ACTIVITY OF MOUND-BUILDING *MACROTERMES BELLOCOSUS* (ISOPTERA: TERMITIDAE) AROUND KWARA STATE UNIVERSITY CAMPUS GUINEA SAVANNAH ECOZONE, NIGERIA

1AJAO, Adeyemi Mufutau, 2OLADIMEJI, Yusuf Usman, 1OLADIPO, Segun Olayinka and 1ADEPOJU, Suraju Adeshina

1Department of Bioscience and Biotechnology, Kwara State University, Malete, Kwara State, Nigeria. 
2Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, PMB 1044, Zaria, Kaduna State, Nigeria.

Corresponding Author: Ajao, A. M. Department of Bioscience and Biotechnology, Kwara State University, Malete, Kwara State, Nigeria. Email: adeyemi.ajao@kwasu.edu.ng Phone: +234 8035058904

**ABSTRACT**

This study was designed to investigate *Macrotermes bellicosus*, nesting mounds, abundance and activity in the savannah ecological zone of Kwara State, North-Central, Nigeria. The research was conducted at four randomly selected villages around and including Kwara State University. A systematic survey of visible mounds of *M. bellicosus* was carried out over the entire study area. Also, the heights of mounds were measured using a measuring tape. *M. bellicosus* collection was conducted using baited traps consisting of cardboard, toilet tissue, wooden stakes and wood shaving. These were embedded or placed on ground within plots at a regular distance of 10 m and checked twice weekly. The samples collected per baited trap per plot per location were preserved in 90% ethanol and identified. Similarly, survey of physically damaged items was conducted and recorded to observe termite activity. The result from the four different locations of the study showed that the number of *M. bellicosus* mounds in urban area was the highest in urban site (74.33 ± 5.93) and was significant when compared to the other locations. Farmland had the tallest *M. bellicosus* mound (17.3 cm) followed by uncultivated land mass (15 cm), while the least mean height (12 cm) was encountered at the urban area. The abundance and distribution of the *M. bellicosus* showed no significant difference when comparing the study locations except in urban site. Proper precautions on protection of the building and barns are recommended.

**Keywords:** *Macrotermes bellicosus*, Nesting mounds, Importance, Savannah ecological zone, Damage

**INTRODUCTION**

*Macrotermes bellicosus* is a species of *Macrotermes*, which is the largest termite known. The queen measures about 110 mm long, workers about 3.6 mm and soldiers between 18 – 19 mm for the major soldier, as there is sexual dimorphism for both workers and soldiers. About 2000 species are distributed in tropical countries. Termites are predominantly tropical in distribution and are at the ecological center of many tropical ecosystems (Backwell and d’Errico, 2001). Most species are abundant and diverse in many tropical soils, and particularly in forests (Eggleton, 2000). They are major agents of decomposition, and play an important part in nutrient and carbon fixation (Bignell, 2006). The recycling of soils organic matter, improve soil physical and chemical properties and improve water-absorbing capacity (Eggleton, 2001; Korb and Linsenmair, 2001). Termites are a source of vegetation and...
tree diversity. Their sensitivity to habitat disturbance causes changes in their species richness, composition and functional characteristics (Aanen et al., 2002; Binate et al., 2008; Engel et al., 2011).

The forests of West Africa have been reported to have the highest termite species richness (Donovan et al., 2000; Eggleton, 2000). For example, in the forests of southern Cameroon, termites are one of the most common of all arthropod groups (Tilahun et al., 2012). In cultivated systems derived from woodland and savanna in West Africa, Macrotermes is an abundant pest. In the wet season, Macrotermes were usually concentrated in the upper 25 cm, whereas the proportion of the population below 50 cm greatly increased in the dry season as they moved deeper in the soil (Gessner and Leuthold, 2001).

In Nigerian riparian forest, report have shown that most termites were in the top 25 cm of the soil profile and had no significant difference in abundance across seasons (Sileshi et al., 2010). In drier or more seasonal habitats, vertical distribution varies with species, soil type and season. This effect was probably less pronounced in tropical forests where the canopy limits fluctuations in soil temperature. Movement of termites may also be linked to rainfall events. In a seasonal humid forest in Cameroon, Korb (2003) found that both species richness and abundance in 10 cm deep soil samples were generally higher in dry periods compared with wet periods. Termite activity, such as mound building, subterranean tunneling and soil feeding, improves soil structure and quality. They feed on dead plant material, while relatively few species feed on living plant tissue (Lesnik, 2014).

Many studies have focused on mounds because they are relatively easy to locate and they can be dominant feature of the landscape, particularly in savanna (Abe et al., 2009b). Very large intra-specific variations in mound density across seemingly homogenous savanna systems are often observed, like for Macrotermes bellicosus in central Africa (Lys and Leuthold, 1991).

