



Distribution patterns of soil mite (Acari: Oribatida) communities in Mukurthi National Park, Tamil Nadu, India

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Abstract

Soil fauna contribute valuable ecosystem functions in forest and grasslands. The present study focused on Oribatid mite distribution patterns from the Mukurthi National Park, Western Ghats, India. The recent studies of mites and other arthropods in natural environments are considered with less priority. Concerning studies of mite community structures in forest fragments, few important studies were developed in Nilgiri Biosphere Reserve. In order to study the diversity and abundance of Oribatid mites, soil samplings were carried out during four seasons in 25 study plots of five major study sites namely 1. High altitude Grasslands, 2. Pine plantations, 3. Deciduous forest, 4. Shola forest and 5. Thorn forest. Among the total of 46 species belonging to 20 genera across 19 families was recorded, Highest abundance with 1233 individuals/500g soil of oribatid mites was observed in Shola forest and less abundance was observed in Thorny forest with 373 individuals/500 g soil. The analysis was done using statistical software SPSS 20.0 and PAST. As the result holds the significant effects on diversity of mites in the study area by the edaphic factors, anthropogenic activities may be reduced and conservation measures need to be with high priority.

Keywords: soil mites, abundance, diversity, mukurthi national park, shola forest, anthropogenic activities

Introduction

The soil ecosystem contains less studied but often contains abundant groups of Mesofauna, like soil mites and other Microarthropods (Coleman and Whitman 2005) ^[1]. Oribatid mites (Oribatida, Arachnida) are abundant animal decomposers and (Wehner, K., Heethoff, M., and Bruckner, A. (2018) ^[2] and most diverse suborders of Sarcopitiformes. nearly 16,000 species are described (Schatz, *et al.*, 2011) ^[3] The primitive groups of these mites deserve more attention, as they exert an incredible impact on the decomposition process and subsequent enhancement of soil fertility through their Macrophytophagous habit (Ramani and Haq, 2001^[4], Alphonsa and Haq, 2005) ^[5]. Type of forest is also a concern of soil mite density and firmly it differs among forest Microhabitat.

Study Area

The Mukurthi National Park is situated on the Western Ghats in Nilgiris, Tamil Nadu. Its geographical location is the between (MNP: 11 ° 26' to 76° 10' to 11°22' N and 76°38' E) extent of the park in 78.48 km. A total of 22 plots distributed over MNP, Nilgiri Biosphere Reserve *viz.*, 1. High Altitude Grasslands, 2. Pine Plantations, 3. Deciduous Forest, 4. Tropical Wet Evergreen Forest (Shola), 5. Tropical Dry Deciduous Forest was surveyed during the present study period for the collection of adequate number of soil/litter samples. Regular/intermittent sampling was made covering different seasons, for subsequent extraction and recovery of the most common and locally important Oribatid mite populations.

Extraction of Mites

Five samples were taken in each study sites 5x5x4. The soil and litter samples were subjected to extraction in the laboratory. The process of extraction was carried out in an Open brass funnel apparatus following the extraction principles of Berlese (1905) ^[6] and Tullgren (1918) ^[7]. The extracted mites in the vials were transferred into Petridishes and sorted out using a fine needle and camel hair brush No.1 under 32x magnification of a Carl Zeiss stereomicroscope. Well cleared specimens were mounted on microscopic slides for microscopic examination.

Statistical analysis

The analysis was done using statistical software SPSS version 20.0 and PAST.

Results

A total of 46 soil mite species belonging to 20 genera across 19 families was found in five different sites. *Allogalumna pellucida*, *Tegeocranellus laevis*, *Scheloribates praeincisus*, *Oppia kuehneli*, *Lamellobates reticulatus* was the most dominant species in all the study sites.

The result of the study reveals that Shola forests have the highest abundance (1233 individuals) of Oribatid mites in comparison with the other vegetations. Less abundance was observed in Thorny forest (373 individuals). The abundance of species also more in the site 4 (1233), followed by site 1 (913), site 3 (727), site 2 (494) and site 5 (373). Species richness is more in site 1 and site 4 (22), less species richness in site 2 (10 species).

