Malays. Appl. Biol. (2009) 38(2): 37–48

TERMITES INFESTATION SELECTED FROM PREMISES IN PENANG, SEBERANG PRAI & SUNGAI PETANI, MALAYSIA

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ABSTRACT

A survey was carried out to detect the presence of termites in and around selected premises in North Peninsular Malaysia (Penang and Kedah). The entire premises surveyed were found infected with termites. It comes from two families and 4 genus; *Coptotermes* (Rhinotermitidae), *Microcerotermes*, *Macrotermes* and *Globitermes* (Termitidae). Genus *Coptotermes* is the most common termites foraging in and around the premises followed by *Microcerotermes*, *Macrotermes* and *Globitermes*.

ABSTRAK

Satu tinjaun telah dijalankan untuk mengesan kehadiran spesis anai-anai di premis yang terpilih di Utara Semenajung Malaysia (Penang dan Kedah). Hasil dari tinjaun yang dijalankan, anai-anai yang dijumpai adalah dari 2 keluarga dan 4 genera; *Coptotermes* (Rhinotermitidae), *Microcerotermes*, *Macrotermes* and *Globitermes* (Termitidae). Genera *Coptotermes* merupakan kumpulan anai-anai yang biasa dijumpai didalam dan dipersekitaran premis dan diikuti oleh genera *Microcerotermes*, *Macrotermes* and *Globitermes*.

Key words: Termites, Malaysia, *Coptotermes*, *Microcerotermes*, *Macrotermes*, *Globitermes.*

INTRODUCTION

Termites contribute significantly to most of the world's ecosystem. Of greatest importance is the role that they play in recycling wood and other plant materials. Their tunneling efforts help to ensure that the soil is porous, aerated and enriched in minerals and nutrients to support better plant growth. For example, termite activity in the desert areas of North Africa helps to reclaim soils damaged by overgrazing. Termites are important food sources for many other animals including many reptiles, birds and mammals. Termite mounds and trees hollowed out by termites provide shelter and breeding sites for many other creatures (Tho and Kirton 1990, Lee and Sajap, 2000 and Lee 2001).

Some termites are destructive feeders and consume homes and agricultural crops. Termites that are most destructive to wooden buildings include the subterranean *Reticulitermes* and *Coptotermes*. These two genera appear to be increasing in importance worldwide, due to the increasing international commerce and movement of people as well as the exchange of goods. In Malaysia, *Coptotermes sp*. is among of the destructive pests in urban areas. Many regions of the world are currently experiencing expansions and/or invasions of subterranean termites. In some areas, termites constitute a significant pest problem in the agricultural areas, especially in rubber and oil palm plantations (Su and Scheffrahn, 1990). In this paper the infestation of termites was evaluated in selected areas in Penang and Sungai Petani the potential damage caused by termite infestation inside and around the building structure was estimated.

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MATERIALS & METHODS

Selection of Study Area

The survey was carried out from 1st April 2005 to 1st May 2006 at 25 houses selected randomly

from 14 sites for in two states, Kedah and Pulau Pinang (Fig. 1). In Kedah the survey was carried out in Sungai Petani while in Pulau Pinang the survey was carried out in Bayan Baru, Greenlane, Bayan Lepas, Sungai Ara, Gua Perahu, Kepala Batas, USM, Mengkuang and Sg. Batu. The survey methods described by Sajap and Wahab (1997) were applied. Each premise was subjected to two methods of termite's surveys: compound and indoor surveys. Table 1 shows the list of the number of houses according to the locations stated.

