

## TERMITE DIVERSITY AND ITS EFFECT ON SOIL FERTILITY IN OKOMU NATIONAL PARK, EDO STATE, NIGERIA

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### Abstract

*Arthropoda is a very large phylum in the subdivision Invertebrata, playing a significant role in the ecosystem, it includes the very important class, Insecta, which are the most diverse and most abundant group of arthropods found virtually everywhere (ubiquitous) in large numbers, constituting nuisance to man and its livestock and crops while playing invaluable roles in ecosystem provisioning and services, as well as support. However, despite the recognized significance of termites in tropical ecosystems, comprehensive studies on termite diversity within Okomu National Park (ONP) is sparse. This study, therefore, identified termite species and evaluated their diversity within termite mounds across ranges within ONP. Termite samples were collected from representative mounds across the four ranges, Arakhuan, Igwuowan, Julius Creek, and Babui Creek in ONP, hand-picked using active search and baiting methods, then preserved in 80% alcohol for laboratory identification. Soil samples were extracted near mounds and analyzed for pH and fertility levels using a 4-in-1 soil tester. Pearson correlation analysis was employed to determine species diversity patterns associated with termite mounds across different habitat types. *Macrotermes natalensis* was the dominant termite species identified, with different maturity stages observed across various mound structures. The study elucidates termite impacts on protected environments, informing enhanced conservation strategies.*

**Keywords:** *Termite samples, *Macrotermes natalensis*, Okomu National Park, Soil fertility, Termite mounds*

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### Introduction

The most varied group of animals on Earth is insects. They play a fundamental role in nearly every ecosystem, contributing to processes such as pollination, decomposition, and food web dynamics. As members of this vast class, termites exhibit unique behaviors and ecological functions that set them apart from other insects. Termites are known as

cellulose-eating and eusocial insects and they belong to the order Isoptera (Inward *et al.*, 2007). They are found all across the world, especially in tropical and subtropical areas where they are crucial to preserving the equilibrium of ecosystems. The ecological system significance is paradoxical; while they contribute to decomposition, nutrient cycling, and soil fertility, they are also notorious for

causing extensive damage to wooden structures, crops, and forestry resources (Vidyashree *et al.*, 2018). Understanding their ecological roles and the dynamics of their interactions within specific environments is crucial for both conservation and management efforts.

Additionally, termites are recognized as engineers of the ecosystem, which means that their actions drastically change the environment benefiting various other species (Adeola *et al.*, 2025). One of their most remarkable contributions is their role in decomposition. They break down dead plant material, particularly cellulose, a complex carbohydrate found in wood and plant fibers. Through this process, they maintain soil fertility and encourage plant growth by releasing vital nutrients back into the soil. Additionally, by building tunnels that promote water infiltration and soil aeration, their operations reduce soil compaction, making them crucial for sustaining agricultural productivity in some regions (Jouquet *et al.*, 2011).

Termites are also an essential component of the food chain. Numerous predators, including as birds, amphibians, reptiles, and mammals, use them as prey. Termites are a major source of food for some animals, including pangolins and aardvarks, underlining the importance of termite populations in maintaining predator-prey dynamics within ecosystems. Therefore, the decline of termite populations in certain areas could affect other species negatively, disrupting ecological balance. One of the most striking aspects of termite ecology is their ability to construct intricate mound structures that serve as microhabitats for a diverse range of organisms. These mounds, built from soil, saliva, and feces, can reach several meters in height and remain stable for decades. They influence

local biodiversity by modifying soil properties, creating localized microclimates, and providing shelter for numerous other organisms (Davies *et al.*, 2014). The internal structure of termite mounds is highly specialized, featuring ventilation systems that regulate temperature and humidity. These conditions make mounds attractive refuges for various invertebrates, reptiles, amphibians, and even small mammals. In some cases, plant species that struggle to grow in surrounding soils find suitable conditions on termite mounds due to the soil's increased nutrient content (Jouquet *et al.*, 2016)

African continent hosts the highest diversity of termite species, largely due to its favorable climatic conditions, which include warm temperatures and high humidity levels conducive to termite survival and proliferation (van Huis, 2017). Among the ecosystems in Africa, tropical rainforests and savannas are particularly rich in termite populations, where their activity influences soil composition and plant communities. In Nigeria, Okomu National Park stands out as an ecologically significant area for studying termites due to its rich biodiversity and conservation importance.