Diversity Indices

The diversity indices showed in the table 3. Shola forest (Site 4) was characterized by the maximum oribatid diversity ($H' = 3.064$), Minimum Shannon index was found in Pine plantations (site 2: $H' = 2.266$). These sites were different with vegetation patterns. The oribatid mites are evenly distributed in all sites of MNP. The evenness of oribatid distribution is ranged between 0.9122 and 0.9682 in MNP. The percentage variation was calculated for the occurrence of Oribatids in MNP in all sites. It shows more species average number of species in Shola forest (56.04) and less in thorny forest (33.90).

Present study clearly states that oribatid mite diversity is low in the pine plantations ($H' = 2.266$), rich diversity is noted in the sholas ($H' = 3.064$) and grasslands ($H' = 2.099$). Shola forests can be defined as stunted evergreen wood, of high elevation, commonly occurring in the higher hills of south India (the nilgiris, anamalais and Palani hills) from above 1525m to 2450m (Puri 1960)^[8]. This rich oribatid mite diversity in sholas is driven because there is no human intervenes in MNP.

Discussion

The soil mite diversity is higher in the composite vegetative ecosystem than monoculture plantation. Forest types have significantly affects the density and diversity of the Oribatid mites (Corral-Hernández *et al.*, 2012)^[9]. The Oribatid mites are sensitive to ecological changes. They get adopted in the different sites according to the vegetation types and human induced anthropogenic events. If the mites get suitable environmental factors, such as temperature and humidity, the species richness becomes accelerated. Previous studies (Echude D *et al.*, 2019)^[10] have showed more soil arthropod population during June month, which have more rainfall. In Mukurthi National Park Pine plantation brings down the mite population due to cultivation pattern. Arthropod community diversity and abundance have shown large influence done by environmental situations and these are related to the type of crop and cultivation techniques followed in the field (Hance 2002)^[11].

Many hydroelectric projects like upper Bhavani, Kundha, Pykara, Avalanche, Mukurthi etc and other developmental activities where at the expense of the sholas and grasslands of MNP. These types of activities have diminished the richness of mites in forest lands drastically. Forest department have planted pine plantations, which have less mite diversity and density than other sites in MNP. Hence the distribution of Oribatids is majorly affected. The similar results were published in urban areas of Brazil, which showed a reduction in Hymenoptera species diversity and abundance over a 6 year period as exotic plants invaded (Laroca and Orth, 2002)^[12].

Distribution of Oribatid species is also influenced by the seasons. Study shows the high abundance was observed on Monsoon (June to September). Oribatid mites are move against the light and heat, towards the inner layers of the earth surface during winter seasons. We further assume local weather and seasonality of community structure to influence distribution pattern of oribatid mite species and cause reproductive cycle in adult mites (Wehner *et al.*, 2018)^[2]. As previous studies (Echude D *et al* 2019)^[10] reported such rainfall and vegetation are good predictors of soil arthropods abundance in a particular ecosystem. Rainy season favors abundance of Oribatids. Adrienne Kinnear., and David Tongway., (2004)^[13] reported in their study that Oribatid mites were present only during spring season. Present study supports this statement that in rainy season mean of oribatid mites in MNP is 329 ± 69 , but 141.4 ± 28 during summer days. An attempt has been made to analyse the impacts of human anthropogenicity and seasonal variations among the mite composition in MNP. This documentation of Oribatids is urgent need of the hour to preserve Western Ghats below ground biodiversity.

Conclusion

Soil biota plays important functioning roles in maintaining ecological balance in forest biomes majorly as decomposers. Our present investigation suggests climatic variations and vegetative patterns influence the health of soil mite in the selected Mukurthi National Park, Western ghats. Reliable steps to be taken on anthropogenic activities, which affect the populations of mite communities in the area. This aspect deserves much attention made on conservation strategies to increase soil mite diversity in the MNP. Further studies on implementing culturing steps for the mites in increasing richness need to be considered in future.

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Conflicts of interest

The authors do not have any conflict of interest regarding the publication of this manuscript.

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