Table 1. List of the houses surveyed according to the locations

State	Location	Number of houses
Kedah	Sg. Petani	1
Pulau Pinang	Bayan Baru	1
	Bayan Lepas	1
	Sungai Ara	1
	Gua Perahu	6
	Kepala Batas	2
	USM	5
	Mengkuang	1
	Minden Height	1
	Sg. Batu	1
	Gelugor	1
	Air Hitam	1
	Balik Pulau	2
	Greenlane	1

In this study two types of survey; compound and indoor survey were carried out. For the compound survey, a five-meter perimeter was demarcated around selected premises. All wooden structures and plant debris within the area were inspected for the presence of termites. For the indoor survey, with the permission of the house owners, an inspection to detect the presence of termites in the buildings was carried out. This was done by examining wooden structures such as windows, doors and cabinets. All destructions caused by the termites in the surveyed areas were photographed using a digital camera to show the economic loss caused by termite infestation, especially in the residential area.

Termite preservation and identification

Foraging soldiers and workers were collected as many as possible by using forceps. They were preserved in vials containing 75% ethyl alcohol. The appropriate locations and dates were labeled. Then the vials were brought to the Medical Entomology Laboratory, University Sains Malaysia for the purpose of identifying termite species. The identification was done based on Tho (1992). The identified features of the soldiers included (1) shape and characteristics of the head and mandibles, (2) antenna, (3) post-mentum, (4) pro-meso and meta-notum, (5) size and colouration of termites, and (6) other individual characteristics (Lee *et al*., 2004). Pictures of all the samples retrieved from the sites were captured by using a video camera JVC 3-CCD KY-F55B and connected to the Olympus BH2 Phase Contrast (40X) microscope. All the videoed pictures were connected to the desktop computer for the purpose of analysis using Soft Imaging Software ver. 2.1. Pictures of the sites were also taken by using a digital camera Canon PowerShot S50.

RESULTS

Composition of Termites in Different Locations

The survey showed that all the houses were infested with subterranean termites, evident through the mud and soil that was carried along during foraging. The survey also showed that the entry points of termites were through the window panes and doors, in between the slits of the woods, in between 2 pieces of wood which were also hidden and through isolated places.

From the survey, a total of 20 premises from 25 out of 14 sites were discovered to be infested with subterranean termites. The sites were from Bayan Baru, Gelugor, Universiti Sains Malaysia, Sungai Ara, Minden Height, Sungai Batu, Greenlane, Air Hitam, Balik Pulau, Guar Perahu, Mengkuang, Kepala Batas and Sungai Petani (Table 1). A total of 10 species of termites, 2 families, and 7 genera were found from the infested sites. The dominant species from the survey was *Coptotermes gestroi.*

In Bayan Baru, the site was only infested with *Coptotermes gestroi*. However, location from Gelugor, three termite species were found. *Coptotermes gestroi* was found infesting the building, meanwhile *Globitermes globosus* was found infesting the mango tree outside the house. In addition *Macrotermes gilvus* was found infesting a dead tree stump outside the house.

In Sungai Ara only *Nasutitermes* sp. was found infesting the mango tree and the external wooden wall of the house. On the other hand, *Coptotermes gestroi* and *Coptotermes curvignathus* were found on the building structures and trees. *Globitermes sulphureus* was also found infesting inside one of the buildings. Meanwhile, *Macrotermes gilvus*, *Macrotermes carbonarius* and *Odontotermes* sp. were found infesting trees outside the buildings.

In Minden Heights, *Comptotermes gestroi* and *Macrotermes gilvus* were found infesting trees around the house. Surprisingly, the location in Sungai Batu was the only location found infested with *Microcerotermes crassus. Coptotermes gestroi* was also found in Greenlane and Air Hitam. In Balik