Approximately 2,650 species of termites have been described to date, and less than 3 % of these cause significant economic damage to buildings or related manmade structures. Similar proportions are serious pests of crops. The termite fauna of urban environments is usually highly depauperate and characterized by wood-feeding species, unlike natural habitats that often support much greater species and functional diversity. The influence of termites’ on ecosystem processes at any site depends on the species composition and abundance of the local termite assemblage (Eggleton, 2000; Obi and Ogunkunle, 2009). However, studies on termite species, nesting mounds, abundance and their activity are scanty for the savannah ecological zone of Nigeria particularly around Kwara State University campus Guinea savannah, Kwara State, North-Central, Nigeria. This research was therefore designed to fill this gap in knowledge.

**MATERIALS AND METHODS**

**Study Area:** The study was conducted at the Kwara State University (KWASU) Malete and its environs. Malete in Moro Local Government Area is situated within Longitude 8°42'0" N and Latitude 4°28'0" E (Figure 1) (Ajao, 2017). The State is located in the tropical zone of North-Central Nigeria with a land area of 36,825 square kilometers and a population of 2,591,555 (KWADP, 2008). The area experiences two seasons, tropical wet and dry climate. The dry season is from October to March and the wet season is from March to September. Kwara State has an annual rainfall range of 1000 mm to 1500 mm.
Mound-building *Macrotermes bellicosus* in Kwara State University campus

Temperature is uniformly high and ranges between 25 °C and 30 °C in the wet season throughout the season except in July – August when the cloud of the sky prevents direct heatstroke while in the dry season; it ranges between 33 °C to 34 °C. The annual temperature ranges from 22.8 °C to 34.9 °C and the rainfall is about 107.3 mm per month.

**Research Design and Sampling Techniques:** The experimental design was an ecological survey carried out in four locations; KWASU campus Malete (urban), Jenkunu (uncultivated area), Apodu (forested) and Sunkuso (farmland). Three sampling points were taken and was carried out randomly in each of the localities including Kwara State University campus. These locations were grouped based on nature of vegetation and human activity.

**Survey of Macrotermes bellicosus Mounds in the Sampled Plots:** A systematic survey of visible mounds and arboreal nests of *M. bellicosus* was carried out over the entire study area. A transect survey was done on foot in each of the selected sample plots to identify the mounds of *M. bellicosus* in each of the study area. Mounds within the sampled plots were counted, measured with a measuring tape and recorded between months of April to October 2016 and November 2016 to April 2017.

**Sample Collection and Identification:** *M. bellicosus* collection was conducted using baited traps consisting of cardboard, toilet tissue, wooden stakes and wood savings. Each was embedded or placed on ground within plots at a regular distance of 10 m. Traps were checked twice weekly for the next six weeks. The termites collected per baited trap per plot per location were preserved in preserved in 90% ethanol, in vials, sorted, counted and identified. Identification of the collected samples was done with the aid of a hand lens and a dissecting microscope based on the morphology of the soldier caste. Features of importance include: colour, appearance, shape of mandibles, shape of head capsule, number of abdominal segments, type of mandible and presence of teeth on mandibles based on established keys (Ahmad, 1950; Chhotani, 1997; Engel *et al.*, 2007; Lawal and Banjo, 2007). Similarly, survey of *M. bellicosus* activity was conducted and recorded on physically damaged or currently fed upon items as evidenced by mud tunnel, half consumed and trees with observable outer and underground termite activity.

**Data Analysis:** Data analyses were carried out using the Statistical Package for Social Sciences (SPSS) version 20.0. Descriptive statistics (frequencies and percentages) was used to summarize the occurrence of *M. bellicosus* in study areas. Analysis of variance was used to compare the occurrence of *M. bellicosus* in different site location.

**RESULTS**

The result from the four different locations in the study showed that the number of *M. bellicosus* mounds in urban area was the highest and was significant when compare to the other locations. Farmland had the tallest *M. bellicosus* mound (17.3 cm) with 43.33 ± 4.40 termites, followed by uncultivated land mass (15 cm) with 45.00 ± 2.89 termites, while the least mean height (12 cm) with 74.33 ± 5.93 termites was encountered at the urban area (Table 1, Figure 2). Different superscripts along the same column are significant (p<0.05).

The abundance and occurrence of the *M. bellicosus* showed no significant difference when compared by studied locations (Figures 2 and 3 a, b and c), although abundance of *M. bellicosus* in urban site (74.33 ± 5.93) was
higher than that of other studied sites (Table 1, Figure 3c). This gave an indication that more damage was done by *M. bellicosus* in the developed areas than in the farmland area. However, the tallest mounds (17.3 cm) was encountered in the farmland followed by uncultivated area with 15 cm, while the least mean height was encountered at urban area (12 cm).

