1997). In Australia, ants have been used extensively as bioindicators (Andersen, 1990, 1997a), particularly in relation to minesite restoration (Majer *et al.*, 1984; Majer, 1985; Andersen, 1997b), but also to other disturbances such as grazing and logging (Vanderwoude *et al.*, 1997). Changes in ant community structure following disturbance have been found to react changes in many other invertebrate groups (Andersen, 1997).

The use of ants as bioindicators is supported by a macro scale functional group scheme (Andersen, 1997), which has been used extensively to analyse biogeographic patterns of community composition (Andersen and Clay, 1996; Reichel and Andersen, 1996) and the responses of ant communities to disturbance (Vanderwoude *et al.*, 1997a). Of all, leaf litter-dwelling ants are currently used as bioindicators in dozens of biodiversity studies

conducted at localities across the globe (Longino *et al.* 2002; Leponce *et al.* 2004). It has been identified from the researchers, the richness and diversity of leaf litter species have been heavily influenced by changes in the vegetation type and its associated assemblages as well as temperature, rainfall and food resources (Olson, 1994). The varied assemblages of litter ant in Shola evergreen and deciduous forest of Wayanad regions in relation to vegetation specific and abiotic factor have been recorded (Anu and Sabu, 2006). Information on such potential indicator species in India, particularly Western Ghats, one of the mega biodiversity hot spot in India, has been studied little (Anu and Sabu, 2006). Hence the present investigation proposed to study the community composition of litter dwelling ants in response to different vegetation as well as abiotic parameters.

Materials and methods

Study area

The Megamalai (9°31'– 9°51'N and 77°10'–77°30'E) popularly known as Highwavy Mountains, a part of the Western Ghats biodiversity hotspot (Mittermeier, 2005) is located along the border of Tamil Nadu and Kerala States. The southern part of Megamalai is bounded with Periyar Plateau (Periyar Tiger Reserve), Srivilliputtur Grizzled Squirrel Sanctuary on the south and southeast, Cumbam floodplains on the north and northeast and alluvial plains of Theni–Periyakulam on the northeast. This area forms a part of the South Sahyadris and Tamil Nadu Uplands. Most parts of the Megamalai are under the administrative jurisdiction of the Theni Forest Division, Tamil Nadu (Anon, 2005). The general area is rugged and forms a catchment for rivers such as Vaigai, Vaippar and Suruliar. A major portion of forests in this area remains unexplored for its biodiversity. The study was conducted in tropical dry deciduous, moist deciduous, open rock with grassland and evergreen forest of Megamalai hills during 2008.

Collection of leaf litter ants

Leaf litter was collected in a 1 x 1 m quadrat and was sifted using a litter sifter (Bestelmeyer *et al.* 2000).

The sifted material was then hung inside a mini-Winkler sack (Fisher 1999) for 48 hours with the leaf litter being removed and shaken after the first 24 hours. This was done so as to agitate the invertebrates into moving again, hence increasing the potential for further collection of fauna from the litter. All material collected from the Winkler extraction was then removed and stored in 70% ethanol.

Statistical analysis

The ant species composition in different sites of Megamalai, were subject to diversity analysis by using statistical package, PAST.

Results

Composition of leaf litter ants in Megamalai

Composition of leaf litter ants in tropical evergreen forest (Figure 1), tropical dry deciduous forest (Figure 2), open rock with grassland (Figure 3) and tropical moist deciduous forest (Figure 4) of Megamalai hills of Southern Western Ghats was studied in the present investigation. A total of 14, 564 individuals belong to 30 genera and 64 species were recorded in the present study. Among the study sites, tropical evergreen forest showed more number of individuals (5322) compared to openrock with grassland (3042),

tropical moist deciduous forest (2913) and tropical dry deciduous forest (2787). Similarly, higher number of individuals was recorded in tropical evergreen forest during the month of November (1072) followed by tropical moist deciduous during October (738) and open rock with grassland during October (551). During the course of investigation, least number of individual was recorded in tropical moist deciduous forest (84) during the month of June, which was followed by tropical evergreen forest during the month of April (97). The tropical evergreen forest had higher number of taxa (55) compared to other study sites. The study also reveals that, the tropical evergreen forest was highly endowed with *Camponotus vagus* (579) followed by *Diacamma rugosum* (493) and *Lepisiota* (346). Similarly, the tropical dry deciduous forest was well occupied by the *Diacamma rugosum* (664) followed by *Monomorium glabrum* (202) and *Monomorium scabriceps* (197). In the case of open rock with grassland and tropical moist deciduous forest, *Crematogaster subnuda* (468) and *Monomorium floricola* (543) were highly dominated the sites followed by *Myrmecaria brunnea* (375) and *Meranoplus bicolor* (348) as well as *Polyrhachis illaudata* (416) and *Meranoplus bicolor* (312) respectively.

Table 1. Diversity indices for the leaf litter ants collected in Tropical evergreen forest of Megamalai, Southern Western Ghats during 2008.