Table 2. Termite species, locations, types of structure and type of damage

No.	Locations	Types of Structure	Species	Types of Damage
1	Bayan Baru	Terrace House	Rhinotermitidae *Coptotermes gestroi*	Switch box Window frame
2	Gelugor	Bungalow house	Rhinotermitidae *Coptotermes gestroi* Termitidae *Globitermes globosus* Termitidae *Macrotermes gilvus*	Parque floor Window frame Mango tree
3	Universi Sains Malaysia	Mosque Plant Garden Herb garden	Rhinotermitidae *Coptotermes gestroi* Rhinotermitidae *Coptotermes curvignathus* Termitidae *Globitermes sulphureus* Termitidae *Macrotermes gilvus* Termitidae *Macrotermes carbonarious* Termitidae *Odontotermes* sp.	Trees Cupboard Window frame Table Books Table Carpet grippers
4	Sungai Ara	Bungalow house	Termitidae *Nasutitermes* sp.	Trees Wooden wall
5	Minden Height	Bungalow house	Rhinotermitidae *Coptotermes gestroi* Termitidae *Macrotermes gilvus*	Trees
6	Sungai Batu	Bungalow house	Termitidae *Microcerotermes crassus*	Trees Wooden wall
7	Greenlane	Semi detached house	Rhinotermitidae *Coptotermes gestroi*	Window frame Door frame
8	Air Hitam	Bungalow house	Rhinotermitidae *Coptotermes gestroi*	Wooden wall
9	Balik Pulau	Malay traditional house Bungalow house	Rhinotermitidae *Coptotermes gestroi* Termitidae *Globitermes sulphureus*	Wooden wall House pillar
10	Guar Perahu	Bungalow house Malay Traditional House	Rhinotermitidae *Coptotermes gestroi* Termitidae *Macrotermes gilvus* Termitidae *Macrotermes carbonarious* Termitidae *Odontotermes* sp. Termitidae *Microtermes pakistanicus*	Wooden wall Wooden floor Trees

No.	Locations	Types of Structure	Species	Types of Damage
11	Mengkuang	Bungalow house	Rhinotermitidae *Coptotermes gestroi* Termitidae *Odontotermes* sp. Termitidae *Macrotermes gilvus*	Window frame
12	Sungai Petani	Bungalow house	Termitidae *Globitermes globosus*	Tree
13	Bayan Lepas	Surau	Rhinotermitidae *Coptotermes gestroi*	Door frame Wooden wall
14	Kepala Batas	Malay traditional House Bungalow house	Rhinotermitidae *Coptotermes gestroi*	Kitchen Cabinet Store room Window frame Door frame Ceiling

Pulau, *Coptotermes gestroi* and *Globitermes sulphureus* were found infesting a house.

The termite species in Guar Perahu were Coptotermes *gestroi, Macrotermes gilvus, Macrotermes carbonarious, Odontotermes* sp. *and Microtermes pakistanicus*. Meanwhile in Mengkuang, *Coptotermes gestroi, Odontotermes* sp. and *Microtermes gilvus* were the termite species infesting there. However, only *Coptotermes gestroi* and *Microtermes gilvus* were found in Bertam. Meanwhile only *Coptotermes gestroi* was found in Taman Rupawan as compared to Sungai Petani where only *Globitermes globosus* and *Microtermes pakistanicus* were found infesting the sites there.

It was discovered that 32% infestation consists of *Coptotermes gestroi* and only 16% infestation of *Macrotermes gilvus.* In addition, the infestation of *Globitermes sulphureus*, *Odontotermes* sp. and *Microtermes pakistanicus* represent 10% of each. The Infestation of *Globitermes globosus* represent a total of 7% from the total infestation surveyed. Meanwhile, the infestation of Macrotermes *carbonarious* was 6%. Lastly, *Nasutitermis* sp., *Microcerotermes carssus* and *Coptotermes curvignathus* represent 3% each from the total infestation surveyed (Fig. 1).

