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Survey on indoor termites of Toru-Orua: a University community in Bayelsa State, Southern Nigeria

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Abstract

Termites are dreaded insect pests that destroy homes and dwellings; eating up wooden and structural supports and thus ultimately depleting people’s sources of livelihood and even national economies. Thirty three (33) encounters with indoor (domestic) termite infestations were made during this survey, principally with *Macrotermes* Holmgreen, *Nasutitermes* Dudley, and *Dicuspiditermes* Krishna species. The relative abundance and prevalence ranking were 85%, 9.1% and 6.1% respectively for the different species. Trails and mud-tubes (indicators of termite presence) as well as the actual damage symptoms (physical evidence of termite damages) were recorded in huts, stalls, homes of the natives, and even in the University buildings and staff offices. Different surfaces (wooden and even concrete), as well as frames of doors and windows, all played host to termite symptoms and attacks. Correct identification of pest species and knowledge of their distributions are known prerequisites for their effective control. This survey therefore aimed at identifying the indoor termites, and their distributions and damage impacts in this University community. The results of this research would be vital for future projects, and shall also, unarguably serve as a useful guide when planning for strategic and environmentally safe, cheap and sustainable control options against termites in Bayelsa State, Nigeria.
Keywords: Indoor termites, infestations, species composition, relative abundance, prevalence ranking, damage impacts.

Introduction

Termites serve vital roles in tropical and subtropical ecosystems; they for instance, facilitate organic matter decomposition, nutrient availability, nutrient cycling and distribution, improvement of soil composition and fertility, amongst several others (Anantharaju *et al*., 2014, Wekhe *et al*., 2019), and are also food sources to other animals (Anantharaju *et al*., 2014). However, in spite of these remarkable benefits, termites are also known globally as noxious pests that cause severe devastations to various structures or materials such as wooden components of buildings and household furniture (Borror *et al*., 1989; Pedigo and Rice, 2009; Wekhe *et al*., 2019); electrical cables (Helmiyetti *et al.*, 2020; Azam *et al.*, 2015); books and fabrics (Borror *et al*., 1989;, agricultural crops (Amatobi, 2007; Ogbedeh *et al.*, 2019; Ahmad *et al*., 2021). Termite damages can be very catastrophic and often result in monumental financial losses to both man and the society at large.

Homes, or dwellings and general infrastructure may suffer severe losses from termites if undetected on time; although Davies (1988) claimed these structures may suffer total collapse if the termite activities go unchecked. Several millions of Naira are spent annually in Nigeria as a result of termite activities (Ibrahim and Adebote, 2012). Su (2002) puts the global economic impact of termites at $22 billion annually – a figure that keeps rising due to increasing economic losses from termites. The current estimate is over $40 billion annually worldwide (Ahmad *et al.*, 2021, Rust and Su, 2012).

Control efforts against termites have mainly focused on use of organochlorines such as aldrin, dieldrin, lindane etc., (Ogbedeh *et al* 2020) but environmental concerns have led to much public outcry, and a consequential search for newer, cheaper and less harmful products. Laboratory and field experiments/trials with bio-pesticides are currently on, and seem to show some promise. Investigations on the repellency and toxicity of the neem plant (*Azadirachta indica* A Juss.) as well as municipal waste extracts in Owerri, Southeast Nigeria, have revealed some considerable promise in the control of termites (Ogbedeh *et al*., 2020). These efforts are however preliminary. Integrated termite management (ITM) which combines cultural, biological, botanical and chemical strategies, however appears the best way forward currently, in tackling the termite problem; though it also has to overcome the cryptic nature of termites - always hiding in galleries and mounds and hence being hardly accessible (Ahmad *et al*., 2021)

As laudable or promising as research findings and strategies may appear, it must be noted that the first steps in developing environmentally safe and sustainable integrated pest management projects for pests, commence with a proper identification of the pest species, and knowledge of their distributions within an area (Wang *et al*., 2009; Ugbomeh *et al.*, 2019) . This study was therefore aimed at identifying and determining the species composition, prevalence ranking and damage impacts of indoor termites within this university community at Toru-Orua. It is the first of its kind in Toru-Orua and in Bayelsa State (or Southern Nigeria) as a whole. The results of this survey would form an essential baseline for future works on termites, and for the development of environmentally safe, sound and sustainable IPM for these pests in this area.

Materials and Methods

Brief description of the survey/study area

The University of Africa Toru-Orua is situated in Bayelsa State, in the Niger Delta terrain of Southern Nigeria. It lies within latitudes 5.0981^{o}N and longitudes 6.0664^{o}E and has a rainforest vegetation with dual rainfall cycle yearly from March to July and September to October, with a brief dry spell in August, and a dry season from November to February. The general monthly temperature range between 25 ^{o}C and 28^{o}C.

