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# Studies on termite infestation of buildings in Ase, a rural community in the Niger Delta of Nigeria

Adaobi Patricia Ugbomeh\* and Abiye ThankGod Diboyesuku

## Abstract

**Background:** Termites (Order Isoptera) are eusocial insects that are of great benefit and economic importance to humans. Despite its benefits and economic attributes to humans, it accounts for serious damage on buildings in Nigeria especially in the rural areas. The aim of this study was to collect preliminary data on termite infestation of the buildings in Ase, a local community in the Niger Delta region of Nigeria. Data was collected by direct observation of termites on the buildings, and a structured questionnaire was presented to respondents in houses with visual signs of infestation. Samples of termites were collected from parts of the houses with mud tubes or nests.

**Results:** A total of 106 houses were inspected with 35.85% infested with termites. The termites found were two species of *Amitermes*, one of *Microcerotermes*, three of *Nasutitermes*, two of *Neotermes*, and one of *Odontotermes*. Most infested homes (71%) were graded as moderate, severely damaged, and collapsed revealing a major problem. Percentage infestation of wood services revealed door frames 62.5% and wall (mud tubes) 87.75%, floor 18.85%, logs outside the house 56.25%, windows and roof 43.75%, ceiling 18.75%, and bathroom, furniture, and kitchen 6.25%. Respondents were 30–90 years old and did not attribute mud tubes to termite infestation. Seventy-two percent of the buildings were less than 60 years, and preventive measures used by respondents were Solignum and used engine oil. Most of the buildings were severely infested, and a < 2-year-old house showed visible signs of slight termite infestation.

**Conclusion:** This study clearly demonstrates the level of termite infestation in Ase and the need for better control measures and increased awareness for early detection.

**Keywords:** Termite, Ase, Niger Delta, Buildings, *Microcerotermes*, *Nasutitermes*, *Neotermes*, *Amitermes*, *Odontotermes*

## Background

Termites are eurytopic as they are distributed throughout the temperate, tropical, and subtropical regions of the world, with the highest diversity found in tropical forests (Eggleton, 2000). They have different individuals called castes in their nests (Food and Agriculture Organisation [FAO], 2000). Termites largely feed on cellulose and lignocellulose, and they are known to process 50–100% of dead plant and decaying biomass in the tropical areas (Bignell & Eggleton, 2000). Damages arise as a result of the feeding activity of termite which is aided by

the symbiotic microbes, bacteria, and fungi capable of digesting cellulose (Ohkuma & Brune, 2011). Termites target structural timber in buildings (roofs, windows, and door frames, etc.) and go even deeper into other things within the building such as furniture, clothing, and books (Tagbor, 2009). There are some common genera that have been associated with destruction and they include *Coptotermes*, *Rhinotermes*, *Macrotermes*, *Odontotermes*, *Reticulitermes*, *Microcerotermes*, *Ancistrotermes*, *Schedorhinotermes*, *Pseudacanthotermes*, and *Microtermes* (Abdurahman, 2000; Ahmed & French, 2008; Su, Ban, & Scheffrahn, 2000). Some countries in Africa are unable to list the losses they have incurred as a result of termite damage, but generally, losses due to

\* Correspondence: [ugbomeh.adaobi@ust.edu.ng](mailto:ugbomeh.adaobi@ust.edu.ng)

Department of Animal and Environmental Biology, Rivers State University, Nkpulu-Oroworukwo, PMB 5080, Port Harcourt, Nigeria

**Table 1** Percentage infestation of termite species found in Ase

Termite species	Percentage infestation (%)
<i>Amitermes</i> spp. A	26.32
<i>Amitermes</i> spp. B	5.26
<i>Microcerotermes</i> spp.	2.63
<i>Nasutitermes</i> spp. A	18.42
<i>Nasutitermes</i> spp. B	34.21
<i>Nasutitermes</i> spp. C	5.26
<i>Neotermes</i> spp. A	2.63
<i>Neotermes</i> spp. B	2.63
<i>Odontotermes</i> spp.	2.63

termite damage worldwide runs into billions of US dollars (Ye, Jones, & Ammar, 2004).

Although termites are abundant worldwide, Africa seems to be the richest in the number of termite species both known and identified with about 38% of recognized

termites (United Nations Environment Programme [UNEP], 2000). The species richness is as a result of the friendly climatic conditions in Africa such that the family Termitidae has 664 African species (Ahmed et al., 2011). There are four known subfamilies under this family listed as follows: Apicotermatinae (70 species) (Kanwal, Acharya, Ramesh, & Reddy, 2011), Termitinae (272) African species (Eggerton, 2000), Macrotermatinae (165 species) (Eggerton, 1999), and Nasutitermitinae (56 species) (Mahaney et al., 1999). The total number of species in the above subfamilies may surpass 90% of the world's known termite species (Ahmed et al., 2011).

