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Original Article

SEASONAL ASSEMBLAGE OF LEAF LITTER ANTS IN MEGAMALAI, WESTERN GHATS, INDIA

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Abstract

The seasonal dispersal of leaf litter ants in Megamalai Western Ghats, India was assessed in the present study during 2008 in different regions namely Tropical evergreen forest, Tropical Moist deciduous forest, Tropical dry deciduous forest and Openrock with grassland. The leaf litter ant composition in the study sites TEF, TDDF, TMDF and ORWG were 5322, 2787, 2913 and 3042 individuals representing 62, 34, 33 and 29 species from 27, 17, 17 and 14 genera and 9, 8, 7 and 9 subfamilies accordingly during 2008. The summer season was abundant by member of subfamily Ponerinae and Myrmicinae with respect to Diacamma rugosum and Monomorium glabrum. Similarly, in Autumn season i.e., Post monsoon season, high abundance of Lepisiota sp. and Diacamma rugosum, member of Formicinae and Ponerinae subfamily respectively were noticed in TEF and TDDF, whereas in TMDF and ORWG, it was by the member of Myrmicinae subfamily, namely Monomorium floricola and Crematogaster subnuda. In spring season, the study sites, TDDF, TMDF and ORWG have shown higher abundance of Formicinae and Myrmicinae while in TEF it was by Paratrechina sp. and Diacamma rugosum of Myrmicinae and Ponerinae subfamilies.

Introduction

With the numerous individuals, dominant animal biomass, genetic variety and successful biotic species interactions, insects are the most prominent bioindicators in the lineup of indicator species in terrestrial ecosystems. It is estimated that about 1.4 to 1.8 million insect species are there in the world, which constitute nearly 20% of all species. In the mean while, exploration of ground and litter dwelling arthropods in biodiversity inventories and environmental assessment surveys has increased (Oliver and Beattie, 1996). Ants, member of formicidae family belongs to Hymenopteran order are ecologically dominant in most terrestrial ecosystem. Mutualism between ants and other species are common, and also drawn in seed dispersal and protection of other organisms against natural enemies (Beattie, 1985). Their nesting habits can alter the soil nutrients concentration and biogeochemical cycles (Wangeret, 1997; Man Mahon et al., 2000). Ants constitutes up to 15% of the total animal biomass in a Central Amazonian rainforest (Fittkau and Klinge, 1973). Over 9000 species representing 296 genera and 16 subfamilies have been described globally (Agosti et al., 2000). The Indian subcontinent records ant species under 8 subfamilies representing 600 species and 92 genera. The subfamilies are Aenictinae, Dolichoderinae, Dorylinae, Formicinae, Leptanillinae, Myrmicinae, Ponerinae and Pseudomyrmicinae (Veeresh and Ali, 1991). Ants belonging to 7 subfamilies represented by 125 species and 44 genera are known to occur in Karnataka. The subfamilies are Dorylinae, Ponerinae, Myrmicinae, Formicinae, Pseudomyrmicinae, Cerapachyinae and Dolichoderinae (Ali, 1992). Ants have repeatedly turned up in fossils; so far 61extinct genera of the living subfamilies have been recognized in addition to 14 genera which are grouped under 4 extinct subfamilies (Bolton, 1995). Wilson (1987) has reported that a single tree in Peruvian tropical lowland forest yielded 26 genera and 43 species of ants. Agosti et al.(1994) have reported a collection of 104 ant species representing 41 ant genera in a 20 m² of leaf litter and rotting logs at Malaysia. Anderson and Clay (1996) have recorded ants under 248 species from 32 genera in an 18 sq km semiarid area in Australia. Sampling in 33 quadrates each of one hectare plots from 12 habitats at the Western Ghats, and reported the collection of 120 species from 31 genera Gadagkar et al. (1990). Studies on leaf litter ant assemblages in Western Ghats, India, tropical countries...
are meager. Hence the present study assessed the leaf litter ant assemblages in Western Ghats, India.

