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Arboreal Crop Tree Termites in the Komkom Community Oyigbo Local Government Area in Port Harcourt, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Termites cause major economic losses by destroying agricultural crop trees. This study aims to survey the arboreal crop tree termites in Komkom community of Oyigbo in the Niger Delta. The study area was divided into 10 zones and 306 trees were examined for the presence of termite nests, hollow sounds and mud tubes. Samples of termites with its nest, hollow, mud tube and tree cuttings were collected from infested trees using metal spatula, sorted and identified. Approximately 9.5% of the sampled trees had some termite presence as arboreal nests, hollowness or mud tubes. The trees most affected were *Gmelina arborea* (Gmelina)*, Dacryodes edulis* (Native pear)*, Persea americana* (Avocado)*, Citrus sinensis* (Orange)*, Chrysophyllum albidum* (African star apple), *Cocos nucifera* (Coconut)*,* and *Mangifera indica* (Mango). The termites identified were *Odontotermes oblongatus, Microcerotermes annandalei, Microtermes sp (new), Microcerotermes paracelebensis, Neotermes* spp, *Glyptotermes kachongensis and Microcerotermes crassus.* Eight crop trees - *Anacardium occidentale* (Cashew)*, Moringa oleifera* (Moringa), *Annona muricata* (Soursop), *Theobroma cacao* (Cocoa)*, Psidium guajava* (Guava), I*rvingia gabonensis* (Bush mango), *Syzygium samarangense* (Java apple), and *Elaeis guineensis* (Oil Palm) had no termite infestation in the study area. The result obtained in this study indicates the termite species that are pests of crop trees in the area.

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1. INTRODUCTION

Termites belong to the insect Order Isoptera, made up of about 2500 species and are social insects living in colonies. Both winged and wingless individuals occur in a colony [1]. They are eurytopic and distributed throughout the temperate, tropical and subtropical regions of the world, with the highest diversity found in tropical forests [2]. Termite's colonies have different individuals called castes in their nests [3]. They are a prime example of insects that display decentralised self-organised system, swarm intelligence and co-operation among colony members to exploit food source and environment that could not be available to any single insect acting alone [4]. A typical colony contains eggs, nymphs, workers, soldiers or reproductive individuals (alates) and the workers toil long hours tending to the queen, building the nest, or gathering food [3]. Termites are essential members of the soil ecosystem and are found throughout the world [5]. They feed on decomposing organic wastes of leaves, trees, animal dung, and living or dead wood [6]. Termites cause major economic losses by destroying agricultural crops, live trees, and wooden structures in the houses [7,8]. They also feed on and often destroy various other structures or materials that people use e.g., wooden portions of buildings, furniture, books, wooden utility poles, wooden fence posts, many fabrics, and other useful materials [9]. Termites are one of the most damaging pests in the tropics and cause considerable problems in housing, agriculture and forestry [5]. Some have their nests underground, others in wood, for example, some termites hollow out trees while some build mounds and mud tubes. Species of *Microtermes* and *Odontotermes* have been found to damage different crops [10,11]. This damage may also extend to household furniture, paper products, many synthetic materials and food substances. Each year hundreds of thousands of structures such as wooden bridges, dams, decks, homes, retaining walls, roads, wooden utility poles, and underground tubes for cables and pipes require treatment against termites [12]. The number of species causing damage to building is between 70 to 80, out of which 50 species are serious pests that require management [7,13]. More than 1,000 of the 2,600 recognized species of termites are found in Africa [12]. Many of the economically important wood feeding species of termites found in the tropics, sub-tropics and temperate regions are in the genera *Coptotermes, Odontotermes, Macrotermes, Microcerotermes, Microtermes, Reticulitermes Ancistrotermes, Schedorhinotermes* and *Pseudacanthotermes* [14,15]. Trees are sources of food and shelter to both termite and humans. Effects of termites on trees are severe including degradation of timber, reduced or complete loss of economic yield from fruit trees like mangoes, oranges etc. Termites can equally lead to loss of roots, bark, leaves and flowers of medicinal plants like *Azadirachta indica* (Indian lilac - Dogonyaro) and could in severe cases lead to mortality of trees. However, termites have beneficial values such as organic matter recycling, improving soil fertility and serving as food sources for other animals [12, Changlu *et al*., 2009). Noting the benefits and severe economic losses associated with termites, it is therefore, necessary to do a survey of arboreal crop termite infestations in the Komkom community of Oyigbo, Rivers State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Area

The study area was the Komkom community (Fig. 1) in Oyigbo Local Government Area of Rivers State. Niger Delta, Nigeria, made up of residential areas, agricultural establishments, institutions, markets and other corporate organizations. There were an assortment of trees such as *Dacryodes indica, Cocos nucifera, Pterocarpus mildraedii, Moringa oleifera, Psidium guajava, Persea americana, Citrus sinensis, Annona muricata, Elaeis guineensis, Gmelina arborea* and others in the area.