### Table 1: Abundance and height of mounds of *Macrotermes bellicosus* around Kwara State University Campus, Nigeria

<table>
<thead>
<tr>
<th>Sites</th>
<th>Nature of mound</th>
<th>Height of mound (cm)</th>
<th>Abundance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site A</td>
<td>Farmland</td>
<td>17.3</td>
<td>43.33 ± 4.40*</td>
</tr>
<tr>
<td>Site B</td>
<td>Urban area</td>
<td>12.0</td>
<td>74.33 ± 5.93*</td>
</tr>
<tr>
<td>Site C</td>
<td>Forested area</td>
<td>13.0</td>
<td>39.00 ± 2.65*</td>
</tr>
<tr>
<td>Site D</td>
<td>Uncultivated area</td>
<td>15.0</td>
<td>45.00 ± 2.89*</td>
</tr>
</tbody>
</table>

**Figure 2: Percentage occurrence of *Macrotermes bellicosus* mounds around Kwara State University Campus, Nigeria**

Table 2, Figure 3 d and e presents the prevalence of *M. bellicosus* through bait collection. Out of 17,699 termites collected, 5,524 was recorded from cardboard, 4,547 from toilet tissue, 3,834 from wooden stakes while 3,794 the least was recorded from wood savings (Table 3). 4,741 *M. bellicosus* was recorded from the four bait types for urban area, followed by the uncultivated area (4,588), 4,240 from forested area, while 4,110 was recovered from the farmland respectively. Table 4, Figure 3 f and g presents *M. bellicosus* feeding and damaging activities in the studied locations.

**DISCUSSION**

The soil that is available in a particular locality has an effect on the type, shape, size and height of the mound. Termites of the genus *Macrotermes* and other family of *Macrotermitidae*, as found in the study area use only the subsoil in their mound building operations. The physical properties of the soil and the climate are especially important in relation to mound building.
Hinze et al. (2002) similarly observed that under similar climatic condition, areas where the subsoil has high clay content will have *M. bellicosus* mounds tall and steep-like than areas where the subsoil is sandy. When a mound-building termite, such as *M. bellicosus* occurs over a wide range of soil types and climatic conditions, many styles of superficial architecture result. These are modifications of a pattern of building acted upon by local conditions and do not necessarily indicate any fundamental change in behavior and activity.

*M. bellicosus* play an important role in the ecosystem balance and certainly improve the fertility of soil (Abe et al., 2006). Termite activity, such as tunneling, soil feeding and mound building, helps to maintain macro pore structure, redistributes organic matter and improves soil stability and quality (Obi and Ogunkunle, 2009).

The influence of termites’ on ecosystem processes may depend on the species abundance of the local termite assemblage and certain extensive damage to woodworks in buildings, agricultural crops and other wooden materials have been reported (Yamada et al., 2005).

The present study revealed that *M. bellicosus* at the studied locations causes damage to trees, wooden structures, wooden buildings, wooden furnishings and items made of paper (Yamada et al., 2005; Ekpo and Onigbinde, 2007). In addition, they have a wide range of dietary, foraging and nesting habits, with many species showing a high degree of resource specialization. The vast majority of species feed on dead plant material, while relatively few species feed on living plant tissue (Lesnik, 2014).
Baits attract foraging termites, and it helps to give estimates of relative intensity of foraging activity rather than relative population density. Baiting has been useful in studying inter- and intra-specific foraging activity (Donovan, 2000), size of foraging territory (Lobry de Bruyn and Conacher, 1990) and rates of food consumption (Abe et al., 2009b). Likewise, it has also been used to estimate local species richness (Wood et al., 1982). However, this can be problematic because not all species are attracted to bait. Arboreal species that do not forage on the ground, and other species that do not forage close to the soil surface, may be excluded during the sampling. Food preference trials have also shown that not all termite species are attracted to the same bait materials (Engel and Delclos, 2010), implying that using a single bait type will under-sample the local species richness. The current work has shown different baiting method in estimating the abundance of the termite present in different locations.

The abundance showed that termites infest the university environment. This in contrast to the work that maintains that the termite fauna of urban environments is usually highly depauperate and characterized by wood-feeding species, unlike natural habitats that often support much greater species and functional diversity the more (Eggleton, 2000). Therefore, proper precautions need to be taken to ensure the protection of the building in the university community. The damage done to the farm product giving a need for proper harvesting and processing of farm output to ensure adequate availability of food to the community.

**Conclusion:** The result revealed that *M. bellicosus* mounds in urban area was the highest and was significant when compare to the other locations. The abundance of *M. bellicosus* in urban site was higher than that of other study sites which was an indication that more damages can be done by *M. bellicosus* in the developed areas than the farmland area. The abundance shows that the university environment is highly prone to termite’s infestation and proper precautions needs to be taken to ensure the protection of the building in the school community.

**ACKNOWLEDGEMENTS**

We thank the Head of villages and the farmers for their assistance and cooperation during the sampling periods.

**REFERENCES**


Environmental Biology, Kwara State University, Malete, Kwara State, Nigeria.