Despite their relative abundance, termites have gotten far less attention among the eusocial species (Khan *et al.*, 2018). Studies on termite abundance, distribution, diversity and their effect on fertility of the soil within Okomu National Park are lacking. Much of the existing research on termites in Nigeria focused on savanna regions, leaving the lowland rainforest under-studied. This knowledge gap hinders our understanding of species composition, distribution patterns, and the functional roles termites play in this critical habitat. Thus, there is a need to

explore termite species diversity and its effect on soil fertility in Okomu National Park to better support biodiversity conservation and ecosystem management.

This study filled an existing knowledge gap on termite diversity, mound distribution, and their influence on soil fertility across different ranges within Okomu National Park (ONP) in Edo State, Nigeria, through the identification of termite species present. The results provide baseline information on termite activity in the park, which can support the formulation of conservation strategies that utilize the ecological functions of termites, thereby enhancing the resilience of Okomu National Park to environmental changes.

**Materials and Methods**

**Study Area**

Study was conducted in Okomu National Park, located in the Ovia South-

West Local Government Area of Edo State in southern Nigeria. The park lies between latitudes 6°15'N and 6°25'N and longitudes 5°09'E and 5°23'E (Olaniyi, 2018). It is the smallest national park in Nigeria, representing a conserved forest block within the larger Okomu Forest Reserve. The park covers an area of 181 km<sup>2</sup>, accounting for 15 percent of the 1,200 km<sup>2</sup> Okomu Forest Reserve (Oladejo and Eghenure, 2021; Digun-Aweto *et al.*, 2018). Okomu National Park is subdivided into four primary ranges: Arakhuan, Igwuowan, Julius Creek, and Babui Creek, each characterized by distinct vegetation types and varying degrees of anthropogenic disturbance. As a protected area, the park plays a crucial role in conserving Nigeria's lowland rainforest ecosystem, serving as a sanctuary for a wide array of wildlife and plant species (Akpovwovwo, 2020).