	January	February	March	April	May	June	July	August	September	October	November	December
Taxa	35	17	22	12	23	27	23	32	40	45	55	51
Individuals	261	114	303	97	217	316	316	438	610	788	1072	790
Dominance	0.08991	0.1156	0.1528	0.2873	0.1153	0.1588	0.1375	0.07318	0.05495	0.05141	0.04052	0.06813
Simpson	0.9101	0.8844	0.8472	0.7127	0.8847	0.8412	0.8625	0.9268	0.9451	0.9486	0.9595	0.9319
Shannon	2.92	2.414	2.299	1.774	2.561	2.415	2.547	2.951	3.168	3.244	3.549	3.199
Evenness	0.5295	0.6576	0.4527	0.4911	0.5631	0.4143	0.5551	0.5975	0.5939	0.5695	0.6323	0.4806

Table 2. Diversity indices of leaf litter ants collected in Tropical dry deciduous forest of Megamalai, Southern Western Ghats during 2008.

	January	February	March	April	May	June	July	August	September	October	November	December
Taxa	17	18	14	17	23	19	18	17	18	14	20	26
Individuals	189	154	176	209	222	226	215	159	237	208	355	437
Dominance	0.0937	0.08973	0.1231	0.09549	0.1341	0.1999	0.1544	0.2327	0.153	0.3034	0.1393	0.1091
Simpson	0.9063	0.9103	0.8769	0.9045	0.8659	0.8001	0.8456	0.7673	0.847	0.6966	0.8607	0.8909
Shannon	2.562	2.571	2.279	2.527	2.441	2.142	2.29	1.962	2.241	1.726	2.336	2.541
Evenness	0.7622	0.7269	0.6979	0.7363	0.4991	0.4484	0.5485	0.4185	0.5223	0.4011	0.5172	0.4881

Diversity analysis

The diversity indices analysis (Tables 1-4) reveals that, in the tropical evergreen forest the species dominance was found high in the month of April (0.2873) followed by June (0.2873) and February (0.1156). In the case of tropical dry deciduous forest, it was in the month of October (0.3034) and August

(0.2327). In open rock with grass land, the species dominance was found high in the month of July (0.1537), which was similar to that of the dominance level predicted in the month of May (0.1531). The species dominance in tropical moist deciduous forest was found high in February (0.2946) and October (0.2159).

Table 3. Diversity indices of leaf litter ants collected in open rock with grassland of Megamalai, Southern Western Ghats during 2008.

	January	February	March	April	May	June	July	August	September	October	November	December
Taxa	19	17	14	16	13	14	19	17	22	26	26	26
Individuals	111	118	162	119	122	129	150	186	363	551	541	490
Dominance	0.11	0.105	0.1174	0.1025	0.1531	0.1255	0.1537	0.1153	0.1098	0.08948	0.08084	0.09586
Simpson	0.89	0.895	0.8826	0.8975	0.8469	0.8745	0.8463	0.8847	0.8902	0.9105	0.9192	0.9041
Shannon	2.452	2.462	2.324	2.468	2.139	2.287	2.35	2.421	2.535	2.743	2.828	2.697
Evenness	0.6113	0.6899	0.7297	0.7375	0.6531	0.7034	0.552	0.6625	0.5737	0.5972	0.6507	0.5708

Table 4. Diversity indices of leaf litter ants collected in Tropical moist deciduous forest of Megamalai, Southern Western Ghats during 2008.

	January	February	March	April	May	June	July	August	September	October	November	December
Taxa	22	17	19	17	20	10	18	24	22	24	22	23
Individuals	177	170	111	103	173	82	237	320	264	738	454	84
Dominance	0.1221	0.2946	0.0827	0.127	0.1103	0.1984	0.1523	0.1324	0.1171	0.2159	0.1872	0.07426
Simpson	0.8779	0.7054	0.9173	0.873	0.8897	0.8016	0.8477	0.8676	0.8829	0.7841	0.8128	0.9257
Shannon	2.549	1.899	2.716	2.385	2.477	1.832	2.233	2.371	2.477	1.973	2.274	2.795
Evenness	0.5818	0.393	0.7961	0.6386	0.5954	0.6246	0.5183	0.4461	0.5413	0.2997	0.4419	0.7115

The species dominance recorded in the tropical moist deciduous forest was comparatively higher than that of the open rock with grassland, while it was as similar to that of the tropical evergreen and tropical dry deciduous forest as well. The Simpson and Shannon diversity indices reveals the higher species diversity during November (0.9486 and 3.244) and October (0.9595 and 3.549) in tropical evergreen forest as well as open rock with grassland (0.9192 and 2.828) accordingly. In the case of tropical dry and moist deciduous forests, it was in the month of February (0.9103 and 2.571) and December (0.9257 and 2.795) respectively. Among the study months, the species distribution was found even in the month of February (0.6576) followed by August (0.5975) in tropical evergreen forest, while it was dry deciduous forest, it was in the month of January (0.7622). In the case of open rock with grassland and tropical moist deciduous forest, the evenness was found high in the month of April and March respectively.