2.2 Collection of Sample

Samples were collected monthly from March to July 2019. Samples of termites were collected by cutting open and collecting termites from mud tubes, nests and live trees with hollow sounds using metal spatula and placed in plastic containers.

2.3 Identification of Termite Species

Termite specimens collected from different infested trees were examined under a dissecting microscope and identified using a manual by Muzaffer [16] to a genus level based on the

termite morphology such as head structure, segments of the thorax, shape and serrations of the mandible (Fig 2), antenna and wing venation pattern. The absence of an inventory of termites found in Nigeria and the difficulty in identification using only morphological characters limited the identification to species for some.

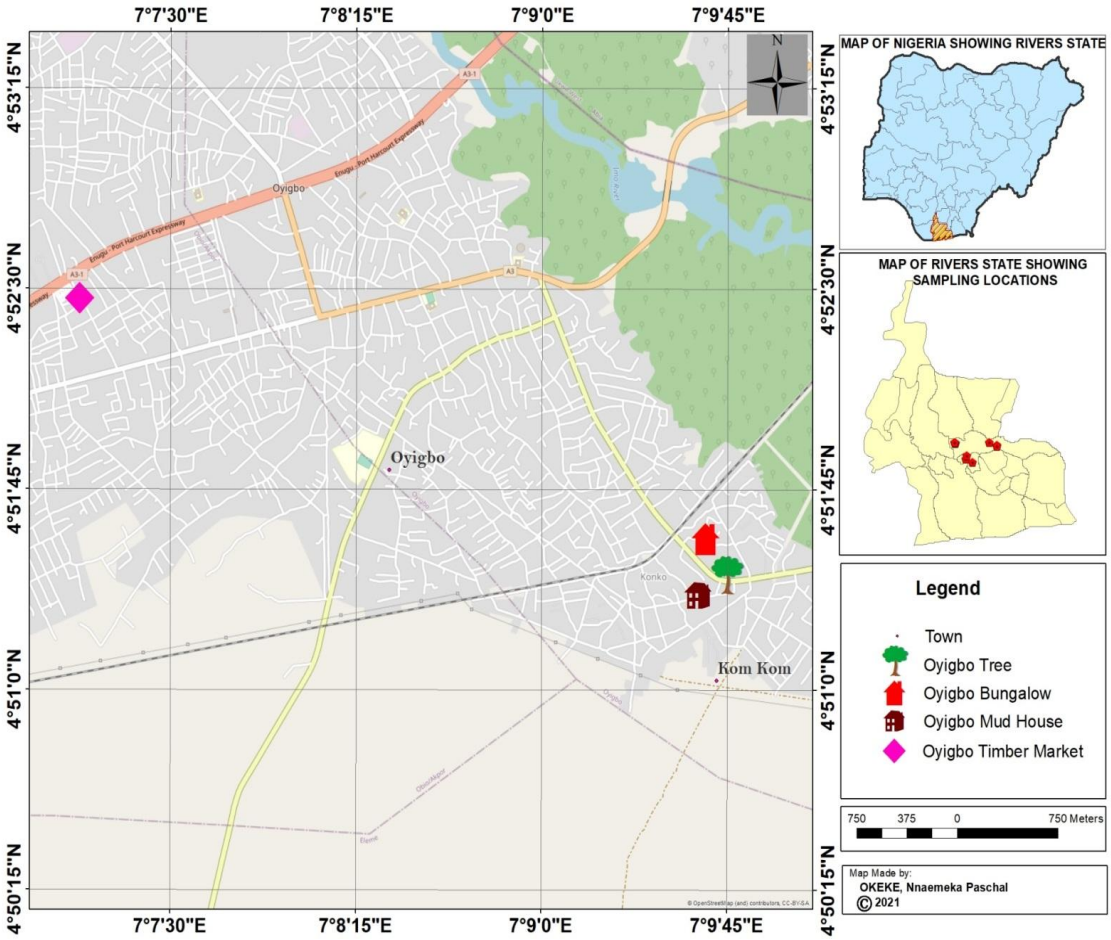

Fig. 1. Map of Rivers State showing sampling location

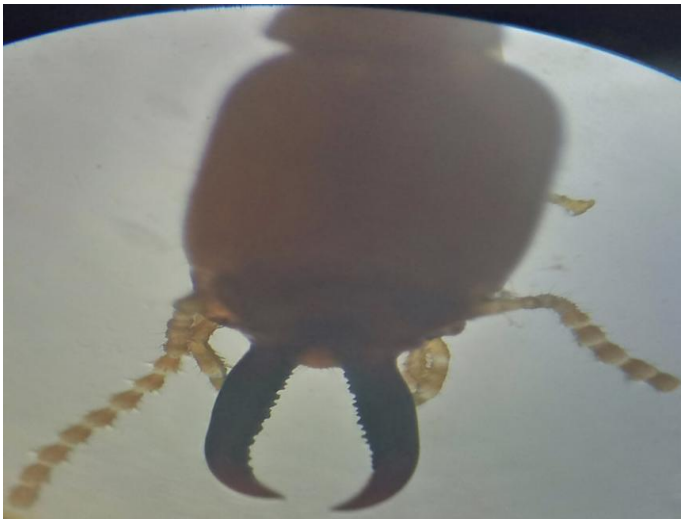

Fig. 2. Head of soldier of *Microcerotermes paracelebensis*

2.4 Statistical Analysis

Statistical analysis include % prevalence per tree type and for all trees and mean % abundance of caste, these tests were done using MS Excel.

3. RESULTS

3.1 Termite Species in the Study Area

Out of 306 trees that were examined, 29 had termite infestation (9.5%). The prevalence of termite-infestation of specific trees species varied from 0 to 100% (Table 1). Eight crop trees such as *Anacardium occidentale* (Cashew), *Moringa oleifera* (Moringa), *Annona muricata* (Soursop), *Theobroma cacao* (Cocoa), *Psidium guajava* (Guava), *Irvingia gabonensis* (Ogbono), *Syzygium samarangense* (Java apple), and *Elaeis guineensis* (Oil Palm tree) had neither termite nests, mud tubes