

The Species and Abundance of Subterranean Termites (Insecta: Isoptera) in the Area of University of Bengkulu

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ABSTRACT

A study on the species and abundance of subterranean termites (*Insecta: Isoptera*) in the area of the University of Bengkulu has been carried out from December 2018 to February 2019. This study aimed to find out the types and abundance of subterranean termites (*Insecta: Isoptera*) in the area of the University of Bengkulu. The points for research locations were determined using a purposive sampling technique. Termites were collected using the wood bait method in all research locations. The collected termites were then sprayed with 4% formalin and put into vials containing 70% alcohol, after that stored in a collection box. Furthermore, they were identified in the Laboratory of Animal Anatomy and Physiology, Basic Science Building, Faculty of Mathematics and Natural Sciences, University of Bengkulu. They were classified based on their families, subfamilies, and species. The obtained data were analyzed qualitatively and quantitatively. The results showed that from 770 individuals collected, it consisted of 3 species, 2 families, and 2 subfamilies, namely *Microtermes inspiratus* (family *Termitidae*, subfamily *Macrotermitinae*), *Macrotermes gilvus* (family *Termitidae*, subfamily *Macrotermitinae*), and *Coptotermes curvignatus* (family *Rhinotermitidae*, subfamily *Coptotermitinae*). The highest abundance was found in *Macrotermes gilvus* species with an abundance value of 150.000 individuals/m³.

Keywords: *Abundance, Campus UNIB, Subterranean Termites*

1. INTRODUCTION

Subterranean termites are a species of termite that make their nests below the soil surface and above the soil surface by making mounds of soil. Termites are decomposers in the tropics, especially on peat soils, and generally considered to be potential pests because they destroy wood, building construction, and cellulosic materials in buildings or attack trees and living plants [1]. The presence of subterranean termites difficult to detect directly. Generally, subterranean termite colonies will create wandering tunnels or holes under the surface of the soil so that they appear on the ground once in a while [2].

The growth of the termite population is highly influenced by environmental conditions such as the physical and chemical conditions of the soil. The diversity of subterranean termites in a certain area are influenced by the level of vegetation cover, soil

topography, and micro-climatic conditions of an environment [3].

Termite infestation is very fast, ferocious, and can cause serious damage. The intensity of infectious are getting higher and wide can cause losses year by year and tend to increase. According to [4] that based on experience over the last twenty years, termites are the most disturbing factors because they can destroy woods and buildings. They are capable of damaging building construction and even electrical cables.

Several studies concerning subterranean termites that have been conducted previously are as follows. [5] Conducted a study on the diversity of subterranean termite types and the impact of their attacks on housing in the area of Mijen, Semarang, in which they found two species, i.e. *Macrotermes gilvus* (family *Termitidae*) and *Coptotermes curvignathus* (family *Rhinotermitidae*). [6] reported three types of termites that attack traditional houses

in Minangkabau, i.e. *Macrotermes gilvus*, *Macrotermes* sp., and *Nasutitermes matangensis*. [7] conducted a study on the diversity of subterranean termite species in West Jakarta and East Jakarta in which he found four species of subterranean termites in those areas, i.e. *Macrotermes gilvus*, *Microtermes inspiratus*, *Capritermes mohri* (family Termitidae), and *Coptotermes curvignathus* (family Rhinotermitidae). [8] conducted a study concerning the diversity of subterranean termites with the feeding technique using a pile of rice straw and bagasse at a mushroom company, PT. Zeta Agro Corporation, Central Java, in which she found 7 species of subterranean termites, i.e. *Microtermes inspiratus*, *M. pallidus*, *Macrotermes gilvus*, *Odontotermes javanicus*, *O. holmgreni*, *O. grandiceps*, and *Capritermes buitenzorgi*.

University of Bengkulu was built on a former forest area that still maintains the forest ecosystem in it. With several components of the building structure composed of wood, especially in old buildings, and in it many important aspects that need to be protected such as university documents, important archives, books, and all materials composed of cellulose are susceptible to termite attack. Several cases of subterranean termites that attacked UNIB campus buildings were attack on-campus building frames, cabinets, and bookshelves made of wood. Based on this background, there is a concern that termites will damage the campus buildings of the University of Bengkulu, considering that from time after time University of Bengkulu always develops campus buildings so that the authors are interested in

researching the types and abundance of subterranean termites in the University of Bengkulu.