Materials and Methods

STUDY AREA

The Megamalai (9°31′–9°51′N and 77°10′–77°30′E) popularly known as Highway Mountains, a part of the Western Ghats biodiversity hotspot (Mittermeier, 2005) is located along the border of Tamil Nadu and Kerala States.

Winkler’s Litter Shifting

The ant community was sampled using Winkler-Litter sifting and arthropod extraction devices (Ward, 1987). Sifting litter is very effective way of surveying litter fauna because large quantity of litter is processed. Around the center of each sampling sites, there is half-a-square meter samples of litter was collected on a single occasion at three different habitats (e.g., near ground, vegetation, and under trees), situated 10 meter apart from each other. Three meter is a distance which exceeds the foraging range of most litter inhabiting ants (Carvalho and Vasconcelos, 1998). The half-a-square meters were chosen randomly within a circular area with a radius of 15 m to the center of the sampling. Each selected half-a-square meter of litter was enclosed by a metal frame to prevent the escape of ants during the sampling process. The litter within a frame was sifted on the spot using a sieve with a 1 x 1 cm mesh sieve. Litter is defined as the layer of leaves and detritus which can be easily scraped from the more compact soil. The fine leaf litter obtained after sifting was collected in numbered plastic bags adjusted below the sieve. The bags are always kept in cool places to avoid over heating of the samples. Sifting was conducted between 8.00 h to 14.00 h. Thus time frame was adjusted to the local environmental conditions. The study was carried out during 2008.

Seasonal Pattern

The selected study sites such as tropical evergreen forest (TEF), tropical moist deciduous forest (TMDF), tropical dry deciduous forest (TDDF) and openrock with grassland (ORWG) were visited during different seasons namely Summer season: Mid April to end of June; Rainy season: Early July to September; Autumn season: September to end of November; Winter season: Early December to end of February; Spring season: March to Mid April. The percentage of assemblages by each subfamily during different season was recorded (Bharti et al., 2009).

Results

The leaf litter ant composition in the study sites TEF, TMDF, TDDF and ORWG were 5322, 2787, 2913 and 3042 individuals representing 62, 34, 33 and 29 species from 27, 17, 17 and 14 genera and 9, 8, 7 and 9 subfamilies accordingly during 2008.

