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Study of Diversity of Soil Arthropod Fauna in Pitfall Catches in a Litter Rich Habitat

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Abstract:

The abundance, richness and composition of invertebrate orders were examined in pitfall catches in a litter rich habitat beside Sree Chaitanya College, Habra, North 24 Parganas, West Bengal. A total of 11 types of organisms belonging to 8 orders were found. The main dominant fauna in all the pitfall samples was spider (order Araneae). The other main orders included Collembola, Hymenoptera and Orthoptera. The other groups contributed to the community in small numbers among the fauna during both the years of study. However, different types of plantations did not exert any effect on the soil faunal composition of the area under study.

Keywords: *Pitfall; Soil Fauna; Spiders*

Introduction

The soil fauna is an important part of terrestrial ecosystems. The soil fauna may be characterised by the degree of presence in the soil. The extent of biodiversity in soil is extremely large. The soil food webs are linked to above ground systems, on the other hand. Soil fauna is one of the major drivers of plant litter decomposition (Peng *et al*., 2023) and is diverse in litter rich habitats. However, the role of soil fauna on litter decomposition is poorly understood, despite the fact that it could influence decomposition by modification of the activities of microorganisms. Soil animals such as litter feeding macrofauna interact with leaf litter composition and modify effects exerted by litter species diversity (Schadler & Brandi, 2005). Soil communities exert strong influences on the processing of organic matter and nutrients. Soil faunal activity improves soil physico-chemical properties (Barrios, 2007; Kumar & Singh, 2016). Soil food web diversity impacts on ecosystem processes (Sunderland *et al.,*1995; Kardol *et al.,* 2016). Soil fauna also play a role in the regulation of plant litter decomposition and nutrient release. Research suggests that litter decomposition is primarily controlled by climate, litter quality and also decomposers present therein (Mori *et al.,*2020). Leaf litter provides habitat as well as food resources for soil organisms. In natural ecosystems, plants occur in mixtures; therefore, litter mixtures are also of different quality in different ecosystems (Grossman, Cavender-Bares & Hobbie, 2020). Recent studies suggest that the quality of litter is species specific and litter quality would surpass climate in controlling decomposition rates across biomes globally (Cassart *et al*., 2020; Hoeber *et al*., 2020). The aim of this study was to investigate the diversity of soil macrofauna as well as to find out whether the soil communities differ under different tree species. The pitfall trapping is the most efficient sampling strategy for detecting diversity of soil fauna and one of the most widely used methods for collecting soil arthropods (Southwood, 1987; Sunderland *et al.,*1995; Brown & Matthews, 2016).

A pitfall trap catches animals, mostly invertebrate macrofauna that move across the soil surface. The use of Tullgren funnels for extracting soil fauna, which consists of separating arthropods from a soil sample using heat and desiccation that induce migration of trapped organisms towards a collecting device, is also followed by some. Pitfall trap methodologies and designs vary considerably among studies and investigators. In this study, however, the pitfall trapping technique was used to study the soil fauna. A literature review was conducted to know the most common methods used by past investigators who placed pitfall traps for the purpose of collecting and identifying soil fauna and this information was used for the pitfall trapping methods. A common garden experiment beside the college premises with lots of trees and a good amount of litter beneath them was a good opportunity to conduct this study.

Methodology

The research was carried out beside Sree Chaitanya College (Habra), North 24 Parganas, West Bengal, India for two consecutive years. The study site included an area full of different kinds of large and small trees and grasses. Some common trees and plants include *Azadirachta indica, Polyalthia longifolia, Ficus religiosa, Mangifera indica, Terminalia arjuna, Shorea robusta, Areca catechu, Madhuca longifolia, Neolamarckia cadamba, Psidium guajava, Thuja occidentalis, Agave tequilana, Adhatoda vasica, Rauwolfia serpentina, Ocimum sanctum, Hibiscus rosasinensis, etc.*