Termite damage to buildings in tropical countries is a serious concern. An estimate of the annual loss caused by termite attacks in Nigeria is currently unavailable due to the difficulty in collecting such information from individual home owners or tenants. However, there has been an increased appreciation of the importance of termite

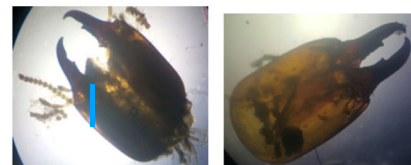
*Amitermes* spp,



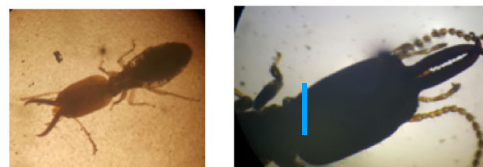
*Nasutitermes* spp,



*Neotermes* spp



*Microcerotermes* spp



*Odontotermes*



**Fig. 1** Heads of some of the termite species found in Ase showing their mandibles—*Amitermes* spp., *Nasutitermes* spp., *Neotermes* spp., *Microcerotermes* spp., and *Odontotermes* spp. (Scale bar = 0.73 mm)

**Table 2** Site of termite infestation of buildings

Site of termite infestation	Termite species	% Infestation in infested houses
Window frame	<i>Nasutitermes</i> spp. A, B, and C <i>Amitermes</i> spp. A and B <i>Neotermes</i> spp B	43.75
Door frames	<i>Microcerotermes</i> spp. <i>Nasutitermes</i> spp. A and B	62.5
Wooden frame of the roof	<i>Nasutitermes</i> spp. A and B <i>Neotermes</i> spp. A and B <i>Amitermes</i> spp. A	43.75
Wood around the houses/fences	<i>Nasutitermes</i> spp. C and B <i>Amitermes</i> spp. A	56.25
Wall (mud tubes) in and outside the house	<i>Nasutitermes</i> spp. A and B <i>Amitermes</i> spp. A and B	87.75
Floor and under carpets	<i>Odontotermes</i> spp. <i>Neotermes</i> spp. A <i>Amitermes</i> spp. A	18.75
Ceiling	<i>Nasutitermes</i> spp. A	18.75
Bathroom walls	<i>Nasutitermes</i> spp. B <i>Amitermes</i> spp. A	6.25
Kitchen walls	<i>Amitermes</i> spp. A <i>Nasutitermes</i> spp. B	6.25
Furniture	<i>Amitermes</i> spp. A	6.25

damage to buildings due to regular repairs of wooden services. This has resulted in the use of Solignum and used engine oil as a preventive measure during construction. Due to this and other poor building techniques like lack of flooring with concrete (cement and granite chip-pings) and tiles, many houses are attacked by termites within a few years of construction. Any form of preventive measure may rapidly deteriorate under the humid tropical conditions (Cassens, Johnson, Feist, & DeGroot, 1995) making it difficult to control. This treatment added to the cost of replacing damaged furniture, doors, windows, and roofs makes the threat very real. The threat of damage to buildings and the high cost of repairs create a need for constant vigilance on the part of home owners (Wood, 1991). Home owners must therefore be aware of and seek to eliminate the economic loss

associated with termite activity. The aim of the study was to collect preliminary data on prevalence of termites and the level of damage due to termite infestation and to conduct a home owner interview in Ase a community in the Niger Delta of Nigeria.

## Materials and methods

### Description of study area

Description of the sampling area is as in Aisien, Ugbomeh, and Awharitoma, 2017. Ase town (05.17° N; 06.18° E), Delta State in the Niger Delta of Nigeria, lies on the shores of the Ase Creek on the course of the Ase River, which is a tributary of the Forcados River, the western branch of River Niger in the Delta of Southern Nigeria. The climate of the area is tropical, divided into the rainy (February to October) and dry (November to January)

**Fig. 2** Mud tubes on the wall (slight infestation)



**Fig. 3** Showing *Nasutitermes* on a wall (moderate infestation)

seasons, with intermittent rains in the month of December. During the latter part of the rainy season (September and October), the area gets inundated and aquatic species of both plants and animals are carried ashore with some getting stranded when the water recedes.

