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Arthropod biodiversity in tropical forest litter around Nagpur (Maharashtra)

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Abstract
A study on litter arthropod population was carried out in four tropical dry region distributed in forest areas of Indian state of Maharashtra India. The study was conducted in an around Nagpur, lakeside region and tropical dry region vegetation types. The leaf litter present inside a 1 m^2 quadrat was collected, shifted in polythene bags. Total 195 litter arthropods representing 13 insect orders were recorded from the forty unit (15cm x 15cm) samples collected from four tropical region sites viz. (Site 1:- Gorewada lake, Site 2:- Ambazari lake, Site 3:- Futala lake, and Site 4:- Civil line forest). The insect orders, Hymenoptera, Isoptera, Thysanura, and Orthoptera dominated the litter arthropod abundance, and the top five orders contributed 73% of the total litter arthropods collected from all the four tropical dry region of Nagpur, India. The results of this study will initiate future research on litter arthropod population and their diversity and abundance in Nagpur forest.

Keywords: Tropical, ambazari, quadrat, litter, arthropod

Introduction
The Nagpur, Vidarbha is the eastern region of the Indian state of Maharashtra with a wide array of bioclimatic and topographic conditions. It has a high level of biodiversity and endemism and at the same time it is one of the most threatened regions, that has earned it the status of biodiversity. Vidarbha lies on the northern part of the Deccan plateau. Unlike Western Ghats, there are no major hilly areas. Vidarbha has Tropical dry deciduous forests which are home to a variety of flora and fauna. Though the floral and faunal diversity found in the region are well documented, little is known of the litter ant and other arthropod distributional patterns or assemblages in the different vegetation types of central Indian forests. Low elevation evergreen tropical forests dominated by dipterocarps constitute the most threatened habitat in the Vidarbha region has been fragmented (Nair 1991; Pascal 1991) [15, 18]. It is well known that structural changes in vegetation and related variations in site temperature, rainfall and food resource availability control litter organism species richness and diversity (Alonso, 2000; Brühl *et al*., 1999; Olson, 1994) [1, 8, 17].
The arthropods is the largest proportion of species richness at ant spatial scale (Hammond 1992) [11] so they represent higher biodiversity that any other group of organisms (Obrist & Duelli 2010) [16]. The number of biodiversity measures developed recently, four indices based on taxonomic relatedness between the species or individuals (Warwick & Clarke 1995, 1998 and 2001) [24, 25, 26] are rated as most promising for biodiversity assessment (Feral *et al*., 2003; Magurran, 2003) [9, 13].
Litter organism assemblages of around Nagpur, lakeside region and temperate forests consist predominantly of functional guilds adapted to exist in wet/moist litter habitats (unpublished observations). Similar ecological conditions namely, wet conditions at around Nagpur, lakeside region and tropical forests result in the presence of litter organism from closely related taxonomic groups in which all genera would be relatively more species-rich leading to high unevenness in the distribution of taxa. Hence, this present study was carried out on litter arthropod population in four tropical dry regions of Nagpur.

Materials and Method

Study Site: The study was conducted in an around Nagpur, lakeside region and tropical dry region vegetation types in the Vidarbha region. All four sites are located in Nagpur City and close human habitation. The average mean Temperature is 26.98 ºC whereas average annual rainfall is 1064.1 mm.

Sampling protocol: A preliminary transect, following the standard 'ants of leaf litter' protocol (Agosti *et al*., 2000) [1] was conducted in the evergreen forest at Nagpur. A 200 m long line transect proposed in the protocol was traced at intervals of 10 m. The leaf litter present inside a 1 m^2 quadrat was collected, shifted and put in a bag. The shifted material was brought back to the field laboratory in collecting bags and fauna was extracted with a mini-Winkler apparatus (Fisher, 1998; Bestelmeyer *et al*., 2000) [10, 5] for 24 h. Litter organism was forceps and handpicked, and transferred to labeled containers of 70% alcohol.

Species identification: Collected arthropods litter samples were identified based on Bolton (1994) [7] and Fauna of British India, Bingham (1903) [6]. Voucher specimens were temporarily stored with 70% alcohol.

