



## OCCURRENCE AND DIVERSITY OF TERMITE SPECIES IN *EUCALYPTUS* PLANTATIONS IN AFAKA, KADUNA STATE, NIGERIA

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### ABSTRACT

*Termites are one of the key pests attacking Eucalyptus species and also play important roles in ecological processes. A better understanding of the roles of termites in ecosystem processes requires information on termite diversity and could also provide useful information to identify noxious species. There is inadequate information on the termite diversity associated with Eucalyptus plantations in Nigeria. Therefore, occurrence and diversity of termite species in four Eucalyptus species plantations in Afaka, Nigeria was investigated. Termite samples were collected from E. camaldulensis, E. cloeziana, E. citriodora and E. tereticornis plantations in five micro-habitats: epigeal mound, leaf litters, wood litters, soil and under stem bark. The results showed that seven termite species, Macrotermes bellicosus, Macrotermes subhyalinus, Odontotermes obesus, Nasutitermes germinatus, Amitermes evuncifer, Microtermes sp., and Ancistrotermes sp., were identified from the four Eucalyptus plantations. All the identified termite species were distributed across E. cloeziana, E. citriodora and E. tereticornis plantations. Macrotermes subhyalinus, Nasutitermes germinatus, Amitermes evuncifer, Microtermes sp., and Ancistrotermes sp., were present in E. camaldulensis plantation while M. bellicosus and O. obesus were absent. All the termite species encountered in this study are soil dwellers while 85.71% occurred among the leaf litters. The percentage (57.14%) of the termite species in epigeal mounds, wood litter and under the stem bark was the same. Members of the sub-family Macrotermitinae represented 71.4% of the total termite species identified while members of the sub families Termitinae and Nasutermitinae each represented 14.3%.*

**Key Words:** Occurrence, Diversity, Termite Species, *Eucalyptus*, Plantations.

### INTRODUCTION

*Eucalyptus* belongs to the family Myrtaceae. It is a large genus of aromatic trees of over 600 species indigenous to Australia and Tasmania and the neighbouring island but now grows in all tropical and subtropical areas (Adeniyi et al., 2015). *Eucalyptus* tree species are of economic, industrial and environmental importance and are widely planted in plantations throughout Africa. They are widely used for timber in building construction and joinery, plywood making, power transmission poles, pulp and paper, fencing posts, firewood, bee forage, medicine, oils for perfumes and pharmaceuticals, ornamental, provision of shade, windbreaks, and soil stabilization (Krzysik et al., 2001; Tournier et al.,

2003; Gorrini et al., 2004; Foley and Lassak, 2004; Coutts, 2005; Ogunwande et al., 2005; Langat et al., 2015).

Termites are important pests of *Eucalyptus* and have been reported to cause damage to young and old *Eucalyptus* trees (Nogueira 1987, Santos et al. 1990; Moraes et al., 2002; Valerio et al., 2004). The susceptibility of *Eucalyptus* to termite attack has also been reported in Africa (Atkinson et al., 1992; Ssemaganda et al., 2011). However, termites are also one of the most abundant macro fauna in tropical forests and contribute immensely to forests maintenance by decomposing litter and dead wood on the forest floor (Eggleton et al., 1999; Yamada et al., 2005, 2006). Ecologically, they are referred to as ecosystem engineers and play key roles in

decomposition processes, nutrient cycling, nitrogen fixation, carbon fluxes, soil aeration, distribution and inversion (Collins, 1983; Jones, 1990; Bignell *et al.*, 1997; Jouquet *et al.*, 2011).

A better understanding of the roles of termites in ecosystem processes requires information on termite diversity and could also provide useful information to identify noxious species. Despite much importance associated with *Eucalyptus* species world-wide and Africa in particular, information on termite species diversity in *Eucalyptus* plantations in Nigeria is insufficient. The objective of this study therefore, was to investigate the occurrence and distribution of termite species in different *Eucalyptus* plantations in Afaka, Nigeria.

