Short communication

Study on the abundance and diversity of soil invertebrate macro-fauna across different land use types at the GKVK Campus, Bengaluru

Abstract

At the University of Agricultural Sciences, GKVK, Bengaluru, four different land use types—roadside soil, forest ecosystem, paddy ecosystem ZARS, and botanical garden are taken into consideration in this study to analyze the abundance, diversity, and community composition of soil invertebrate macro-fauna. Three soil macrofauna sampling sites are selected from each land use category. The transect has a randomly selected beginning point, and tiny land units (25*25*30 cm) are excavated at 5-meter intervals perpendicular to the slope. A total of 12 units (4 treatments * 3 replications) of various land use types were sampled in May 2021. Berlese-Tullgren funnels are used for excising and collecting soil invertebrates. This study's results indicate that intensive land cultivation leads to quantitative alterations in the abundance and diversity of soil invertebrate macrofauna (SIMF) communities.

Keywords Soil macrofauna, Berlese-Tullgren funnel, land use type, abundance and diversity

Introduction

Soil macrofauna diversity, abundance, and community composition are all impacted by land use type. Changes in land use and intensification have an influence not just on plant communities but also on soil food webs and the connections between above- and below-ground populations (Wardle *et al.,* 2004). Annual cropping techniques don't provide permanent soil cover, it will disturb the soil and reduce the diversity and abundance of soil fauna communities (Barrios, 2007; Rossi *et al.*, 2010). Soil macro-fauna are also impacted by unsustainable land management techniques such as overgrazing, fire, deforestation, pollution, soil erosion, and fertility depletion (Bignell *et al.*, 2005). The development of soil macrofauna is facilitated by forest land and garden fields, which have more soil cover and less soil disturbance. These characteristics are absent from grazing areas and crop-cultivated fields, which leads to greater soil compaction, deterioration, and a lack of food and cover that are necessary for the survival of soil macrofauna (Moreira *et al.,* 2008).

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It is well established that residue inputs and soil management techniques affect the distribution, abundance, and diversity of soil invertebrate macro-fauna (SIMF) (Brown et al., 2004; Manhaes et al., 2013). It is therefore assumed that there are variations in the effects of various land management techniques on SIMF. Prior studies conducted at the UAS, GKVK, campus Bangalore, have revealed a knowledge gap about local SIMF assemblages in several land use categories. To discover how land use changes, impact the abundance and diversity of SIMF.

Materials and Methods

Description of the study area

The study was carried out in four primary land use types: roadside soil; botanical garden; forest ecosystem; and paddy ecosystem ZARS at UAS, GKVK, Bangalore, which is situated in the northern region of the Bangalore district; Geographically, the region is located between Latitude: 13° 04' 55.92" N and Longitude: 77° 34' 34.57" E.

Sampling Methods and Experimental Design:

Sampling was carried out in May 2021, during the beginning of light rainfall, when soil macrofauna activity is normally heightened. Every category of land use (Plate 1-3) has 3 sampling locations. Using an excavator tool soil was dug to a depth of 25 × 25 × 30 cm at 10-meter intervals along a transect perpendicular to the slope and with randomly placed starting points (Anderson & Ingram, 1993). Three sample monoliths were taken from each type of land use to create a total of twelve sampling points. Using Berlese funnels (Muvengwi *et al.,* 2018) (Plate 4), the macro-fauna was separated from the soil, collected in vials with 70% alcohol, then identified and counted. After the extraction of macrofauna, the extracted soil was put back in its original location to reduce soil disturbance in selected land use types.

Identification of soil macro-fauna

The collected soil invertebrates were identified and counted. According to Eaton and Kaufman (2007), identification keys and visual aids such as photographs were used in the laboratory to identify species of soil invertebrate macro-fauna (SIMF). Four different land use categories were evaluated for macro-fauna abundance (Table 1). The abundance and diversity of each macrofauna within the four land use groups were calculated.

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Results

There was a total 55 soil macrofauna were collected from four land use categories (Table 2). While earthworms and Collembola were collected in the forest, roadside, and botanical areas but absent from the cultivated paddy habitat. Ants and spiders were identified in all 4 land use types (Fig. 1). The abundance of SIMF was observed in the order of forest land > botanical garden > paddy field > roadside soil. Overall, the abundance of SIMF was lowest in cultivated field and roadside soil and highest in forest land (49.09%) followed by the botanical garden (29.09%) (Table 1).

Discussion

Composition and occurrence of SIMF community

Under unsustainable land use management methods, the reaction of the soil invertebrate macro-fauna (SIMF) community to environmental disturbance became apparent. Notably, SIMF groups showed preferences in the habitats of forests and botanical gardens, possibly as a result of less soil disturbance and/or higher quality of litter. The positive relationship between vegetation and the diversity of soil macro-fauna suggests that higher availability of energy and nutrients enhances the growth and activity of soil macrofauna (Negasa *et al.*, 2017). This preference could be explained by the higher levels of organic matter found in garden and forest areas, which offer beneficial substrates for soil macrofauna (Beare et al.,1997). Conversely, paddy-cultivated fields had lower organic matter content and greater soil acidity conditions will lower the SIMF. Consistent with findings by Decaens et al. (1994), soil macro-fauna abundance tends to decrease to low levels in crop-cultivated lands.