Results and Discussion

A total of 195 litter arthropods representing 13 insect orders were recorded from the forty unit (15 cm x 15 cm) samples collected from four tropical forest sites *viz*. (Site 1:- Gorewada lake, Site 2:- Ambazari lake, Site 3:- Futala lake, and Site 4:- Civil line forest). Arthropod diversity was high at all sites i.e 51, 46, 54 and 44 (Table 1). At all four selected sites, the Hymenopteran and Isopteran diversity was significantly higher as compared to other orders.

Futala Lake (FL), Ambhazari Lake AL, Civil Line CL with 11 orders and in Gorewada lake GL 10 orders were found. Shannon diversity index (H') for the four sites ranged from 0.775 (at sites CL) to 0.87 (at site AL) (Graph 1).

In Futala lake site order Hymenoptera dominated the forest floor organisms followed by Isoptera in all sites (Graph 2). Overall, the insect orders, Hymenoptera, Isoptera, Thysanura, and Orthoptera dominated the litter arthropod abundance, and the top five orders contributed 73% of the total litter arthropods collected from all the four tropical dry tropical forests of Nagpur, India (Graph 3).

In the present study of litter diversity we found 13 litter arthropods orders which is almost same to the richness of litter arthropod 12 orders found in a wet evergreen forest at south Western Ghats (Anu et al. 2009) [3]. As abundance is concern, Coleoptera dominated the wet evergreen forest and contributed 42% of the total abundance (Anu et al. 2009) [3]. In present study, Coleoptera contributed only 5%, whereas Hymenoptera contributed 30% to the total arthropods in four sites of forests (Graph 2). This difference may be attributed due to climatic as well as habitat variations between the two forest types.

One way ANOVA revealed that abundance of litter arthropod did not vary significantly between the four sites. T test also showed that arthropod distribution did not vary significantly. However there is significantly difference in litter arthropod between the collected samples.

The arthropod abundance is directly related to forest floor mass and floor nutrients concentration (Sayer et al. 2010) [21]. According to Milton and Kaspari (2007) [14], the forest floor is significantly heterogeneous over short distances in the forests area. The changes in chemical and physical properties of the forest floor will impact on the fauna of forest (Sayer et al. 2010) [21]. Also, in the present study there existed heterogeneity of litter arthropod distribution inside all the four sites of Forests.

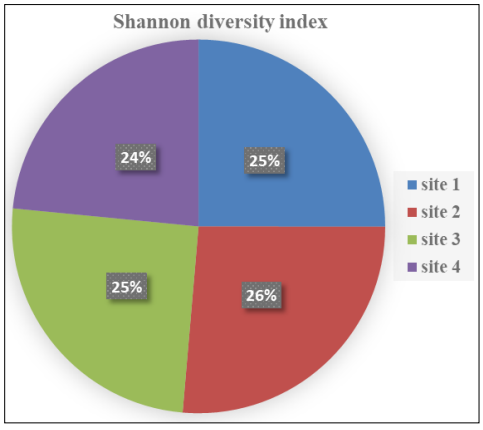
Arthropod diversity is directly depends upon soil moisture and temperature (Reddy 1984) [20]. The forest litter provides suitable habitat for prey and predator hence litter accumulation provides complex food web and creates habitat for more diverse group of insects (Barberena-Arias & Aide 2003) [4]. The predators are more likely to respond to prey density and changes in habitat structure (Uetz 1979) [23]. The accumulation of organic matter can reduce arthropod populations and habitat and make the forest floor unsuitable for growth (Levings & Windsor 1984) [12] and volatile compounds from decomposing litter could be a barrier for arthropods (Sayer 2006) [22]. Therefore various ecological factors like forest floor mass, chemical & physical properties, soil moisture and temperature play a vital role in arthropod population.

In the present study, the abundance relationship Hymenoptera > Isoptera > Thysanura > Orthoptera > Araneae > Hemiptera > Coleoptera > Blattodea > Chilopoda > Opiliones > Acarinae > Pseudoscorpiones > Collembola. In Tropical dry evergreen forest of peninsular India, Similar type of study carried out where Araneae, Hymenoptera, Blattodea, Hemiptera and Isoptera was dominated litter arthropods (Pragasan 2013) [19]. The difference may be due to ecological conditions as site GL, AL and FL connected with large water bodies whereas site CL without water body.