nor hollow sound. All other trees had some degree of termite presence (Figs 3 and 4). All *Gmelina arborea* (*Gmelina*) examined were infested and had termite nests and mud tubes on them (Fig 4) with three termite species namely; *Microcerotermes annandalei, Microtermes sp* and *Odontotermes oblongatus. Gmelina arborea* had the highest infestation rate (100%) as shown in Table 1. *Persea americana* (Avocado) was infested with four different termite species namely; *Microcerotermes paracelebensis, Neotermes* spp, *Microcerotermes annandalei and Glyptotermes kachongensis. Microcerotermes annandalei* was also found infesting *Mangifera indica* (mango) tree, *Microcerotermes paracelebensis* and *Microtermes sp* were found infesting two different trees such as *Citrus sinensis* (Orange) and *Dacryodes edulis* (Native pear "Ube"), *Microcerotermes crassus* was found on *Chrysophyllum albidum* (African star apple "Udara") and *Cocos nucifera* (Coconut).

The termite species on the trees differed, *Neotermes* spp and *Glyptotermes kachongensis* were selective, they were found only on *Persea americana* (Avocado), *Microcerotermes crassus* and *Odontotermes oblongatus* were also selective, *Microcerotermes crassus* were found only on *Chrysophyllum albidum* (African star apple) while *Odontotermes oblongatus* were found only on *Gmelina arborea* (Gmelina) as shown on Table 2. *Microcerotermes paracelebensis* and *Microcerotermes annandalei* were found in five tree types: *Citrus sinensis, Gmelina aborea, Mangifera indica, Persea americana,* and *Dacryodes edulis. Microtermes sp* were found in 4 tree types: *Citrus sinensis, Gmelina aborea, Persea americana,* and *Dacryodes edulis* as shown in Table2.