Discussion

Ants are a particularly prominent invertebrate group used in assessing ecological responses to disturbance (Underwood and Fisher, 2006). The present study on leaf litter ant survey unveiled sum of species belonging to 9 subfamilies in selected sites of Megamalai, Southern Western Ghats. LaPolla *et al.* (2007) have used methodology and recorded 38–74 species in Guyana, which was in accordance with the present investigation. Lopes and Vasconcelos (2008) also reported 59–72 species from Brazilian Cerrado. In a study by Delsinne *et al.* (2008), almost 91 species was observed in the Paraguayan Chaco. The diversity analysis reveals that, the species diversity was comparatively high in tropical evergreen forest than other sites. Earlier studies of tropical forest litter ant communities found Myrmecinae to be the most common family followed by Ponerinae (Sabu *et al.*, 2006). Similar pattern was observed in the present

investigation. Similarly, higher diversity and abundance of *Myrmecaria brunnea* in open rock with grassland was often highly supported by Buckley and Gullan (1991) which often tend homopterans for honeydew. The abundance of *Polyrhachis* in tropical dry deciduous forest was highly supported by Watanasit *et al.* (2003). It was also clearly observed from the present study that, the ant species collected were highly diverse and the individuals were distributed evenly in the tropical evergreen forest compared to other sites such as tropical dry and moist deciduous forest as well as open rock with grassland. Besides, it was also discussed that, the dominant influence of soil and vegetation on ant communities were studied (Bestelmeyer *et al.*, 2006). It was also known from the earlier report that, vegetation type and structure is a major determinant of ant community composition (Andersen, 1995). Soil texture also directly affects ants through moisture availability and nest architecture, and further indirectly through food plant species distributions (Johnson, 2000, 2001; Boulton *et al.*, 2005). Thus the present study detailed the composition and distribution of leaf dwelling ant species in different sites of Megamalai, Southern Western Ghats. The higher leaf litter ant composition and taxa reveals that, the tropical evergreen forest was the most dominant among the study sites and the role of meteorological as well as vegetation types would be further analysed.

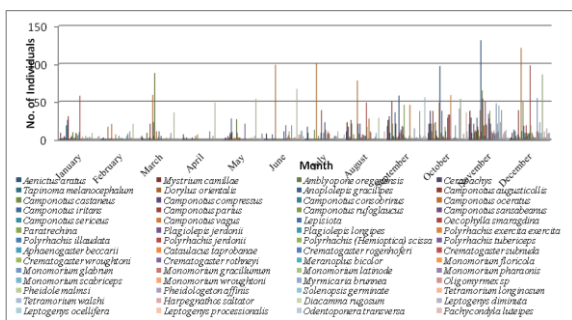


Fig. 1. Composition of leaf litter ants in Tropical evergreen forest of Megamalai hills, Southern Western Ghats, India during 2008.

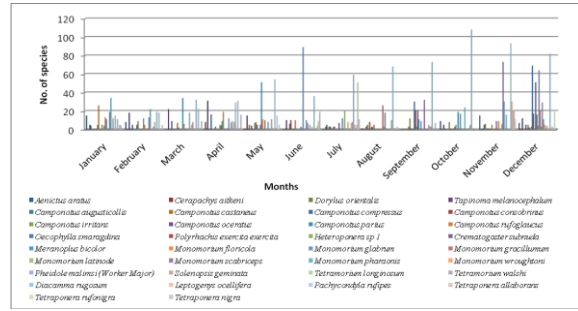


Fig. 2. Composition of leaf litter ant in tropical dry deciduous forest of Megamalai hills, Southern Western Ghats, India during 2008.

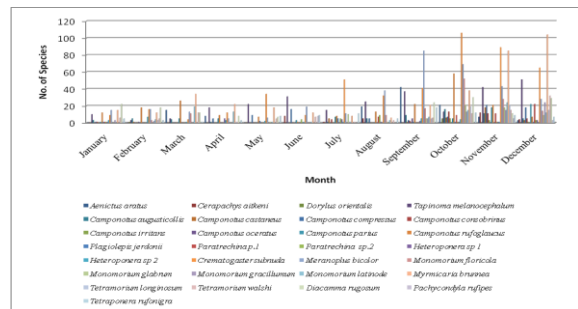


Fig. 3. Composition of leaf litter ants in Open rock with grasslands of Megamalai hills, Southern Western Ghats, India during 2008.

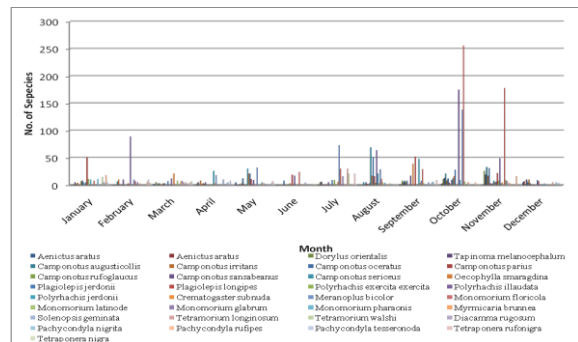


Fig. 4. Composition of leaf litter ants in tropical moist deciduous forest of Megamalai hills, Southern Western Ghats, India during 2008.

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