## MATERIALS AND METHODS

### Study Site

The study area, Afaka, Kaduna State, Nigeria is located between latitude 10. 33<sup>0</sup> N – 10. 41<sup>0</sup> N and longitude 07. 26<sup>0</sup> E – 07. 28<sup>0</sup> E. The climate of Afaka is characterized by a clear distinction between dry and rainy seasons which last from late October to early April and mid-April to early October, respectively. The climate of the area has been categorized into: the warm rainy season, the cool dry season and the hot dry season (FAO 1971). The mean annual rainfall is 1266.0 mm based on annual rainfall record of forty-three years (1969 – 2012) (NIMET 2012). The general vegetation of the area is classified under the Isoberlinia Savannah or the Northern Guinea Savannah vegetation characterized by woodland consisting of different layers rather less distinct than those of the forest (Barbour *et al.* 1999).

### Termite Sampling

Sampling for termite species was carried out in four *Eucalyptus* species plantations: *Eucalyptus camaldulensis*, *Eucalyptus citriodora*, *Eucalyptus tereticornis* and *Eucalyptus cloeziana* in five different microhabitats between August, 2012 and July, 2013 using the method of Vasconcellos (2010) described below:

**Leaf litters:** Twenty 50 x 50 cm quadrats were laid out randomly on the soil surface in each of the four plantations. All dry and decaying leaves within the quadrats were collected inside polythene bags and transported to the laboratory where termites in the samples were sorted out manually.

**Nests:** A 100 X 100 m plot was mapped out in each plantation, and all termite nests (epigeal)

encountered within their borders were examined. Active termite mounds were opened and representative individuals were collected in 70% ethanol for identification.

**Soil:** Ten 20 x 20 x 30 cm monoliths (12 dm<sup>3</sup>) were dug randomly in each plantation and the soil from each monolith was collected in polythene bags and carried to the laboratory. The soil was spread out on flat surface in the laboratory and termites within them were sorted out.

**Wood litter:** Five 6 m x 5 m plots were laid out randomly in each of the plantations; and all decomposing pieces of wood in these plots with diameters greater than 1 cm were collected and taken to the laboratory. In the laboratory, the woods were dissected and all the termites present were sorted out manually.

**Stem bark:** Live *Eucalyptus* trees with termite mud tubes within three plots of 30 m x 30 m each measured along one diagonal axis in each plantation were sampled for the presence of termites. Mud tubes and stem barks were gently opened and representatives of termites' present were collected in glass vials containing 70% ethanol.

Samples of termites' species encountered in each microhabitat were preserved in specimen bottles containing 70% ethanol for identification. The termite species were identified in Entomology laboratories of National Horticultural Research Institute, Ibadan and Forestry Research Institute of Nigeria, Ibadan. Termites were classified into different feeding groups based on their habitats and food source.

## RESULTS

### Species Diversity and Distribution of Termites in *Eucalyptus* Plantations

The occurrence and distribution of termite species in five micro-habitats in *Eucalyptus* plantations is shown in Table 1. Two species from the genera *Macrotermes*: *M. subhyalinus* and *M. bellicosus* were present in all the micro-habitats sampled and were also found under their foraging galleries built on soil surface. *Odontotermes* sp. was present in the mound, leaf litter and in the soil while *Microtermes* was found in the soil, among leaf litters, wood litters and also in the stem bark. *Trinervitermes germinatus* was present both in the mound and in the soil while *Amitermes evuncifer* was detected among decaying leaf debris, in the soil, under the wood bark and mud tube built on the stem of *Eucalyptus* trees. All termite species

encountered in *Eucalyptus* plantations in this study occurred in the soil while 85.71% of all the species occurred among the leaf litters. The percentage occurrence (57.14) of species occurred in the epigeal mounds, wood litter and under the stem bark were the same (Table 1).

Table 2 showed the distribution of different species of termites among the four *Eucalyptus* plantations. With the exception of *M. bellicosus* and *Odontotermes* sp. which were absent in *E. camaldulensis* plantation, *Ancistrotermes* sp., *Microtermes* sp., *Trinervitermes* sp. *Amitermes evuncifer* were widely distributed in the four *Eucalyptus* plantations. The classification of termites' species identified in the four *Eucalyptus* plantations showed that all the termite species belong to the family Termitidae and in the sub-

families Macrotermitinae, Termitinae and Nasutitermitinae. The members of the sub-family Macrotermitinae include *M. subhyalinus*, *M. bellicosus*, *Odontotermes* sp., *Ancistrotermes* sp. and *Microtermes* sp., while *A. evuncifer* and *T. germinatus* belong to the sub-families Termitinae and Nasutitermitinae, respectively (Table 3). Members of the sub-family Macrotermitinae represented 71.4% of the total termite species identified while members of the sub families Termitinae and Nasutitermitinae each represented 14.3% (Figure1).