Several infrastructures such as administrative and classroom blocks, staff offices and quarters, student hostels etc. are present inside the campus. Many farms of the natives also occupy extensive portions of this university land. Land preparation activities (involving land/bush clearing and burning) by farmers alongside government and communal developmental projects such as housing and road construction works) are a common feature in this University community.

Surveys on Indoor Termites

Painstaking surveys were carried out on doors, window-frames, roof-members and domestic furniture in staff houses, offices, students' hostels, village huts and sheds etc., within and around the immediate surrounding of the university community in Toru-Orua for presence of termites. Special notes were made on any observed termite trails, tracks, nests etc., and also of the sites or locations where they were found. All termite symptoms and damage impacts were additionally captured in photographs, along with the causative termite species. The survey was for barely 8 weeks (February – March 2022), during which a total of 95 structures/properties were examined. Much more would have been covered if time had not been a constraint.

Collection of Termite Specimens and Identification

A kitchen knife was used to scrap observed termite trails, tracks or nests at each site/location and emptied into perforated plastic Petri-dishes and glass vials with the aid of camel brush/a pair of forceps. Collected specimens were immediately moved to the laboratory for identification, after careful labeling of dishes and vials with survey dates and the site/location details.

In the laboratory, the collected samples were scrutinized by closely examining termite mandibles, pronotum and postmentum areas under the stereomicroscope (Model MICS-ST 30LL) and then compared with illustrations provided by Ahmad (1965) and Scheffrahn & Su (1994) for correct identification. Similar procedures were adopted by previous researchers (Anantharaju *et al*.; 2014, Ugbomeh *et al*., 2019; Wekhe *et al*., 2019). Identifications were made to generic level only based on observed external morphological characteristics. It could not be progressed to species level due to absence of a termite inventory for comparison of specimens as well as lack of molecular biology techniques for confirmatory tests.

Results

Indoor Termites

Thirty-three encounters with indoor termite infestations were made during this survey that lasted for 8 weeks in February and March 2022 as they presented as trails, mud-tubes, nests etc., or actual damages at different sites/locations within and around the immediate surroundings of the University community. The details are summarized in Table 1 below. It must be stated here that only results of 8 locations are presented here (Table 1), and also captured in photographs (Plate 1). Results from other locations were too scanty, and as a result are not presented.

Table1. The distribution of the Indoor Termites within and around the University community.

Species Composition	**Locations**									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**Total**	**Percent (%) Distribution**	**Areas covered**
Macrotermes spp	14	5	5	2	2	0	0	28	85	5 areas
Nasutitermes spp	0	0	0	0	0	2	1	3	9.1	2 areas
Dicuspiditermes spp	0	0	0	0	0	0	2	2	6.1	1 area only
Total no (N)	**14**	**5**	**5**	**2**	**2**	**2**	**3**	**33**		

A - Trails in some offices at College of Health Sciences (CHS)**;** B - Trails in some offices at Fac. of Arts & Education (FAED); C - Trails in some offices, Fac of Basic & Appl. Sciences (FBAS) ; D - Trails on walls along staircase of FBAS Laboratories; E - Trails on wooden pillar at Com Civic Centre**;** F - Nest on roof members of stall near local church**;** G - Damage on Plank house near Community Transformer

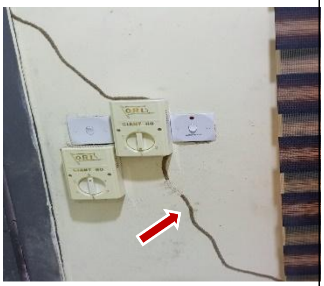
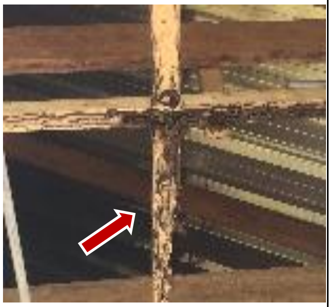
No.	Sites/Locations	Evidence/Symptoms of Attack	Photo of Specimen	Genera
1.	**College of Health Sciences** (Termite trails on concrete walls)			*Macrotermes*
2.	**College of Health Sciences office wall** (Termite trails on concrete walls & window frames)			*Macrotermes*
3.	**Faculty of Basic and Applied Sciences (Annexe/Extension)** (Damages on roof members)		**d** 	*Macrotermes*
4.	**Faculty of Basic and Applied Sciences (FBAS) Laboratories** (Termites trails on concrete wall)			*Macrotermes*

Plate 1. Evidences and symptoms of Termite attacks on structures at different Sites/Locations within and around the University community and the causative termite species.

