Community structure of oribatid mites in improved grasslands: A case study from Central India

Sharmila Roy

Central Arid Zone Research Institute, Jodhpur (Rajasthan)-342 003 INDIA
Contact email: roysharmilaigfri@gmail.com

Keywords: Community structure, grassland, silvipasture, arable land, open tree cover, bare land.

Introduction

About 14% of the land in Central India (25°20'-26°30'N and 79°45'-78°15'E) is classified as grass/range lands, most of which is degraded. In order to improve condition class of these areas, several land development programs have been undertaken by various agencies. However, long term implications of such interventions are not understood properly. Since oribatid mites constitute an important part of soil ecosystem (Noti *et al*. 2003) having intricate relations with the niches in soil and their community structure is a swift reflection on ecosystem habitat structure, complexity and other factors, this study was planned.

Materials and Methods

Land uses

Six land management practices *viz*., natural grassland (dominated by *Cenchrus ciliaris*, *Heteropogon contortus*), tree plantation of *Albizia amara* (for rehabilitation of degraded forest lands), cultivated *Cenchrus ciliaris* and *Stylosanthus hamata* pasture with improved agronomic practices and fertilizer application (for restoration of community lands), silvipasture system (a combination of three grass species and five tree species with recommended package of practices for wastelands), arable land and bare land (representing other land uses) were appraised for oribatid mite community structure.

Soil and climate of study site

The texture of the soil is sandy clay loam to sandy clay. The soil is almost neutral with 39% water holding capacity. Soil nutrient status is in low to medium range. The organic carbon is in low to medium range. The other important nutrients like available nitrogen, phosphorus and potassium are in the range of low - medium, low and medium, respectively.

May was the hottest month with mean maximum air temperature (42.6°C) followed by April (40.0 °C). January was the coldest month with mean minimum air temperature (5.8 ° °C) followed by December (7.6°C). Maximum soil temperature was recorded during May (49.5°C) followed by June (44.9°C). The minimum soil temperature was recorded during January (11.2°C) followed by December (12.8° C). The study period received maximum rainfall (354 mm) in the month of August followed by July (203 mm) and June (158 mm).

Methods

Soil samples were collected at monthly interval from each of the site (up to 10 cm depth) using a cylindrical core sampler (diameter 5 cm). Berlese-Tullgren Funnel method was used, followed with suitable modifications (Macfadyen 1973), for extraction of oribatids. Community structure was expressed by the average density per square meter, frequency of occurrence and relative abundance. Diversity indices were calculated by using Bio Dap 3 plus software. To analyze the relation between oribatids and habitat diversity cluster analyses was performed for untransformed data based on average linkage between groups using squared Euclidian distance using SPSS 10.

Results

A total of 4012 individuals extracted from the study sites belonged to thirty four species out of which twenty one were identified up to family. The epilohmanniidae (54.7%) were the most abundant oribatids followed by scheloribatidae (14.1%), unidentified species-1 (6.5%), orobatulidae (5.0%) and galumnidae (4.7%). Highest average population in soil was recorded in silvipasture system (97.49 X $10^2/m^2$) followed by natural grassland (66.03 X $10^2/m^2$), cultivated pasture system (48.78 X $10^2/m^2$), tree plantation (46.73 X $10^2/m^2$), arable land (26.86 X $10^2/m^2$) and least population were found in bare land (4.60 X $10^2/m^2$). The peak population built up was observed during July – October. Lowest population was recorded during May - June in all the systems.

An analysis of diversity attributes, inter-species associations and abundance revealed a fairly consistent pattern of community organization in natural grassland, silvipasture, cultivated pasture and tree plantation systems (Table1). Highest diversity and richness was found in the silvipasture system of management, closely followed by cultivated pasture land.

Inter-species association between 20 common species were calculated using Pearson index and cluster analysis indicated three strong associations. Schlerobatids formed one group, the second group (oribatulidae, galumanidae and one unidentified species) and the third epilohmaniidae; rest were more loosely attached in another group but showed preference with perennial systems. Galumanidae were randomly distributed while other species have shown aggregated distribution.

Table 1. Diversity indices and annual abundance ($10^2/m^2$) of oribatids associated with different land uses.

Indices	Bare land	Natural grassland	Cultivated pasture	Tree plantation	Silvi-pasture	Arable land
Margalef's Richness	0.58	1.89	2.31	1.92	2.25	1.06
Shannon-Wiener Diversity	0.92	1.68	1.71	1.48	1.74	1.44
Evenness	0.66	0.61	0.58	0.53	0.59	0.62
Simpson's Dominance	0.51	0.33	0.32	0.39	0.31	0.37
Abundance	189	1242	1129	1128	1296	1823

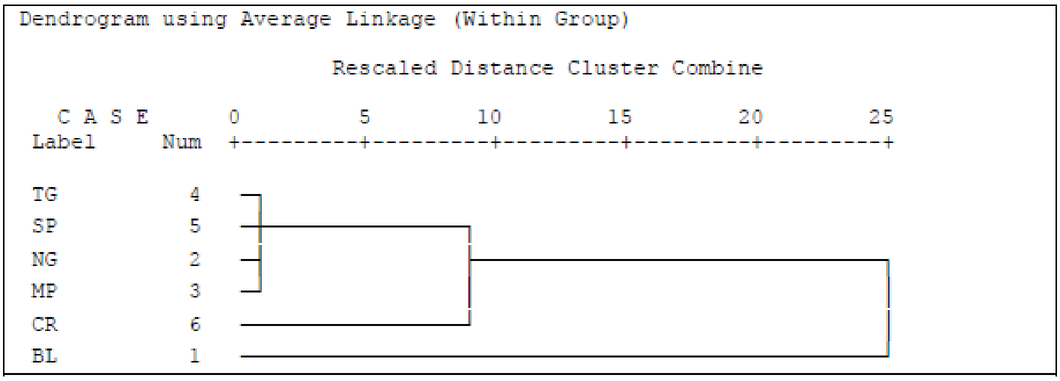

Figure1. Comparison of oribatid mites of different land uses at study site (BL= Bare land, NG = Natural grassland, MP = Cultivated pasture, TG = Tree plantation, SP = Silvipasture, CR = Arable land).

Comparison among the sites was made by average linkage method using squared Euclidian distance. Bare land and arable land use differed from the natural grassland, cultivated pasture, tree plantation and silvipasture system (Fig. 1). This suggests that the incorporation of tree species, and or legumes in the grassland management had positive impact in terms of population diversity and buildup of oribatid mite fauna, which is directly linked with a healthy soil environment, and sustainability of the production system.

Conclusion

The frequency distribution, species richness and diversity show that the oribatid mite species have a certain organization in their occurrence under different management practice of the grassland. The introduction of complexity in terms of plant diversity and management interventions not only helped in restoring degraded rangelands/wastelands but also reinstated soil oribatid mite community structure and hence the soil ecosystem.

Acknowledgement

Author is grateful to Dr P S Pathak, Ex Director, Indian Grassland & Fodder Research Institute, Jhansi (India) for his valuable guidance and providing facility for this research work.

References

Noti MI, Andre HM, Ducarme X, Lebrun P (2003) Diversity of soil oribatid mites (Acari: Oribatida) from High Katanga (Democratic Republic of Congo): a multiscale and multifactor approach. *Biodiversity and Conservation* **12**, 767-785.

Macfadyen A (1973) Soil arthropod sampling. *Advances in Ecological Research* **1**, 1-34.