Fig. 3. *Persea americana* showing *Neotermes* infestation using hollow sound of the tree

Table 1. Prevalence of termite infestation on examined trees and their presentations

Common name of trees	Botanical name of trees	No. Examined	No. Infected	% Infestation	Presentation	Termites found
Gmelina	*Gmelina aborea*	10	10	100	Mudtube Nest	*Microcerotermes annandalei* *Microtermes sp* *Odontotermes oblongatus*
Coconut	*Cocos nucifera*	40	1	2.5	Mudtube	*Microtermes sp*
Orange	*Citrus sinensis*	30	3	10	Mudtube Nest	*Microtermes sp* *Microcerotermes paracelebensis*
Native pear "Ube"	*Dacryodes edulis*	41	4	9.8	Mudtube Nest	*Microtermes sp* *Microcerotermes paracelebensis*
African star apple "Udara"	*Chrysophyllum albidum*	14	1	7.1	Nest	*Microcerotermes crassus*
Avocado	*Persea americana*	38	9	23.7	Mudtube Nest Hollow	*Neotermes* spp, *Microcerotermes paracelebensis* *Microcerotermes annandalei* *Glyptotermes kachongensis*
Mango	*Mangifera indica*	20	1	5	Mudtube	*Microcerotermes paracelebensis*
Bush mango "Ogbono"	*Irvingia gabonensis*	10	0	0	Nil	Nil
Guava	Psidium guajava	34	0	0	Nil	Nil
Moringa	Moringa oleifera	19	0	0	Nil	Nil
Sour sop	*Annona muricata*	23	0	0	Nil	Nil
Almond	*Prunus dulcis*	12	0	0	Nil	Nil
Oil Palm	*Elaeis guineensis*	10	0	0	Nil	Nil
Cashew	*Anacardium occidentale*	3	0	0	Nil	Nil
Java apple	*Syzygium samarangense*	2	0	0	Nil	Nil
	Total	306	29			

Fig. 4. *Gmelina arborea* (tree) with *Microcerotermes annandalei* nest

Table 2. Termite species found on infected trees in study area

Termites Family	Termite species	Trees Infected
Termitidae	*Microcerotermes annandalei*	*Gmelina aborea*
Termitidae	*Microtermes sp*	*Gmelina aborea*
Termitidae	*Odontotermes oblongatus*	*Gmelina aborea*
Termitidae	*Microtermes sp*	*Cocos nucifera*
Termitidae	*Microtermes sp*	*Citrus sinensis*
Termitidae	*Microcerotermes paracelebensis*	*Citrus sinensis*
Termitidae	*Microtermes sp*	*Dacryodes edulis*
Termitidae	*Microcerotermes paracelebensis*	*Dacryodes edulis*
Termitidae	*Microcerotermes crassus*	*Chrysophyllum albidum*
Termitidae	*Microcerotermes paracelebensis*	*Persea americana*
Kalotermitidae	*Glyptotermes kachongensis Neotermes* spp	*Persea americana*
Termitidae	*Microcerotermes paracelebensis*	*Mangifera indica*

Table 3 shows the mean % abundance of caste, for termite spp. and tree type. Majorly, there was a random distribution of the termite species on the tree types in the sampled area, a few termite species however showed specificity. The alates of *Neotermes* spp and *Microcerotermes annandalei* were observed during the study period as well as the presence of nymphs in *Neotermes* spp, *Microcerotermes annandalei*, *Microtermes* spp, *Microcerotermes crassus*, and *M paracelebensis* (Table 3).

4. DISCUSSION

Seven species of termite belonging to six genera of two families were encountered in this study. The two families were; Termitidae and Kalotermitidae. The termite species were*; Odontotermes oblongatus, Microcerotermes annandalei, Microtermes sp, Microcerotermes paracelebensis, Neotermes* spp*, Glyptotermes kachongensis* and *Microcerotermes crassus.* This agrees with the works of Ugbomeh *et al*. [17] who recorded five genera; *Amitermes, Microcerotermes, Globitermes, Nasutitermes* and *Glyptotermes* belonging to two families Termitidae and Kalotermidae while, Ogedegbe and Eloka [18] that recorded five species namely; *Nasutitermes havilandi, Odontotermes* secies, *N. arboreum, Amitermes evencifer and Microtermes* species as important pests of plants in Edo State, Nigeria. Termites could be identified based on their external morphology which include; venation pattern of wings of the winged reproductive or alates, antennae, mandibles, segments of abdomen and pronotum or thorax of different castes e.g. reproductive, nymph, workers, soldiers [19,9].