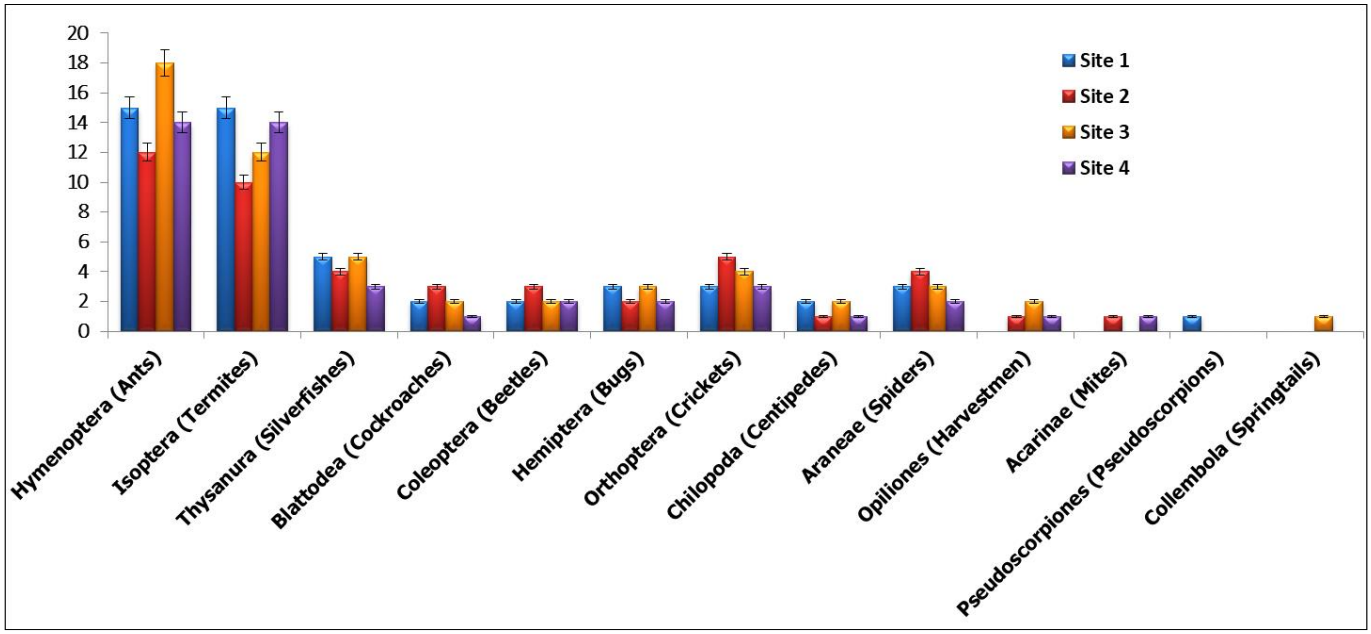
Table 1: Distribution of litter arthropod in four tropical dry region

Taxa (Common name)	Site 1 (GL)	Site 2 (AL)	Site 3 (FL)	Site 4 (CL)
Hymenoptera (Ants)	15	12	18	14
Isoptera (Termites)	15	10	12	14
Thysanura (Silverfishes)	5	4	5	3
Blattodea (Cockroaches)	2	3	2	1
Coleoptera (Beetles)	2	3	2	2
Hemiptera (Bugs)	3	2	3	2
Orthoptera (Crickets)	3	5	4	3
Chilopoda (Centipedes)	2	1	2	1
Araneae (Spiders)	3	4	3	2
Opiliones (Harvestmen)	-	1	2	1
Acarinae (Mites)	-	1	-	1
Pseudoscorpiones (Pseudoscorpions)	1	-	-	-
Collembola (Springtails)	-	-	1	-