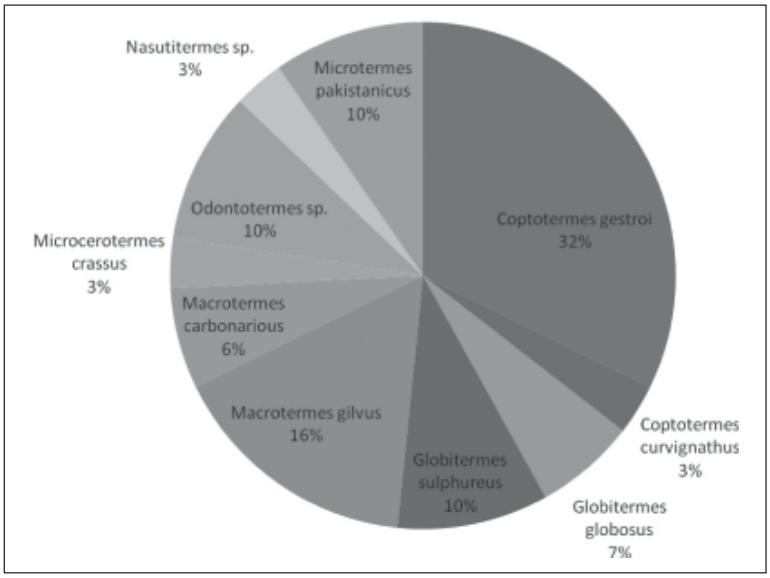

Fig. 1. Percentage of termites species found from the survey conducted in selected premises in 14 sites in Penang, Seberang Prai and Sungai Petani.

Termites species and damage

Coptotermes gestroi Wasmann

Coptotermes gestroi (Fig. 2 & 3) was the most abundant species found infesting the buildings. From the survey, 9 out of 14 sites were found infested with *C. gestroi*. The sites were Bayan Baru, Gelugor, Universiti Sains Malaysia, Minden Height, Greenlane, Air Hitam, Balik Pulau, Guar Perahu, and Mengkuang. It was the main species that caused serious damage and economic loss of wooden building structures (Fig. 4 - 7).

Coptotermes curvignathus Haviland

Coptotermes curvignathus was found only in 1 site out of the 14 sites in Universiti Sains Malaysia (Fig. 8 & 9). There was an infestation on old stump at the Herb Garden, School of Biological Sciences, USM, especially at roots of the herbs plant (Fig. 10 & 11). According to Mohd Yusri (2001), the *C.*

Fig. 2. *C. gestroi* soldier.

Fig. 3. *C. gestroi* worker.

Fig. 4. Books infested with *C. gestroi.*

Fig. 5. Carpet grippers infested with *C. gestroi.*

Fig. 6. Switch box infested with *C. gestroi*.

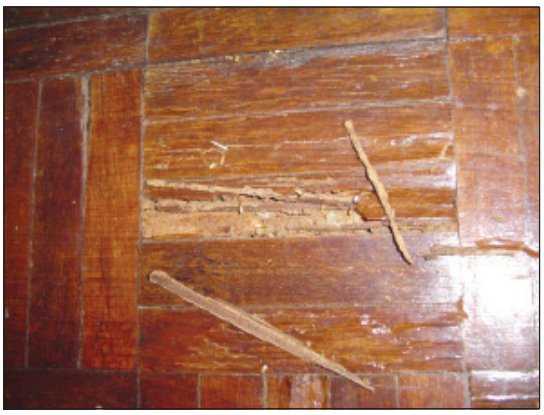

Fig. 7. Parquet floor infested with *C. gestroi.*

Fig. 8. *C. curvignathus* soldier.

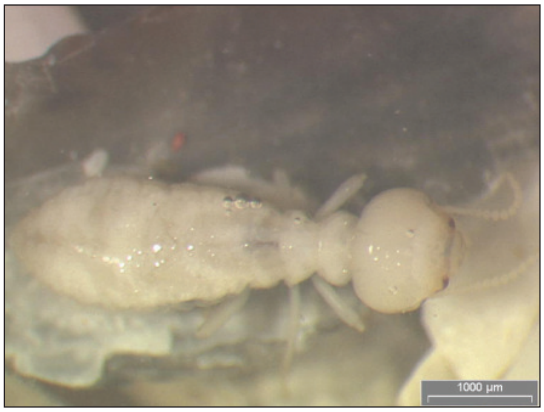

Fig. 9. *C. curvignathus* worker.