Seasonal dispersal and abundance of leaf litter ants during 2008

The diversified dispersal of leaf litter ants in different study sites in response to season of Megamalai, Southeastern Western Ghats during 2008 was recorded and presented in figures (1-4). During summer, the study site TEF showed high abundance of the members of the subfamily Ponerinae and Formicinae i.e., Diacamma rugosum and Camponotus vagus respectively. In the case of TDDF, the summer season was abundant by member of subfamily Ponerinae and Myrmicinae with respect to Diacamma rugosum and Monomorium glabrum. However, the study sites TMDF and ORWG were abundance only by Monomorium bicolor and M. floridica as well as Myrmica brunnea and Crematogaster subnuda, the member of subfamily, Myrmicinae. Besides, these two sites were also observed with higher number of Formicinae and Dolichoderinae, members namely Polyrhachis and Tapinoma melanocephalum. The patterns of domination by subfamilies in study site during rainy are Myrmicinae (25.8%; 32.35%; 24.13% ); Formicinae (20.97%; 23.52%; 20.64%); Ponerinae (14.51%; 5.88%; 6.89%) with respect to TEF, TDDF and ORWG while in TMDF it was Formicinae (36.36%) followed by Myrmicinae (24.24%) and Ponerinae (9.09%). In rainy season i.e., Monsoon period, the study site TEF, TMDF and TDDF had shown higher abundance of Myrmicinae subfamily namely, Camponotus vagus, C. sericen, Monomorium bicolor, Crematogaster subnuda, while in ORWG it was dominated by the only member of Ponerinae, Diacamma rugosum. The patterns of domination by subfamilies in study site during summer are Myrmicinae (35.29%; 24.13%); Formicinae (29.41%; 20.64%); Ponerinae (5.88%; 6.89%) with respect to TDDF and ORWG while in TEF and TMDF it was Formicinae (32.25%; 36.36%) followed by Myrmicinae (30.64%; 24.24%) and Ponerinae (9.67%; 9.09%). Similarly, in Autumn season i.e., Post monsoon season, high abundance of Lepisiota sp. and Diacamma rugosum, member of Formicinae and Ponerinae subfamily respectively were noticed in TEF and TDDF, whereas in TMDF and ORWG, it was by the member of Myrmicinae subfamily, namely Monomorium floricola and Crematogaster subnuda. The patterns of domination by subfamilies in study site during winter are Myrmicinae (32.29% ); Formicinae (26.47%); Ponerinae (8.82%) with respect to TDDF while in TMDF and ORWG it was Formicinae (39.39%; 34.48%) followed by Myrmicinae (24.24%; 31.3%) and Ponerinae (9.09%; 3.44%). In TEF, there was equal domination by Myrmicinae (33.87%) and Formicinae (33.87%) existed. There was Formicinae dominance in TEF during Winter season, while in TDDF and TMDF, it was by the member of subfamily Myrmicinae species such as Camponotus vagus, Crematogaster subnuda, Monomorium pharoanus, Plagiopleis sp. and Polyrhachis sp. In the case of ORWG, Ponerinae (Diacamma rugosum) dominance was existed during winter season. The patterns of domination by subfamilies in study site during summer are Myrmicinae (35.29% ); Formicinae (26.47%); Ponerinae (8.82%) with respect to TDDF while in TEF, TMDF and ORWG it was Formicinae (35.48%; 36.36%; 37.93%) followed by Myrmicinae (33.87%; 30.3%; 31.03%) and Ponerinae (16.12%; 12.12%; 6.89%). In spring season, the study sites, TDDF, TMDF and ORWG have shown higher abundance of Formicinae and Myrmicinae while in TEF it was by Paratrechina sp. and Diacamma rugosum of Myrmicinae and Ponerinae subfamilies. The patterns of domination by subfamilies in study site during spring are Myrmicinae (26.47%; 27.58%); Formicinae (11.76%; 20.68%);
Figure 1. Percentage of subfamilies of leaf litter ants collected in different season during 2008 in tropical evergreen forest (TEF), Megamalai Western Ghats.

Figure 2. Percentage of subfamilies of leaf litter ants collected in different season during 2008 in tropical dry deciduous forest (TDDF), Megamalai Western Ghats.

Figure 3. Percentage of subfamilies of leaf litter ants collected in different season during 2008 in tropical moist deciduous forest (TMDF), Megamalai Western Ghats.
Ants, prominent invertebrate group used in assessing ecological responses are one of nine proposed indicators (Underwood and Fisher, 2006). Ants have been targeted because they are ubiquitously abundant and important component in terrestrial ecosystems, are easily sampled and have numerous advantages over vertebrates and other arthropods in studies of environmental stress, disturbance species diversity. (Andersen, 1990). In the present investigation, leaf litter ant composition in different study sites namely tropical evergreen forest (TEF), tropical moist deciduous forest (TMDF), tropical dry deciduous forest (TDDF) and openrock with grassland (ORWG) of Megamalai, Western Ghats, India during 2008 was assessed.

**Seasonal Pattern**

The seasonal dispersal and dominance of leaf litter ants in different study site were observed in Australia. Andersen (1995) highlighted the involvement of temperature as the main abiotic stress factor regulating ant community, while in the Mediterranean ant community, Cros et al. (1997) showed that seasonal ant activity patterns followed temperature fluctuations. In the present study, the relationship between litter ants and rainfall as well as temperature was very low except at ORWG and TEF during 2009 while TMDF reveals weak positive correlation. Delsinne et al. (2010) mentioned that, local species diversity was neither related to mean annual rainfall (Chao2: r=0.055, p<0.05). In contrast to this, Gunawardene et al. (2010) reported that, four important variables such as air temperature, relative air humidity, litter depth, and foliage density at 101–150 cm gave the highest correlation coefficient with ant species distribution in unlogged forest (Spearman’s Rho = 0.207). Medianero et al. (2007) stated that, arthropod abundance may depend on interactions between air temperature and litter moisture instead of rainfall. In the case of present investigation, sites, ORWG, TEF and TMDF reveal a weak positive correlation which intern supports the Medianero et al. (2007) statement.