Site No.	Sites/Locations	Evidence/Symptoms of Attack	Photo of species	Genera
5.	**Community Civic Centre** (Termite trail on a wooden pillar)			*Macrotermes*
6.	**Faculty of Arts & Education (FAED) Office** (Termite trails on concrete walls and windows frame)			*Macrotermes*
7.	**Community Centre near Winners Chapel** (Termite nests on roof members of an abandoned wooden stall)			*Nasutitermes*
8.	**Plank House Near Community Power Transformer** (Termite damages on the plank house)			*Dicuspiditermes*
9.	**College of Health Sciences** (Lecture-room door and door frames completely destroyed by termites) **[See close-up photos in Plate 2]**			*Macrotermes*

Plate 1. Continued.

A B C

Plate 2A, B and C. IndoorTermite Damges to doors & door frames at CHS from *Macrotermes* attacks.

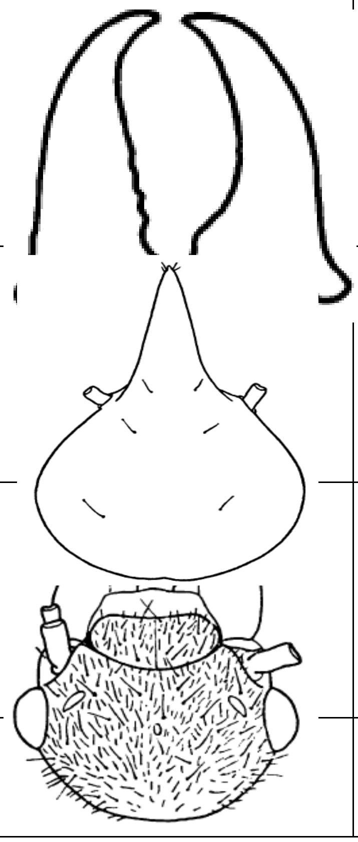
	Labrum with hyaline tip; mesonotum and metanotum greatly expanded laterally *Macrotermes* Holmgren Mandibles stout, thick at bases, tips incurved … … *Macrotermes gilvus* (Hagen) (suspected)
	Antennal articles short; apical projection of mandible without tooth … … … ***Nasutitermes*** Dudley
	Right mandible with second marginal tooth distinct; angle between apical tooth and first marginal tooth in both mandibles comparatively narrow, head covered with bristles and a mat of short hairs … … ***Dicuspiditermes*** Krishna

Fig. 1. Illustrations and brief descriptions of identified indoor termites (Courtesy of Ahmad, M., 1965)

Data Summary on Indoor Termites

Table 1 gives a summary of the different locations where the indoor termites were found plus their respective percent distributions; while Fig. 2 presents details of the termites species composition, relative abundance and their prevalence rankings within and around the university community.

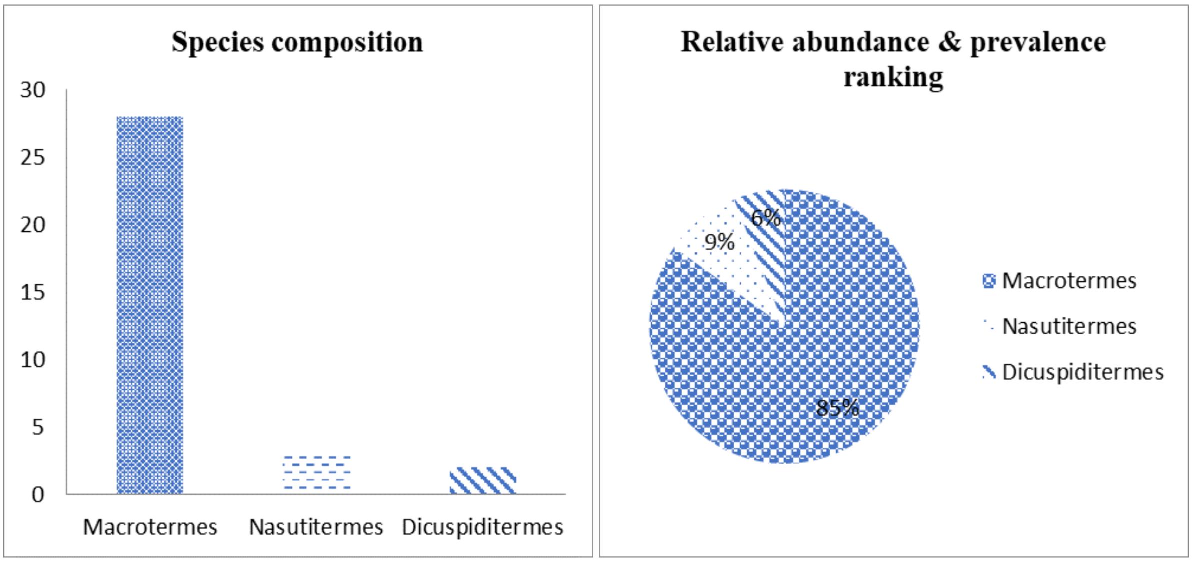


Fig. 2: The indoor termites' species composition, relative abundance and prevalence ranking at Toru-Orua.