Fig. 10. *C. curvignathus* infestation on dead stump.

Fig. 11. *C. curvignathus* infestation on undisturbed tree.

Fig. 12. *M. gilvus* soldier.

Fig. 13. *M. gilvus* worker.

curvignathus was found to be dominant at the place where the structures was built on land previously planted with oil palm and rubber trees. It was an important pest for ornamental plants, oil palms and rubber (Mohd Yusri, 2001).

Macrotermes gilvus Hagen

Macrotermes gilvus were found at 5 sites from the 14 sites studied (Fig. 12 &13). These are in Gelugor, Universiti Sains Malaysia, Minden Height, Guar Perahu and Mengkuang. From the conducted survey, it was discovered that *M. gilvus* always infested the dead stump and also the nearby tree. The species was observed at nearby structures but they were never found indoors.

Microtermes pakistanicus Ahmad

Microtermes pakistanicus were found at 3 sites in Guar Perahu, Kepala Batas and Sungai Petani (Fig. 14 & 15). The species were found infesting the

Fig. 14. *M. pakistanicus* soldier.

Fig. 15. *M. pakistanicus* sworker.

trees surrounding the premises. Nevertheless, the mud tubes were also found covering a dead stump. Usually a crushed soldier produced lemon-like odour (Tho, 1992).

Globitermes sulphureus Haviland

Globitermes sulphureus were found in two sites, Balik Pulau and Universiti Sains Malaysia out of 14 (Fig. 16 & 17). They infested a wooden house internally and externally in a house in Balik Pulau and carpet gripers in the mosque of Universiti Sains Malaysia (Fig. 18 & 19). Usually this species is very common in rubber, coconut, oil palm and sugar cane plantations. The soldiers of *Globitermes sulphureus* are very distinctive in having bright yellow abdomens. No other species in Peninsular Malaysia have this colouration (Tho, 1992).

Fig. 16. *G. sulphureus* soldier.

Fig. 17. *G. sulphureus* worker.

Fig. 18. *G. sulphureus* attacking a wooden wall.

Fig. 19. *G. sulphureus* infestation under the carpet.

Nasutitermes sp. Holmgren

From the survey, it was discovered that only one out of 14 sites, was occupied by *Nasutitermes* sp in Sungai Ara (Fig. 20 & 21). It was found that the species infested a mango tree nearby a house and the outside wall of the premise (Fig. 22 & 23). The mud tube built by them connected from the nearby mango tree to the premise.

Odonotermes sp. Ahmad

From the survey, it was found that only 2 out of 14 sites were occupied by *Odonotermes* sp in Guar Perahu and Mengkuang (Fig. 24 & 25). The species was found infesting a tree outside the house. In addition, the mud tubes covered a dead stump and abandoned pieces of wood outside the house.

Fig. 20. *Nasutitermes* sp. soldier.

Fig. 21. *Nasutitermes* sp. worker.

Fig. 22. *Nasutitermes* sp. mud tubes.

Fig. 23. *Nasutitermes* sp. infestation on external wooden wall.

Fig. 24. *Odonotermes* sp. soldier.

Fig. 25. *Odonotermes* sp. worker.

Micocerotermes crassus Synder

From the survey, it was discovered that only one out of 14 sites were occupied by *Micocerotermes crassus* in Sungai Batu (Fig. 26 & 27). The species was found infesting a mango tree outside the house and also the external wooden wall of the premise (Fig. 28). The mud tubes were connected from a nearby mango tree to the house.