This study aims to find out the species, abundance, and attack intensity of subterranean termite in the area of the University of Bengkulu.

2. METHODOLOGY

This study was conducted in the main campus area of the University of Bengkulu which is located in Kandang Limun, Beringin Raya Village and in the Basic Science Laboratory, Biology Department, Faculty of Mathematics and Natural Sciences, University of Bengkulu from December 2018 to February 2019. The tools used in this study were vials, stereo microscopes, Petri dishes, brushes, tweezers, tape measure, hammer, crowbar, digital camera, soil tester, soil thermometer, lux meter, thermometer, GPS, pencils, and identification books.

The materials used were 70% alcohol, 4% formalin, raffia rope, plastic bags, nails, and rubberwood with a size of 2 cm x 2 cm x 40 cm. The points of the research location were determined using a purposive sampling method by directly surveying the location based on the terms of life for termites. According to [4], several places where subterranean termites are commonly found have vegetation cover, soil with high humidity, tree stumps that have been felled, and haystack or dead wood. Based on those recommendations, the researcher found 5 location in the area of the University of Bengkulu that are possible to find subterranean termites (see Figure 1)

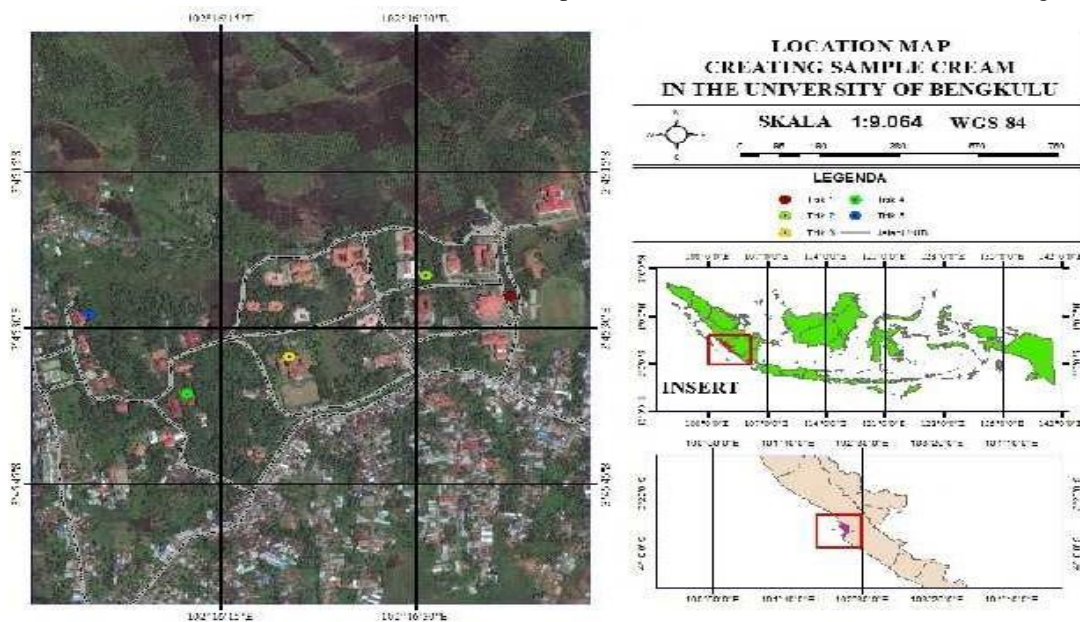


Figure 1. The Map of the University of Bengkulu [9]