In terms of pH, the study sites reveal relatively negative correlation while TDDF in 2008 and TMDF in 2009 and 2010 have weak positive correlation with pH. Usually, arthropod abundance increases with rainfall and litter moisture (Wiwatwitaya and Takeda, 2005). In the present study, an average temperature prevailed during study periods ranged between 22°C (minimum) and 31°C (maximum). Thus, it was clear that, these species are highly tolerant to thermal fluctuations. Bharti et al. (2009) reported that, subfamilies namely Myrmicinae, Ponerinae, Cerapachyinae, Formicinae, Dolichoderinae, Dorylinae, Aenictinae and Pseudomyrmecinae were able to withstand extreme temperature fluctuation ranging from 2.26°C to 36.54°C. Besides, they also reported scanty availability of Dorylinae, Aenictinae and Pseudomyrmecinae. In addition, species namely Camponotus vagus, Camponotus sericeus Camponotus irritans, Polyrhachis sexcincta, Paratrechina sp. Oecophylla smaragdina, Monomorium glabrum, Monomorium latinode Monomorium floricola Monomorium pharoanis, Myrmicaria brunnea, of subfamily Formicinae, Crematogaster subnuda, Crematogaster rogenhoferi, Tetramorium walsi of subfamily Myrmicinae, Diacamma rugosum of Ponerinae, Tapinoma melanocephalum of Dolichoderinae, Tetraponera rufonigra and Tetraponera nigra of Pseudomyrmecinae were observed throughout the study period. It was highly supported by Bharti et al. (2009) who has also observed the species namely Camponotus, Paratrechina sp. of subfamily Myrmicinae and Tapinoma of subfamily Dolichoderinae during the whole study period. But the present investigation, in addition to Camponotus, Paratrechina and Tapinoma, presence of other species were also observed which details the tolerance of these species over microhabitat as well as climatic conditions. In summer season, the study sites TEF, TDDF and ORWG were highly dominated by Myrmicinae followed by Formicinae and Ponerinae. It was highly supported by Bharti et al. (2009) who observed the domination of Myrmicinae representing 29.16% of the total catch followed by Formicinae (25%) during summer season. In monsoon season, equal abundance of Myrmicinae and Formicinae was observed in the present study. Domination

**Figure 4.** Percentage of subfamilies of leaf litter ants collected in different season during 2008 in openrock with grassland (ORWG), Megamalai Western Ghats.
of Myrmicinae and Formicinae during rainy season i.e., monsoon season was also highlighted by Bharti et al. (2009). It highly support the present study site TDDF which showed higher Myrmicinae followed by Formicinae and Ponerinae in all the season while in other sites it was by Formicinae. Further, arthropod abundance is usually greater in years with wetter than usual dry seasons (Pearson and Derr, 1986). Usually, evergreen forests comprised extremely of specialized predators as Harpegnathos saltator, Diacamma rugosum. Pachycondyla rufipes and cryptic species as Monomorium dichrous and Bothriomyrmex sp. Scrub jungles had a composition of hot climate specialists (Meranoplus and Lophomyrmex) ants (Ramachandran et al., 2012). In the present study, species such as Diacamma rugosum, Camponotus vagus, Monomorium bicolor, Monomorium glabrum, Crematogaster subnuda, Myrmicaria brunnea, Polyrhachis sp. and Tapinoma melanocephalum were recorded during the summer season in tropical evergreen forest (TEF). Off all, the seasonal pattern of leaf litter ant reveals the susceptibility of Myrmicinae towards microhabitat, climatic and soil profile than Formicinae in all the study sites except TDDF and merely summer and rainy season of TEF during 2008. It also exemplifies the tolerance of Formicinae subfamily.

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References

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