Conclusion

The findings of this study indicate that intensive cultivation of land leads to quantitative alterations in the abundance and diversity of soil invertebrate macrofauna (SIMF) communities. These changes are attributed to specific management practices that result in habitat destruction and the removal of organic substrate, consequently diminishing the availability of food sources for associated SIMFs. Among the four land use classes examined, forested areas exhibit relatively high diversity of SIMFs followed by botanical garden, because of low soil disturbance and availability food sources in this land use type. crop cultivated fields and roadside soil display lower diversity in invertebrates because land disturbance by human activity. Therefore, it is advisable to

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adopt sustainable cropping systems that uphold acceptable levels of SIMF abundance while minimizing human disturbances. Achieving this goal necessitates incorporating knowledge of biological processes into the design of land management systems. Additionally, further in-depth studies are crucial to identifying the optimal combination of land use and varying management practices across different land types, ensuring the most effective sustainability of SIMF populations.

Table 1: Composition and distribution of soil invertebrate macro-fauna in different land use types at GKVK, Banglore

Taxa	Distribution			
Earthworm	Paddy Ecosystem ZARS	Botanical Garden	Forest Ecosystem	Roadside Soil
Collembola	-	+	-	+
Spider	-	+	+	-
Ant	+	+	+	+
Millipede	+	+	+	+

+ indicates present, − indicates absent

Table 2: Abundance of each taxon in different land use types

Land use types	Earthworm	Collembola	Spider	Ants	Millipede	Total % of arthropods
Paddy ecosystem	0	0	5	2	0	12.72%
Botanical garden	3	4	8	1	0	29.09%
Forest ecosystem	0	9	11	4	3	49.09%
Roadside soil	2	0	1	1	2	10.90%

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(a)


(b)


(c)

Plate 1: Collection of Soil Sample from (a) Paddy field, (b)Forest ecosystem, (c) Roadside soil

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Plate 2: Setting of Berlese Funnel for the Estimation of Soil Invertebrate population from collected samples

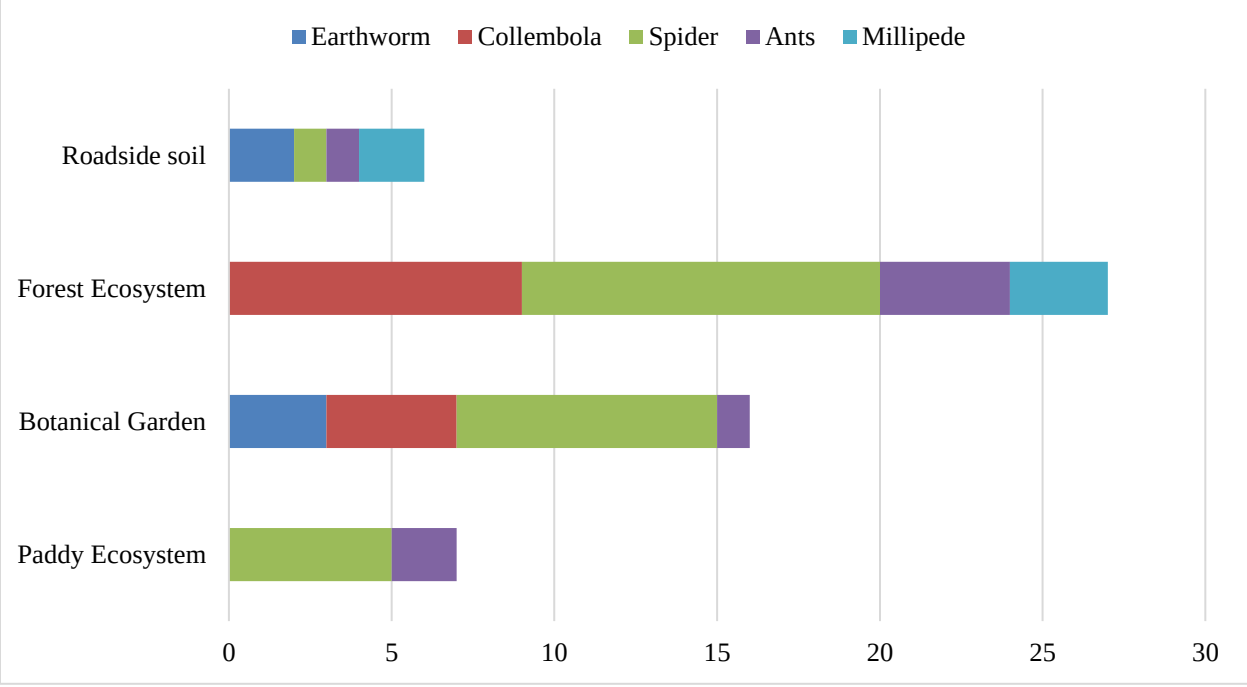

Fig.1. Density of soil invertebrate macro-fauna in different land use types at GKVK, Bangalore

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