Macrotermes carbonarius Hagen

From the survey, it was discovered that only two sites out of 14 were occupied by *Macrotermes carbonarius* in Guar Perahu and Universiti Sains Malaysia (Fig. 29). The species was usually found infesting the surrounding trees outside the house. These termites built an epigeal mound which could easily be detected. They are often found on the external wooden wall of the premise and on other crop plantations and are common in rural areas (Mohd Yusri, 2001).

Globitermes globosus Haviland

Globitermes globosus was found at two sites out of 14 in Gelugor and Sungai Petani (Fig. 30-31). However, the species was from a small genus. The species was found infesting the surrounding trees outside the houses, especially rubber and mango trees. The soldier is easily distinguished from *G. suiphureus* by its white abdomen and small size.

DISCUSSION

The termites collected were represented by two families, Rhinotermitidae and Termitidae and six genera *Coptotermes* (Rhinotermitidae), *Macrotermes*, *Microtermes, Microcerotermes, Odonotermes* and *Globitermes* (Termitidae). The genus *Coptotermes* appeared to be the most common termites foraging around building premises followed by *Macrotermes* and *Globitermes.*

Two species from genus *Coptotermes* were found in 10 out of 14 premises surveyed. They were *C. curvignathus and C. gestroi.* Genus *Coptotermes* usually enter the house through cracks where the cement structures and wooden structures come into contact with the soil. The detection of *Coptotermes* nest is very difficult because the termites do not

Fig. 26. *M. crassus* soldier.

Fig. 27. *M. crassus* soldier.

Fig. 28. *M. crassus* infestation on external structure of a house.

Fig. 29. *M. carbonarius* soldier.

Fig. 30. *G. globosus* soldier.

Fig. 31. *G. globosus* worker.

build mounds and the nests are constructed underground. In addition, the survey made by Sajap and Wahab (1997), also showed the same result where *Coptotermes* were found in 10 out of 17 premises surveyed by them. Nonetheless, the survey conducted by Mohd Yusri *et al*. (2005) showed that *Coptotermes* was found infesting in 27 out of 42 premises.

From the survey conducted it was discovered that genus *Coptotermes* from the family Rhinotermitidae had been a major economic pest of buildings, agricultural crops and trees. The *Coptotermes* built mud tubes to forage food outside its colony. The active mud tube is always wet, while the inactive mud tube is dried.

The genus *Coptotermes* can easily be identified because the soldiers produce white latex from the mandible. In some places, soil trails emerged out of the walls through small holes in the plaster, indicating that the termites had also been moving along the crevices between the cement plaster and the brickworks of the walls. The difference between *Coptotermes gestroi* and *Coptotermes curvignathus* can be seen from the sizes of the soldiers. The result of the survey shows that the infested areas are mostly wooden structures in the buildings, such as window frames, door frames, carpet grippers, fuse boxes, parquet floor, cabinets, books, walls and ceilings. On the other hand, outdoor infestations are mostly found on dead stumps and undisturbed trees.

The infestation of *Coptotermes* occurs in all tropical regions of the world (Lee, 2002). At the latitudinal limits of its range, *Coptotermes* is present in some temperate regions, such as southern Japan and New Zealand. *Coptotermes* colonies can produce functional replacement reproductives (called neotenics) and thus rapidly exploiting available food resources by establishing satellite colonies (Gay, 1975; Lenz and Barrett, 1984). This ability also allows fragmented colonies to thrive in the absence of the primary founding queen. This is seen to be possibly the most important factor for the success of *Coptotermes* in the colonizing areas opened through the activities of man (Lenz et al., 1990). Species of *Coptotermes* have been introduced into many parts of the world, including continental USA, New Zealand and numerous sites in the Pacific Ocean including Fiji, Hawaii, Guam and the Marshall Islands (Gay and Calaby, 1970). In particular, *C. formosanus* is now established in many countries and has become a serious pest.