Table 3. Termite caste percentage abundance on trees in Komkom

Tree type	Termite species	Soldier	Worker	Alates	Nymph
Gmelina above	*Microcerotermes annandalei*	21.2	37.1	25.7	16.0
	Microtermes sp	38.1	61.9	0	0
	Odontotermes oblongatus	35.6	64.4	0	0
Cocos nucifera	*Microtermes sp*	21	66.1	0	12.9
Citrus sinensis	*Microtermes sp*	37.3	40.8	0	21.8
	Microcerotermes paracelebensis	4.2	95.8	0	0
Dacryodes edulis	*Microtermes sp*	22.4	70.3	0	7.3
	Microcerotermes paracelebensis	10.3	72.1	0	17.6
Chrysophyllum albidum	*Microcerotermes crassus*	2	90.4	0	7.6
Persea americana	*Neotermes* spp	25.0	33.0	17.7	24.4
Persea americana	*Microcerotermes paracelebensis*	14.3	74.3	0	11.3
Persea americana	*Glyptotermes kachongensis*	22.2	77.8	0	0
Mangifera indica	*Microcerotermes paracelebensis*	3.9	96.1	0	0

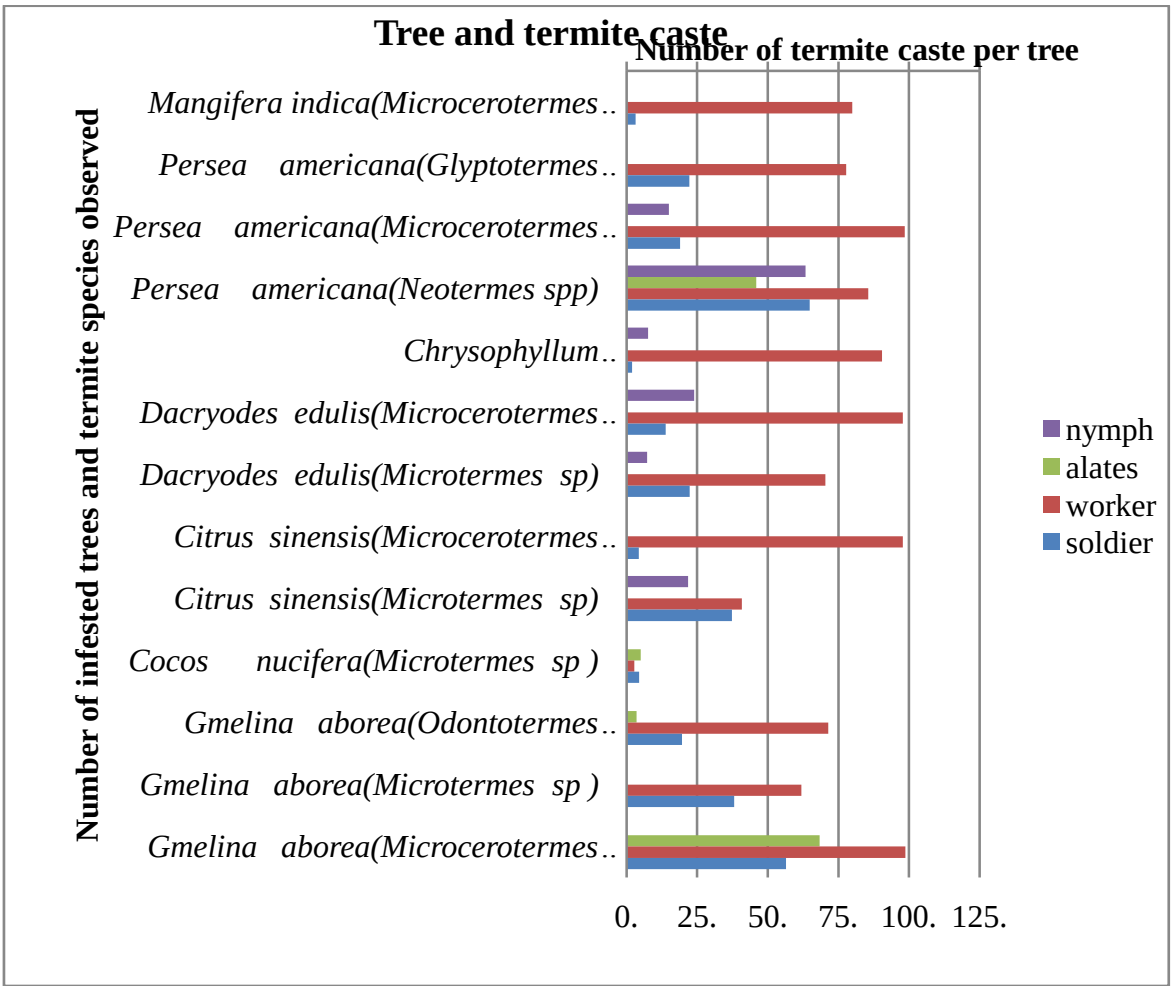

Fig. 5. Termite mean caste percentage abundance on tree in komkom

This study shows that among the seven species of termite in the study area, *Microcerotermes paracelebensis* had the highest abundance (47.2%,) but Anantharaju *et al. [20]* who studied species abundance observed that *Hypotermes obscuriceps* was the most abundant species