Macrotermes spp was the most prevalent within and around the University community. It was found at 5 different sites/locations (College of Health Sciences, Faculty of Arts & Education, Faculty of Basic & Applied Sciences (FBAS) and FBAS laboratory area); followed by *Nasutitermes* (2 sites i.e. an abandoned wooden stall beside the Community Church, and a plank house beside the Community Power Transformer); and *Dicuspiditermes* spp (1 site only, i.e. a plank house near the Community Power transformer area) respectively. (see details in Table 1 and Plate 1 above).

Table 2. Relative Abundance and Diversity Index of Indoor Termites in Toru-Orua

Species Composition	**N**	**n/N**	**$\sum(n/N\}^2$**	**Simpson's Index [1 - $\sum(n/N\}^2$]**
Macrotermes spp	28	0.848	0.719	
Nasutitermes spp	3	0.091	0.008	
Discupiditermes spp	2	0.061	0.004	
Total No (N)	**33**		**0.731**	**1 – 0.731 = 0.269**

NB: Simpson's index ranges between 0 and 1. Values close to 0 imply low diversity, while values close to 1 indicate high diversity (Jones et al., 2014)

Discussion

The surveys on indoor termites in this University community, has revealed three (3) main species: *Macrotermes* Holmgren, *Nasuditermes* Dudley and *Dicuspiditermies* Krishna as being predominant with a relative abundance and prevalence ranking of 85%, 9.1% and 6.1% respectively. Previous works by Kemabonta and Balogun (2014) and Wekhe *et al*. (2019) placed *Macrotermes* as being the second most important/abundant termite species in Lagos and Port Harcourt respectively (i.e. both in southern Nigeria). These are all in agreement with this study, though not in exact proportions in terms of prevalence rankings - it must be noted that termite species are known to vary from locality to locality (Wekhe *et al.*, 2019).

The predominant species in this survey, *Macrotermes* is a well-known wood and litter feeder (Wekhe *et al*. 2019; Amatobi, 2007); a finding that is also consistent with Wekhe's report that the pest is mainly restricted to residential areas (Wekhe *et al*., 2019). The second indoor termite, *Nasutitermes spp* had also been previously reported by Ogedegbe and Eloka (2014) and Ugbomeh *et al*. (2019) as being arboreal termites. In this study, it was found to be associated with a wooden stall (clearly a transference from the field to the house). The third termite species, *Dicuspiditermes* was a rather rare species because it was found only at one location during the study, hence, not surprising, that it has yet to be reported in habitable locations. It is a first report in this study area.

The Simpson's index on the species diversity of the indoor termites in the locations sampled (0.269) indicates a low abundance and distribution. Several factors may be attributable to this observation namely the increased developmental activities in this study area, intensified farming activities and incidences of bush burning and most recently rising flood cases; each of which could adversely affect termite populations and spread. It must also be stated that the limited time frame for this survey affected sampling efforts and hence the low termite's diversity in this area.

The findings of this study reveal the true picture of indoor termites' species composition, relative abundance and prevalence ranking in Toru Orua. It has also made available a vital baseline data that would be useful when considering novel termite control options for Toru-Orua or the Niger Delta areas of Southern Nigeria.

Recommendations

- There is a need to use termite-resistant wood materials in construction of buildings, particularly the high-profile infrastructures as Universities, Government establishments etc., to guarantee safety and durability; and to also prevent embarrassing situations which termite attacks and damages could cause to people, organizations or governments. Davies (1988) reported that certain trees e.g. teak (*Tectona grandis*), mahogany (*Swietenia mahagonia*), iroko (*Chlorophora tinctoria*) and some cedars (*Cedrela toona*) are amongst such trees. Ugbomeh *et al's* (2019) work similarly found the Guava tree (*Psidium guavana*) and Coconut tree (*Cocos nucifera*) to be termite-resistant trees
- There is also a need to treat wooden materials with appropriate termiticides before use in building constructions, to prevent unsolicited and unwarranted termite attacks.

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