In Peninsular Malaysia, species of *Coptotermes* are widespread in lowland forests, up to an altitude of approximately 1350 m (Tho, 1992). The studies of Kirton and Wong (2001) in Peninsular Malaysia revealed that *Coptotermes* generally reach their maximum reproductive success and colony growth in coastal regions, rather than in inland forests. In particular, *Coptotermes* thrives in peat swamp forests, and is frequently found attacking *Casuarina equisetifolia* in beach strand forests, and is closely associated with *Rhizophora* and *Bruguiera* in mangroves (Kirton and Wong, 2001). In Thailand 90% of the termite infestation was from *Coptotermes gestroi*. The survey also supported the earlier research conducted by (Lee 2002) in 1998, which revealed that 90% of infestation on building structures in Malaysia was caused by *Coptotermes*.

Eight species from family the Termitidae were collected in this study. They were *Microcerotermes grassus, Macrotermes gilvus, Macrotermes carbonarious, Nasutitermes sp., Odonotermes, Microtermes pakistanicus, Globitermes sulphureus* and *Globitermes globosus.* These eight species are mound-building termites. They are usually found in rural and sub-urban areas foraging on decayed wood, dead trees and stumps. *Macrotermes carbonarius* usually constructs a mound near a tree. It was found in 2 sites out of 14 surveyed. *Macrotermes gilvus* usually constructs a nest in a huge mound with fungus gardens. They are commonly found foraging on untreated wood that is in contact with the soil,

decayed wood and stumps. *Macrotermes gilvus* was also found feeding on tree roots and this affects the tree growth. The other species, *Micocerotermes crassu*s was only found at one site. The infestation was light and the source was from the nearby mango tree and it was also connected to the house structure through the tree branches. This phenomenon was similar with *Amitermes sp*. that was found only at one site. *Globitermes sulphureus* only feed on decayed wood and stumps. However, it was reported that *Globitermes sulphureus* was also found inside the house infesting the wooden structures (Abdul Hafiz *et al*. 2007). The major areas of infestation of the family Termitidae were mostly located outside the house. *Macrotermes carbonarious* and *Macroterms gilvus* built epigeal mounds. The survey indicated that termites' species such as *Odontotermes* and *Microtermes pakistanicus* usually attack the external structure of houses. In addition, from the survey it was discovered that *Globitermes sulphureus* attacked wooden walls and wooden pillars indoor and outdoor. Additionally the survey also showed that, *Globitermes sulphureus* was found attacking carpet grippers under the carpet. Furthermore, *Globitermes sulphureus* built mud tubes and they were easily identified by its bright yellow colour on the abdomen of the soldiers. *Globitermes sulphureus* also built an epigeal mound outside the structure.

Termite species like *Nasutitermes* sp were found infesting the outside layer of a wooden house but they were never found infesting the internal house structure internally. *Nasutitermes* sp also had built mud tubes to reach a wooden structure outside the house. No epigeal mound was found for this species. Termitidae termite species, like *Microcerotermes crassus,* was also found infesting the external wooden structure of a house. The species was found attacking the mango tree outside the house and this infestation seems to have a line of connection to the house through the leaves and branches of the tree touching the external wall of the house.

CONCLUSION

In conclusion, it can be advocated that the most abundant and destructive termite species are genus *Coptotermes*. It causes serious damage on house structures. Therefore, an early prevention needs to be taken by the house-owner before the termite infestation becomes worse. Nevertheless, other termite species from other genus, like *Macrotermes*, *Microtermes, Micocerotermes, Odonotermes* and *Globitermes*, must be taken into consideration, even though they do not cause serious problems in urban areas. Species, like *Globitermes sulphureus* need to be considered as an important termite pest because it had been found infesting the internal structures of buildings, as indicated at the two sites of this study.

ACKNOWLEDGEMENTS

We would like to thank the School of Biological Sciences, Universiti Sains Malaysia (USM) for the facilities provided for doing the research. We thank Mr. Hadzri Abdullah for his technical assistance and the house owner for allowing us to set up the experiment.

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