#### Sampling methods and data collection

The study area was divided into four groups according to the quarters of the Ase community (Umunotu, Ekukeni, Ashaka Ase, and Ogbentido). Sampling was for 4 days in June 2018. A total of 106 houses were randomly assessed for termite infestation based on visual observation of signs such as termite mud tubes on walls, pores in walls, damaged parts such as roofs (wood and grass), windows and door frames, wood in walls, and wooden furniture among others. When a house was found infested, its condition was recorded as in Debelo and Degaga (2014): *slightly infested*—only mud tubes on walls, roofs, windows and door frames, and mounds (nests) at the base of walls and inside houses without any sign of damage or little damage; *moderately infested*—woods, walls, windows and door frames, roofs, or woods supporting roofs have been partially eaten, but not completely; *severely infested but not collapsed*—windows, door frames, some of the woods in walls and/or

roofs eaten out completely, and windows and/or door frames cut off or slanted; *collapsed*—a highly damaged house, which is collapsed or had wood completely eaten out causing the collapse of the supported structure. Pieces of wood in the premises and wooden fences were also inspected for those houses which had wooden fences. An open-ended semi-structured questionnaire was given to 38 homeowners whose homes had termite infestation. Homeowners were interviewed and asked if their house was infested by termites. The contents of the questionnaire were on the age of the house and roof, what type of chemical treatment given during the cause of infestation, and grading of the damage such as mud tubes, mound, and wood damage. Termites were collected with a metal spatula and fixed in 5% formalin.

#### Laboratory analysis

Termites were identified to genus using the shape of the head, shape and serrations of mandible, and antennal elements. Termite specimens collected from different infested houses were examined using a compound microscope and identified using the manual by Muzaffer (1965). Photographs of the infested wood structures and mud tubes were taken using a cannon camera. Statistical analysis includes percentage (%) prevalence, wood service preference of termite, and distribution of the termites.

#### Results

##### Prevalence of termite infestation

One hundred and six houses were examined, and 38 (35.85%) had some form of termite infestation. Five genera and nine species of termite were observed in this study: *Amitermes* spp. A and B; *Microcerotermes* spp.; *Nasutitermes* spp. A, B, and C; *Neotermes* spp. A and B; and *Odontotermes* spp. The percentage infestation showed that *Nasutitermes* spp. B had the highest occurrence with a percentage of 34.21%, while *Neotermes* spp. A/B, *Microcerotermes* spp., and *Odontotermes* spp. had the least prevalence at 2.63% (Table 1). The *Neotermes* species (Fig. 1) were different from the African



**Fig. 4** *Amitermes* reproductives exposed on a window frame (severe infestation)





**Fig. 5** Newly built house infested with termite on the walls inside the house

*Neotermes*—*N. aburiensis* and *N. agilis* (Onagbola & Scheffrahn, 2017).

According to one of the respondents, termites appear more abundant during the dry season in Ase (around November to March) as they are found in their trails all around the houses, while in the wet season (April to October) they tend to hide under wooden furniture around buildings causing lots of damage. Walls, door frames, window frames, and the roofs were the sites with the highest termite infestation (Table 2). Termites were found under carpets in homes where they also attacked the furniture, in bathrooms on walls and under sinks in kitchens.

The infested sites (Figs. 2, 3, 4, 5, and 6) revealed 30% slight infestation, 33% moderate infestation, 23% severe infestation, and 15% collapsed damaged houses.

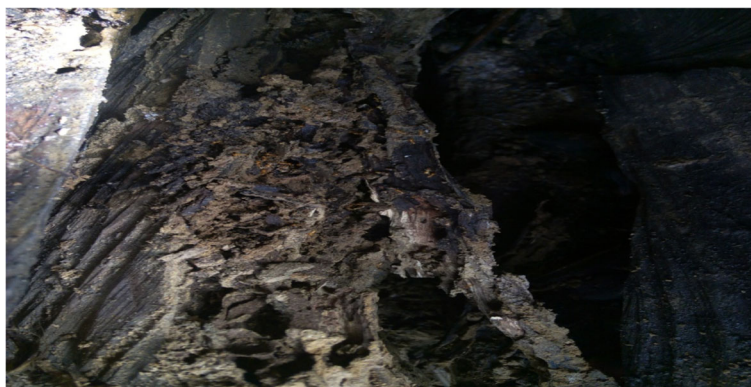
#### Socio-economics from the study area

The socio-economic characteristics of correspondents in Ase (Table 3) showed the mean age, mean family size, age of the house, and roof. Ninety-two percent of the infested houses were more than 5 years old, and all respondents were more than 30 years old. The newest house with termite infestation was less than 2 years

(Fig. 5) with slight termite infestation. All respondents were not aware that the presence of mud tubes meant termite presence or infestation. Twenty percent of respondents with termite infestation had tried different methods to eliminate the termites in severe damage: complete change of woodwork and burning the damaged wood and termite, use of insecticide, and smoking them out.