Soil macrofauna was collected quarterly by pit fall trapping for estimating the abundance and diversity of the fauna obtained. The pitfall trap consisted merely of a jar into which a small quantity of alcohol/water with detergent was placed. The experiment was laid out in a randomised design to control for possible habitat heterogeneity within the area. The traps were installed by burying the jar in the ground up to a depth of 20 cm. The upper rim of the jar was at the same level as the ground so that organisms moving on the ground may fall in it without noticing it. Ten traps placed about 5 m from each other were kept overnight. The number of organisms was counted after removing the jar from the soil. The number of faunas obtained in all the jars was averaged to get the number of each group of organisms each year. The organisms were identified up to the order level. The data obtained from all the pitfalls were compiled each year to calculate the abundance of the fauna obtained. Pitfall trapping is one of the most widely used methods for collecting soil arthropods (Southwood, 1987; Sunderland *et al.,* 1995; Brown & Matthews, 2016).

Results and Discussion

Altogether, 11 types of organisms belonging to 8 orders were identified (Table 1). As indicated in Fig1, the main fauna in all the pitfall samples was spider (order Araneae). The other dominant groups following spiders included orders Collembola, Hymenoptera and Orthoptera. The rest of the groups contributed to the community in small numbers. The abundance of the orders was not significantly different in the two years. Both years, the dominant fauna were the spiders (order Araneae) with a relative abundance of 30.47% followed by spring tails (Collembola -19.04%) while ants and wasps (order Hymenoptera) and crickets (order Orthoptera) showed almost equal relative abundances of 18%.

Many factors affect pitfall catches (Sunderland *et al.,* 1995), such as trapping technique, structure of the habitat and specific characteristics of the animals to be caught. In this study, the population of spiders was found to be the dominant ones. Spiders are actually common predators of forest floor food webs (Wise & Chen,1999).They are able to control the abundance of prey organisms micro detritivorous collembolans (Lawrence & Wise, 2000; Wise, 2004; Lensing*,* Todd & Wise, 2005). The population of spiders obtained in all the pitfalls was high compared to the populations of collembolans. This may be due to the prey-predator relationship of the forest floor or due to the soil characteristics as found by Verheof and Van Selm, 1983.

Plant species richness positively affected litter decomposition by increasing soil fauna (Sauvadet *et al*., 2017; Tresch *et al*., 2019). In this study, the orders recorded were found throughout the year. However, earthworms, which are most common residents of the forest floor, were not found, which may be due to the very dry nature of the soil.

Table 1: *Relative abundance of organisms obtained in pitfall catches in college campus area*

Orders	Organisms	Relative Abundance
Araneae	Spider	30.47%
Diptera	Fly	10.47%
Orthoptera	House Cricket	2.85%
Collembola	Spring tail	19.04%
Hymenoptera	Red ant	9.52%
Hymenoptera	Black ant	6.66%
Orthoptera	Mole cricket	15.23%
Hymenoptera	Wasp	1.9%
Coleoptera	Beetle	0.95%
Hemiptera	Bugs	0.95%
Isoptera	Termite	1.9%

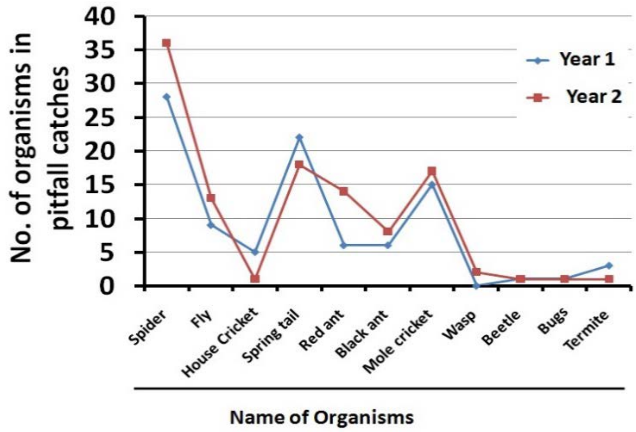

Figure 1: Abundance of organisms (average no.) in pitfall catches in two consecutive years in college campus area, Habra, West Bengal

Conclusion

Plant species richness positively affected litter decomposition but no difference in the composition of the soil fauna was observed due to the difference in the species of plants. In this study, the orders recorded were found throughout the year. However, earthworms which are the most common resident of the forest floor were not found may be due to the very dry nature of the soil.

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