**Table 1.** Occurrence and diversity of termite species in different micro-habits in four

Termite species	Micro-habitats				
	Epigeal mound	Leaf litter	Soil	Wood litter	Stem bark
<i>Macrotermes subhyalinus</i>	+	+	+	+	+
<i>Macrotermes bellicosus</i>	+	+	+	+	+
<i>Odontotermes</i> sp.	+	+	+	-	-
<i>Ancistrotermes</i> sp.	-	+	+	+	-
<i>Microtermes</i> sp.	-	+	+	+	+
<i>Trinervitermes</i> sp.	+	-	+	-	-
<i>Amitermes evuncifer</i>	-	+	+	-	+
% Occurrence	57.14%	85.71%	100%	57.14%	57.14%

*Eucalyptus* plantations in Afaka, Kaduna State, Nigeria. Present (+), Absent (-)

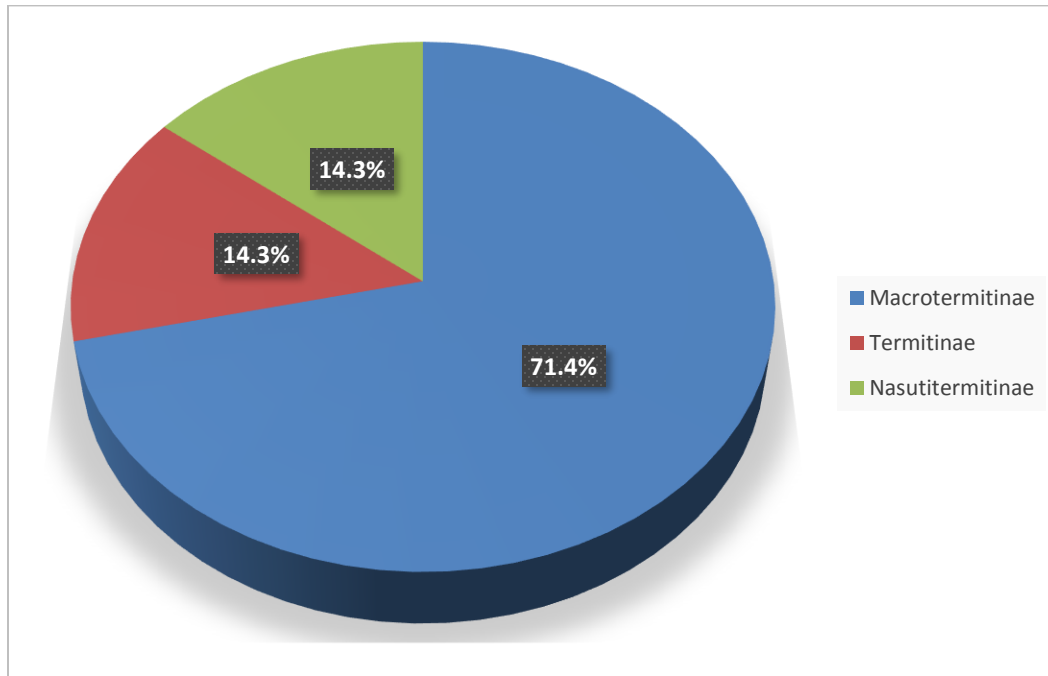
**Table 2.** Distribution of termite species in *Eucalyptus* plantations in Afaka, Kaduna State, Nigeria

Termite species	<i>Eucalyptus</i> plantations			
	<i>E. camaldulensis</i>	<i>E. citriodora</i>	<i>E. cloeziana</i>	<i>E. tereticornis</i>
<i>M. subhyalinus</i>	+	+	+	+
<i>M. bellicosus</i>	-	+	+	+
<i>Odontotermes</i> sp.	-	+	+	+
<i>Ancistrotermes</i> sp.	+	+	+	+
<i>Microtermes</i> sp.	+	+	+	+
<i>Trinervitermes germinatus</i>	+	+	+	+
<i>Amitermes evuncifer</i>	+	+	+	+