having 35% of the sampled population in North eastern, Puducherry, India. The mean caste percentage abundance varied among termite caste in the study area. Workers were more abundant with *Microcerotermes annandaleli* making up 98.7% and *Microcerotermes paracelebensis* 98.5% mean caste percentage abundance when compared to reproductives, nymphs and soldiers. This is in line with the work of Pranesh and Harini, [9] who also studied abundance of termite castes and showed that the workers were more abundant than the other individuals that make up a caste. The presence of the alates of two species (*Neotermes* spp and *M. annandalei)* may depend on the swarming period while the nymphs were found in only the species that formed nests or hollowed out the trees. The nests and hollow of the trees provided nursery grounds for their development. This work shows that termites on trees are found in mud tubes or nests and this agrees with the works of Ugbomeh *et al.* [17] and Echezona *et al.* [21] who observed arboreal colonies that build nest and tunnels at various heights on trees. The total infestation of 9.8% of the trees in the study area shows that anthropogenic effects may have impacted adversely on termite homes as confirmed by some locals who were interviewed, due to felling of trees for timber, urbanization and development. Ugbomeh *et al.* [17]) while studying arboreal termites in a university in Port Harcourt Nigeria, observed total infestation of 37.71% of the trees while this study recorded 9.5%. This could be that a university community may have fewer species of ornamental trees closely planted and hardly felled, while in this Komkom community there were more tree species richness and diversity, widely separated and exploited. There was a significant association of termite distribution and tree type in this study. This contrasts with that of Ugbomeh *et al*., [17] who observed that termite species infested trees at random. More work is required here to determine termite specificity among trees. Observed mode of termite infestation on trees were; mud tubes, nests and hollow tunnels. This agrees with the works of earlier scholars such as Echezona *et al.* [21] and Ugbomeh *et al.* [17] though they did not encounter hollow tunnels in their respective works.

Termite species such as *Neotermes* spp and *Glyptotermes kachongensis* inhabiting hollow tunnels in trees seemed more destructive when compared to the other termite species encountered. Reason could be due to their attack on the internal tissues of the trees. This is collaborated by the work of Harris [22,23] while working on termite infestation on trees observed that *Theobroma cacao* plant infested by termite species *Schedorhinotermes putorius* soon died afterwards even when there was no external termite infestation.

Eight trees namely; *Anacardium occidentale* (cashew)*, Moringa oleifera* (Moringa), *Annona muricata* (soursop), *Psidium guajava* (guava), *Irvingia gabonensis* (bush mango), *Syzygium samarangense* (Java apple), *Theobroma cacao* (cocoa) *and Elaeis guineensis* (oil palm) had neither termite nests, mud tubes nor hollow sound in the study area. This agrees with the work of Ugbomeh *et al.* [17] who also observed that *Psidium guajava* had no form of termite infestation, but contrasts with the works of Sands [6] Haris [21,22] and Malaka [24]. Sands [6,25] and Malaka reported that all the eight trees listed above except *Psidium guajava* had different species of termite infesting them, while Haris [22,23] reported that *Theobroma cacao* was infested by *Schedorhinotermes putorius* [26]. Though some termites may seem to lack host specificity, *Odontotermes oblongatus, Neotermes* spp, *Glyptotermes kachongens and Microcerotermes crassus* appeared specific. *Odontotermes oblongatus* was observed infesting only *Gmelina aborea,* while *Neotermes* and *Glyptotermes kachongensis* infested only *Persea americana* and *Microcerotermes crassus* was found only on *Chysophllum albidum.* Ugbomeh *et al*. [17] reported that *Glyptotermes* species appeared specific for *Chrysophyllum albidum.*

5. CONCLUSION AND RECOMMENDATION

The result obtained in this study indicates that termite species are pest of trees. To prevent termite entry into trees, the environment must be cleared and treated of all signs of termite infestation, trees should be properly examined to determine infestation early, and sounded often to note hollow sounds. Research into biological and other control measures of termite species is recommended to reduce economic loss associated with the infestation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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