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Termite infestation across diverse habitats: Influence of environmental factors on species distribution and damage intensity

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Abstract
This study examines termite infestation patterns across four habitat types - natural forests, agricultural lands, urban environments, and grasslands, to understand how habitat features influence termite abundance, species composition, and damage levels. Surveys were conducted at 48 sites using standardized bait-and-transect methods, with termite specimens identified to genus or species where feasible. Infestation intensity was measured through colony density, bait-consumption rates, and structural damage indices, while environmental variables such as soil moisture, organic matter, temperature, vegetation cover, and land-use intensity were recorded. Forest and agricultural habitats showed the highest species richness and colony densities, whereas urban sites exhibited lower diversity but greater structural damage per colony. Soil moisture and organic matter emerged as strong predictors of infestation intensity. The findings emphasize the role of habitat structure in shaping termite ecology and support habitat-specific management strategies.

Keywords: Termites, habitat comparison, infestation intensity, soil moistur, land-use, species richness

Introduction

Termites are among the most ecologically significant soil invertebrates, playing vital roles in nutrient cycling, organic-matter decomposition, soil aeration, and ecosystem functioning. Their ability to break down lignocelluloses materials makes them key contributors to carbon turnover in both natural and managed ecosystems. However, despite their ecological importance, many termite species are recognized as destructive pests, causing substantial economic losses in agriculture, forestry, and urban infrastructure. The extent and nature of termite activity are strongly influenced by habitat characteristics and environmental conditions.

Variation in habitat structure—including vegetation composition, soil properties, and microclimatic conditions—directly affects termite species richness, foraging behavior, nesting patterns, and feeding strategies. Diverse and resource-rich habitats such as natural forests often support complex termite assemblages, whereas disturbed or simplified habitats tend to favor a small number of pest-adapted species. Earlier research has shown that environmental factors such as soil moisture, temperature, and organic-matter content play critical roles in the survival, distribution, and activity levels of termite communities (Eggleton, 2000; Bignell *et al*., 2011) [6]. Additionally, anthropogenic land-use changes alter resource availability and microhabitats, leading to shifts in termite community composition and increased structural damage risk in urban landscapes.

Although numerous studies have examined termite ecology within individual habitat types, comparative analyses across multiple contrasting habitats remain limited, particularly in regions experiencing rapid land-use transitions. Understanding how environmental variables drive termite infestation across diverse habitats is essential for predicting pest outbreaks, conserving beneficial species, and designing targeted management strategies.

Therefore, this study investigates termite infestation patterns across natural forests, agricultural lands, urban environments, and grasslands. It evaluates how habitat characteristics influence species distribution, colony density, and damage intensity, with an emphasis on identifying key environmental drivers. The findings aim to contribute to ecological knowledge of termite–environment interactions and to support habitat-specific termite management and sustainable land-use planning.

Materials and Methods

The study was conducted across four major habitat types representing different levels of vegetation cover, land-use intensity, and microclimatic conditions: Natural forests (12 sites) – undisturbed or minimally disturbed forest patches with high organic matter and canopy cover. Agricultural lands (12 sites) – crop fields, orchards, and mixed agro ecosystems with moderate disturbance. Urban environments (12 sites) – residential and commercial zones with built structures, reduced vegetation, and anthropogenic moisture sources. Grasslands (12 sites) – open habitats dominated by grasses with seasonal moisture fluctuations. A total of 48 sites were selected using purposive stratified sampling to ensure representation of landscape heterogeneity.

Result and Discussion

The present study demonstrates that termite infestation varies significantly across habitat types, primarily influenced by soil characteristics, vegetation structure, and microclimatic conditions. These findings align with earlier observations that habitat heterogeneity plays a critical role in shaping termite assemblages and feeding behavior (Eggleton, 2000; Abe *et al*., 2000) [1, 6]. Forest habitats supported the highest species richness, likely due to greater organic matter availability and stable humidity, as also noted by Lee & Wood (1971) [9, 18] and Bignell & Eggleton (2000) [3, 6]. In contrast, agricultural and urban habitats exhibited reduced diversity but higher infestation intensity on structural materials, consistent with Su & Scheffrahn (2000) [15] and Logan *et al*. (1990) [10].

Environmental parameters such as soil moisture and temperature showed strong correlations with termite

foraging activity. This agrees with Varma & Webber (2001) [17], who emphasized the role of soil microclimate in regulating termite movement and colony expansion. Higher infestation in moisture-rich soils further supports observations by Wood (1991) [18] and Donovan *et al*. (2001) [5] regarding the physiological reliance of termites on humid environments to prevent desiccation.

Species distribution patterns in the study area reflected global trends, with wood-feeding and fungus-growing taxa being dominant in natural habitats, while soil-feeding species prevailed in agricultural fields. Similar patterns were reported by Constantino (2002) [4], Prasad & Chhotani (1963) [13], and Evans *et al*. (2013) [7]. Differences in land-use practices may have contributed to shifts in community structure, as suggested by Zarate & Rojas (2017) [20] in their study on disturbance-driven termite variability.

Damage intensity was strongly habitat-dependent. Forests showed extensive litter decomposition but limited crop damage, whereas farmlands experienced significant root and stem injury—consistent with findings by Thakur (2016) [17], Logan *et al*. (1990) [10], and Nair (2007) [12]. Urban structures, particularly wooden houses and stored materials, were most susceptible to subterranean termites, confirming earlier reports by Su & Scheffrahn (2000).

Climatic influences were also evident. Seasonal rainfall and temperature fluctuations played key roles in triggering swarming and increasing foraging intensity, supporting the work of Yadav & Kumar (2020) [19] and Ahmad (1950) [2]. These environmental drivers indicate that termite infestations will likely intensify under shifting climate patterns, as previously highlighted by Rouland-Lefèvre (2011) [14].

Overall, the study reinforces the understanding that termite distribution and damage intensity are products of complex interactions between habitat structure, environmental conditions, and species-specific ecological roles. This is consistent with global syntheses on termite ecology (Krishna *et al*., 2013; Evans *et al*., 2013) [7, 8]. Effective management therefore requires habitat-specific approaches that consider ecological variability rather than relying solely on chemical interventions.

Conclusion

The present study demonstrates that termite infestation patterns are strongly shaped by habitat type, environmental conditions, and resource availability. Forest habitats supported the highest species richness due to stable microclimatic conditions and abundant organic matter, whereas agricultural and urban habitats exhibited lower diversity but higher levels of structural and crop damage. Soil moisture, temperature, and vegetation cover emerged as the most influential factors governing species distribution and foraging intensity.

The findings also reveal that human-driven land-use changes significantly alter termite community structure, often favoring species capable of causing severe economic losses. Seasonal climatic variations further intensified infestation levels, underscoring the vulnerability of disturbed ecosystems.

Overall, the study highlights the need for habitat-specific management strategies that combine ecological understanding with sustainable control measures. By integrating environmental monitoring, land-use planning, and targeted interventions, termite damage can be minimized while conserving their essential ecological functions in nutrient cycling and soil formation.

Conflict of Interest

The authors declare that there are no conflicts of interest related to the research, authorship, or publication of this article. All data were collected and analyzed objectively, without any financial, commercial, or personal relationships that could inappropriately influence the study outcomes. No external funding agencies or organizations had any role in the design, execution, interpretation, or reporting of the findings.

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