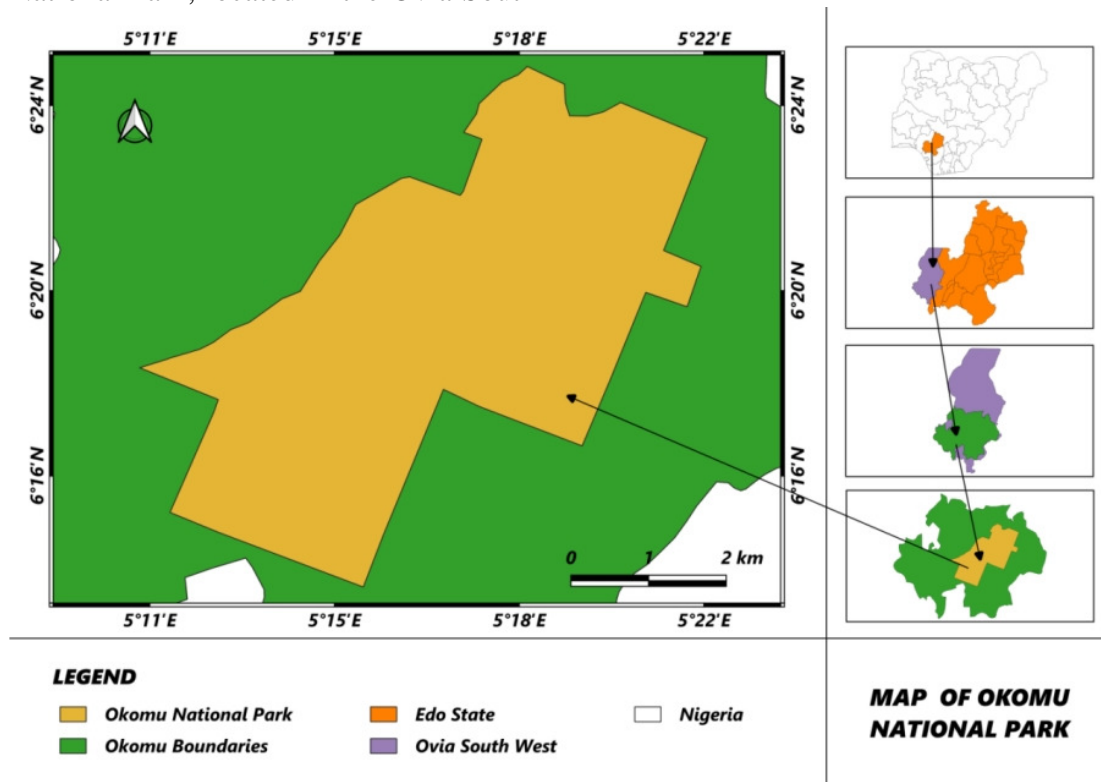


Fig. 1: The Map of Okomu National Park

**Data Collection**

Termite samples were gotten from termite mound structure representatives across the ranges by capturing the worker and soldier termites. The termites were hand-picked using active search and baiting methods, then preserved in 80% alcohol and labeled according to mound structure and ranges for laboratory identification. Species identification was conducted using morphological characteristics in Crop Protection and Environmental Biology (CPEB) Insect Laboratory, University of Ibadan using identifying keys and comparisons with recognized species found in literature (Eggleton, 2000). Soil samples surrounding Termite mound was taken for analysis of pH, and fertility test using soil tester (4-in-1 soil tester, JQ003)

**Data Analysis**

Soil samples were extracted near mounds and analyzed for pH and fertility levels using a 4-in-1 soil tester.

**Results**

**Termite Species Identification Across the Ranges in Okomu National Park**

Termite samples were collected from 21 termite mounds, each representing termite mound structure (Cone mounds structures, cathedral mound structure, cylindrical mound structure, mushroom-shaped mounds) encountered in each range. The samples were identified under the microscope (Wild Heerbrugg Swiss M1B stereo microscope) using taxonomy identification keys (for insects) at Crop Protection and environmental Biology (CPEB) Laboratory with the assistance of the laboratory specialist. Samples of termites only revealed a genus – *Macrotermes* with the species *M. natalensis* clearly identified. The findings showed termite species of different maturity stages, which indicate that younger termites are found in small to medium sized mounds while the bigger ones are found in big mound structure such as the cathedral mounds.

Table 1: Scientific classification of termite species identified during study at ONP

<b>Classification</b>	<b>Name</b>
Kingdom	Animalia
Phylum	Arthropoda
Class	Insecta
Order	Blattodea
Infraorder	Isoptera
Family	Termitidae
Genus	<i>Macrotermes</i>
Species	<i>M. bellicosus</i> (Smeathman,1781) <i>M. nigeriensis</i> (Sjöstedt, 1911) <i>M. natalensis</i> (Sjöstedt, 1926)

The top most soil layer around the termite mounds was tested for pH and fertility status across the four ranges (Igwuowan, Arakhuan, Julius Creek, and Babui Creek) using soil tester. These parameters provide insights into their

effects on soil fertility as well as their potential influence on vegetation. The average pH values range from 5.58 to 5.80, which indicate that the soil in all study sites across the four ranges is acidic (below pH 7).

Table 2: The average soil fertility and pH level at the study site

Range	Average Soil pH	Soil fertility rate
Igwuowan	5.60	Moderately fertile
Arakhuan	5.63	Moderately fertile
Julius Creek	5.58	Moderately fertile
Babui Creek	5.80	Moderately fertile

## Discussion

Termites are commonly regarded as ecosystem engineers, a designation attributed to their profound ability to modify soil structure, facilitate nitrogen cycling, and generate microhabitats that sustain a wide variety of organisms within their environment (Jouquet *et al.*, 2016). Therefore, the presence of diverse mound structures in Okomu National Park suggests that termite activity contributes to habitat heterogeneity, which in turn supports biodiversity. Recent studies suggest that termite mounds enhance ecosystem resilience to climate change by stabilizing soil structure and improving water retention (Bonachela *et al.*, 2015).

This study recorded moderately acidic soil pH (5.58 – 5.80) across all study sites, which is consistent with findings from tropical ecosystems where termites prefer slightly acidic soils for mound construction (Jouquet *et al.*, 2016). Also, previous research has shown that termite mound soils tend to be more alkaline than surrounding soils due to calcium and magnesium accumulation from termite activities (Jouquet *et al.*, 2011). A lot of researches have documented the fact, that termite mounds act as nutrient hotspots, supporting enhanced plant growth compared to surrounding soils. In tropical ecosystems, termite activity increases nitrogen, phosphorus, and organic matter in mound soils, leading to increased plant biomass (Tilahun *et al.*, 2021).