Present (+), Absent (-)

**Table 3.** Classification of termites associated with *Eucalyptus* plantations in Afaka, Kaduna,State, Nigeria

Family	Sub-family	Species
Termitidae	Macrotermitinae	<i>Macrotermes subhyalinus</i>
		<i>Macrotermes bellicosus</i>
		<i>Odontotermes</i> sp.
		<i>Ancistrotermes</i> sp.
	Termitinae	<i>Amitermes evuncifer</i>
	Nasutitermitinae	<i>Trinervitermes germinatus</i>



**Figure 1.** Frequency distribution of the three termite sub-families in *Eucalyptus* plantations in Afaka, Kaduna State, Nigeria

## DISCUSSION

Survey of termite species diversity in *Eucalyptus* plantations in Afaka, Nigeria revealed that the termite assemblage consists of only one family, Termitidae, three sub-families, Macrotermitinae, Termitinae and Nasutitermitinae and seven termite genera. The dominant species belong to the sub-family Macrotermitinae and include four genera, *Macrotermes*, *Odontotermes*, *Ancistrotermes* and *Microtermes* which were widely distributed among the four *Eucalyptus* plantations. The occurrence and the dominance of these termite species indicate that the micro-climate in the plantations favour their survival. Mugerwa *et al.*, (2011) also reported on similar termite assemblage and the dominance of species from the sub-family Macrotermitinae in the rangelands of Central Uganda as well as in *Eucalyptus* plantations in Thailand (Yamada *et al.*, 2003).

All termites observed in *Eucalyptus* plantations in this study were either epigeal or hypogeal nesting species. The percentage of epigeal nesting species was higher than the hypogeal nesting species. Termite population study in savanna woodland reserve in Tropical Australia has shown that epigeal nesting species were the most abundant

species (Dawes-Gromadzki, 2008). One of the prominent epigeal nesting species encountered from this study was from the genus *Macrotermes*. Members of this genus are known to build large epigeal mounds from where workers forage outwards for distances up to 50 m in galleries either just below or on the soil surface (Abdurahman, 1990). Reports have also shown that in Africa, *Macrotermes* species build large epigeal mounds which are prominent in many grasslands and savanna woodlands (Adekayode and Ogunkoya, 2009; Sileshi *et al.*, 2009; Abdurahman *et al.*, 2010).

Members of the genera *Microtermes*, *Ancistrotermes* and *Amitermes* do not build epigeal mounds, however, they build extensive network of underground nests and galleries. *Amitermes evuncifer* may build small above-surface mounds but not as conspicuous as *Macrotermes* and *Odontotermes* species. Hypogeal nest builders reach their food and water sources by moving through the soil, and many times to great depth, to reach the water table. It has been reported that subterranean termites utilize a variety of food sources simultaneously (FAO and UNEP, 2000). This is clearly evident in this study as species of *Microtermes* and *Ancistrotermes* were discovered

among leaf litters, wood litters and in the soil. Members of the sub-family Macrotermitinae are described as generalist feeders and can feed on various food sources such as grass, wood, litter and dung (Donovan *et al.*, 2001; Mugerwa *et al.*, 2011). The destruction of such food source and habitat in newly established *Eucalyptus* plantations may be used as a means of reducing termite population. However, their activities on the leaf and wood litters could enhance the decomposition of these plant materials to improve soil fertility. *Macrotermes* spp. have been known to take soil from adjacent soils to build their epigeal mounds. It has been reported that members of the sub-family Macrotermitinae collect up to 60% of the grass, woody material, and annual

leaf fall to construct the fungus gardens in their nests (Lepage *et al.*, 1993).

## CONCLUSION

The information on the local termite species diversity, their habitat and their feeding habits as revealed in this study has created an awareness of their presence in the study area. The study has also generated useful information that is critical in taking the right decision in effective termite management programme.

## RECOMMENDATION

Further study is required to determine the most abundant of the termite species and their effects on *Eucalyptus* plantation establishment in Nigeria.

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