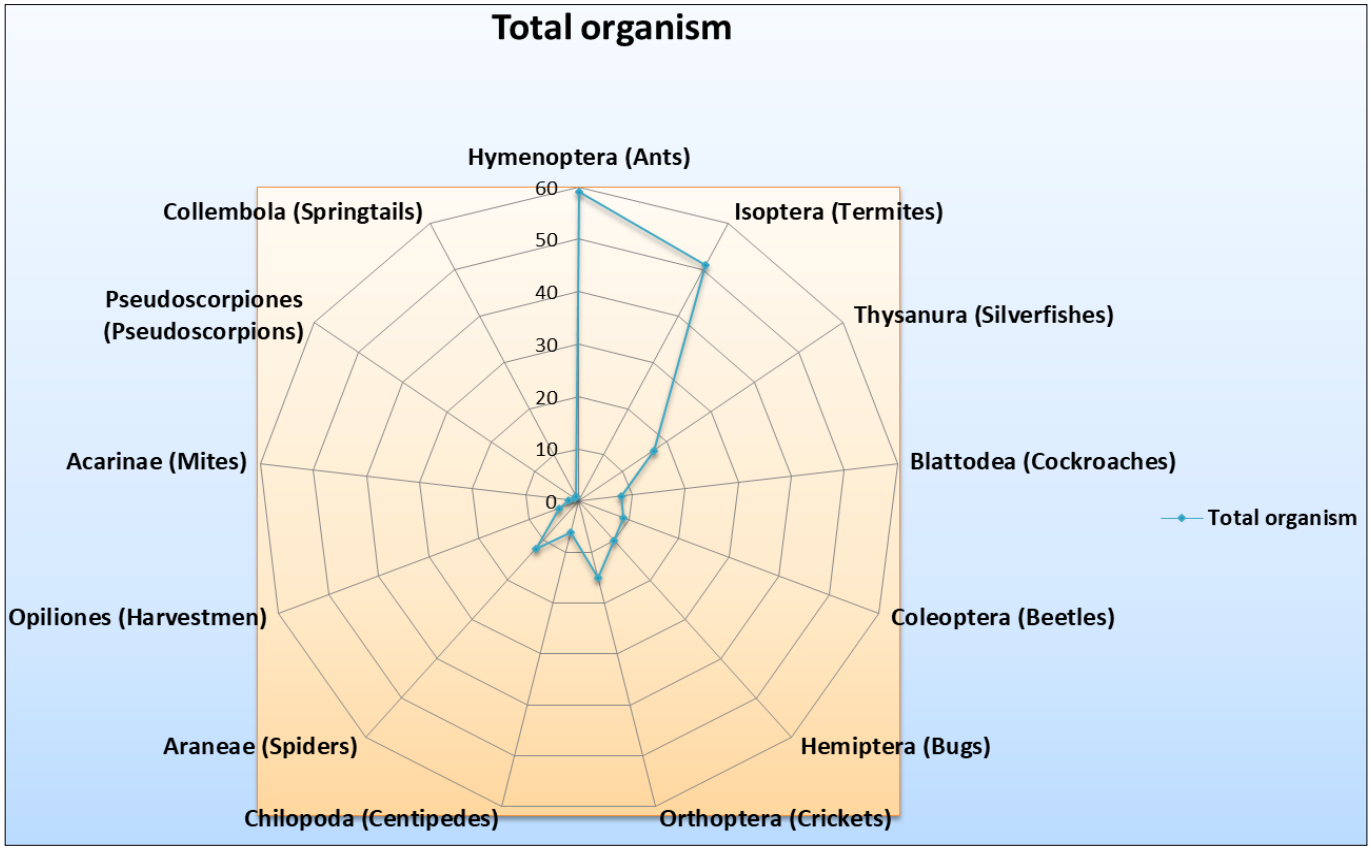
Site 1:- Gorewada lake (GL)
Site 2:- Aambazari lake (AL)
Site 3:- Futala lake (FL)
Site 4:- Civiline forest (CL)



Graph 1: Shannon diversity index (H') for the four tropical dry region



Graph 2: Distribution of litter arthropods in four sites



Graph 3: Quantitative abundance of litter arthropod in four sites

Conclusion

The results of present study provide a of diverse litter arthropod population in four tropical dry regions distributed in forest areas of Vidarbha of India. The total litter arthropod abundance did not vary significantly between the four study sites. But, it varied significantly between the unit samples collected at all the sites revealing the heterogeneity of litter arthropod distribution inside all the forest sites. It is hoped that the results of this study will initiate future research on diversity and abundance of litter arthropod population in Nagpur Forest region.

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