This study observed higher termite mound density in forested areas such as

Arakhuan and Igwuowan, while termite presence was relatively lower in open buffer zones near Julius and Babui Creek. This pattern aligns with research by Bonachela *et al.* (2015), who found that termite mound distribution is often correlated with shading, as termites avoid extreme heat and dry conditions. The termite species identified in Okomu National Park belonged to the genus - *Macrotermes*, with *M. natalensis* being the most prominent species. Nigeria has been recorded to host over 50 termite species, primarily from the Termitidae, Rhinotermitidae, and Kalotermitidae families (Adeola *et al.*, 2025) Among these, *Macrotermes* species, including *M. natalensis*, dominate mound-building termite communities, in tropical and particularly subtropical regions and savanna ecosystems (Opayele and Popoola, 2012; Eggleton, 2000). *Macrotermes* species are higher termites (family Termitidae, subfamily Macrotermitinae) and are known for their symbiotic relationship with fungi, which enhances their ability to decompose plant material efficiently. Therefore, the dominance of *Macrotermes natalensis* in this study aligns with existing research, as this species has been widely documented in Nigerian forests, particularly in regions with moderate soil fertility and abundant deadwood resources (Eggleton and Tayasu, 2001), but it quite disagreed with Adeola *et al.*; 2025 that identified six taxa with *M. natalensis* not dominating, but just one of the taxa (14.3%).

The identification of *Macrotermes natalensis* in Okomu National Park reinforces its ecological significance as an ecosystem engineer. This species is known to enhance soil fertility by redistributing nutrients through mound-building, support plant growth by improving soil aeration and water retention as well as influence carbon and nitrogen cycles through organic matter decomposition (Tilahun *et al.*, 2021; Jouquet *et al.*, 2016).

The presence of *M. natalensis* in different mound types (cylindrical, mushroom-shaped, cathedral) suggests that this species is highly adaptable to varying environmental conditions within the park, a trait consistent with findings from tropical African ecosystems (Hyodo *et al.*, 2015).

Given that *Macrotermes* species contribute significantly to soil and ecosystem health, their dominance in Okomu National Park suggests that termite conservation should be considered in biodiversity management plans. Studies in West Africa have shown that protected areas harbor greater termite diversity than disturbed habitats, emphasizing the importance of conservation strategies that maintain termite populations and their ecological functions (Dosso *et al.*, 2012). The slight variations in pH levels may influence termite mound distribution, as termites generally prefer certain pH ranges for constructing and maintaining their mounds.

All the study sites are categorized as 'moderately fertile', suggesting that the soil has a balanced but limited supply of essential nutrients. The moderate fertility levels indicate that termite activity might be contributing to nutrient redistribution, as termite mounds are known to improve soil structure and fertility by mixing organic and inorganic materials. The

uniform fertility level across the study sites suggests that the impact of termites on soil nutrients might be relatively consistent throughout the park.

This study suggests that termite mound density and distribution in Okomu National Park are influenced by habitat. Since termite mounds contribute to soil enrichment, habitat heterogeneity, and plant recruitment, conservation strategies should consider maintaining termite populations to support ecosystem functions. Also, the preference of *Macrotermes natalensis* for moist, shaded environments aligns with previous studies, while the influence of termite mound soils on plant diversity and forest structure highlights their importance in ecosystem dynamics. These findings therefore emphasize the need for conservation strategies that recognize the ecological value of termites as habitat engineers, ensuring that their contributions to soil fertility and forest regeneration are preserved.

## Conclusion

The ecological contributions of termites extend beyond soil enrichment, playing an integral role in habitat formation and biodiversity conservation. The identification of *Macrotermes natalensis* as the dominant termite species further strengthens existing knowledge on termite species distribution in West African rainforests. Despite their ecological significance, termites remain understudied in tropical rainforest ecosystems, particularly in protected areas such as Okomu National Park. This study sheds light on how termites affect the ecology of protected areas, providing crucial information for improving conservation strategies in the face of mounting environmental pressures. Long-

term stability and ecosystem resilience can be strengthened by managing termite dynamics.

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