#### Discussion and conclusion

Five genera of termites were identified, *Nasutitermes*, *Amitermes*, *Neotermes*, *Microcerotermes*, and *Odontotermes* with *Nasutitermes* as the most prevalent (57.89%). A number of factors affect the prevalence of termite species such that it varies from location to location. Ogedegbe and Eloka (2015) found *Macrotermes bellicosus* as the most prevalent among *Coptotermes*, *Nasutitermes havilandi* and *N. arboretum*, *Amitermes evuncifer*, *Odontotermes*, and *Microtermes* in Edo state. In Indiana, Wang et al. (2009) found five species of *Reticulitermes* in homes whereas Zhao, Dong, Yu, and Zhang (2012) found *Coptotermes formasanus* to severely damage homes in China. Materu, Jacob, and Bruno (2013) found *Microtermes*, *Pseudocanthotermes*,



**Fig. 6** Collapsed window frame

**Table 3** Socio-economic characteristics of respondents in Ase

Age of infected roof and houses of respondent	
Age	% of termite infested houses
< 5	8
5–30	44
31–60	20
61–90	24
91–120	4
Family size of correspondent	
Family size	% of respondents with family size
< 2	12
2–3	20
4–5	44
6–7	20
8–9	4
Mean age of correspondent	
Mean age	% of respondents within age class
< 30	0
30–40	26.9
41–50	11.53
51–60	15.38
61–70	11.53
71–80	15.38
81–90	19.23

*Macrotermes*, and *Odontotermes* to infest coconut nurseries in Tanzania. Debelo and Degaga (2014) recorded 91% termite infestation in a rural community in Ethiopia due to *Macrotermes* and *Odontotermes*. According to the natives in Ase, during the wet season (around February to October), termites tend to be abundant in houses. This is because the environment is humid, wet, and often inundated by water. The termites therefore in search of a drier habitat enter homes and damage the buildings. During the dry season, which is from November to January, they tend to hide under wooden furniture, venturing outside the houses in their trails. They build mud tubes and mounds around the buildings, on the wall, window frames, wood, door frames, floor, roof, ceiling, kitchen, bathroom, and furniture. The presence of two species of *Neotermes* different from those recorded by Onagbola and Scheffrahn (2017)—*N. aburien-sis* and *N. agilis* from Ghana and Ijare Nigeria, respectively, is significant. *Neotermes* is a damp wood termite.

Respondents were mostly the elderly with a few middle age. The relatively low infestation (35.85%) could be due to the modern houses of less than a year which were not infested and also due to constant rebuilding of old houses. However, of the infested houses, more than 71%

had more than slight infestation which should be seen as a problem in the area. Infested houses were 2–100 years old and were without tile flooring. It is important to encourage proper concrete flooring and tiling to reduce the ease of termite infestation as a 2-year-old relatively modern house showed visible signs of termite infestation by *Amitermes* spp. All respondents claim to have used Solignum and used - engine oil on the wood as a preventive measure but this had not eliminated the termites. This may be due to wrong applications, fake Solignum, or just termite resistance to the effect of the Solignum, and therefore, more studies are required on control measures. In more than 43% of the infested homes, door and window frames, walls, and roofs were damaged in various degrees. There is the need to create more awareness on early detection of termite presence and effective control measures in the area. The termites appear to overwhelm the people. According to one of the respondents, a newly built house was so severely damaged by termites that the roof collapsed in less than a year. In conclusion, the study has revealed the percentage prevalence of termite infestation in Ase due to five genera of termites *Nasutitermes*, *Amitermes*, *Microcero-termes*, *Odontotermes*, and *Neotermes*. It has also revealed the need to educate the natives on the early signs of termite infestation and effective preventive measures.

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#### Availability of data and materials

All data and materials used in this study are available on request.

#### Authors' contributions

UAP conceived the study, identified the termites, and wrote the manuscript. DAT carried out field and laboratory work and analyzed the data. All authors read and approved the final manuscript.

#### Ethics approval and consent to participate

The authors declare that there was no ethics committee set up on the use of termites for research when the study was carried out. To the best of our knowledge, there are no guidelines either at the institutional or national level needed for ethics approval.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.

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