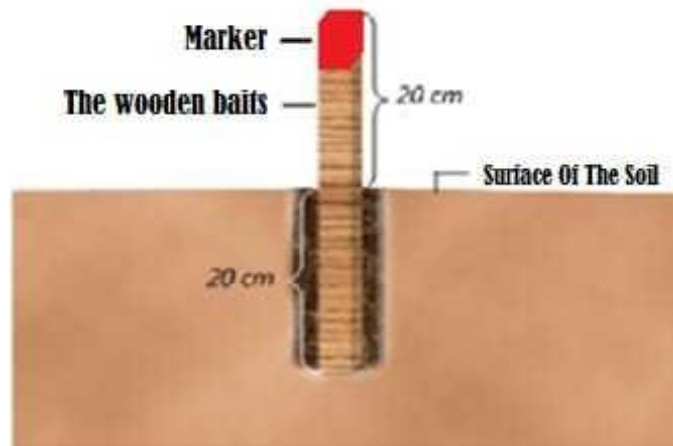


Figure 2. How to place the wooden baits [7]

The wood used as bait is rubber tree wood. The structure of rubberwood that is soft and easy to decay is very popular with termites [10]. The wooden bait to be used as the termite bait is cut into 50 pieces of 2 cm x 2 cm x 40 cm size. After the wooden block was cut, the volume of the block is counted to find the initial volume. Wooden lures that are ready numbered in the order of 1-50, on the top surface of the wooden bait are given nails and tied with raffia ropes as a marker and marked with the cardinal directions on the side of the wooden bait (North / South) using a pencil.

For each location, it was placed 10 blocks of woods as baits. The method of placing the baits was by immersing 20 cm part of the wood in the soil vertically, while the other 20 cm was on the ground as a marker (see Figure 2). The distance for placing baits refers to the book of Methods for Sampling Termites [11] in which all baits were arranged with the in- between distance of 5 meters in each research location point.

Observation on the baits was carried out after 2 months. All samples of planted baits were collected and observed for the direction of the termite attack. After that, they were put in a plastic bag then sprayed with 4% formalin. Furthermore, they were taken to the laboratory to collect samples of termites. The wooden baits were then dried and calculated their final volume. All types of obtained termites were put in vials containing 70% alcohol. Each vial was labelled with the date and the location point of collection. After that, termites were then identified and counted.

Abiotic factors measured in this study were soil temperature, soil pH, light intensity, air temperature, and soil moisture. The termites with the soldier caste at each location were identified down to the species level. The identification of termite species was carried out at the Basic Science Laboratory of the Department of Biology, Faculty of Mathematics and Natural Sciences,

University of Bengkulu. It included body length, head length, head width, and the number of antenna segments by using the books "Biology of Termite" [3] and "Termites and Sustainable Management" [1] as references. The data found then analysed qualitatively and quantitatively. The qualitative analysis included a descriptive analysis of the type of collected termites. Meanwhile, the quantitative analysis covered termite abundance, relative abundance, and attack intensity.

3. RESULTS AND DISCUSSION

University of Bengkulu, the three species of subterranean termites found, i.e. *Microtermes inspiratus* (family Termitidae, subfamily Macrotermitinae), *Macrotermes gilvus* (family Termitidae, subfamily Macrotermitinae), and *Coptotermes curvignatus* (family Rhinotermitidae family and subfamily Coptotermitinae) (Table 1).

According to [7] that regarding the diversity of subterranean termite species in West Jakarta and East Jakarta using pinewoods as baits, he found four types of subterranean termites in those locations. They consisted of two families, i.e. Termitidae (*Macrotermes gilvus*, *Coptotermes curvignatus*, and *Capritermes mohri* species) and Rhinotermitidae (*Coptotermes curvignatus* species).

According to [5] that in the area of Mijen Housing, Semarang, they reported that they found two types of subterranean termites, i.e. *Macrotermes gilvus* species (family Termitidae) and *Coptotermes curvignatus* species (family Rhinotermitidae). [6] based on the results of their research on the types of termites in Minangkabau Traditional Houses in West Sumatra, reported that they found three types of termites in that location, i.e. *Macrotermes gilvus*, *Macrotermes* sp., and *Nasutitermes matangensis* species.

Table 1. The species of termites found in the area of University of Bengkulu campus using rubberwood as baits

No	Species	Locations				
		1	2	3	4	5
1	<i>Microtermes inspiratus</i>	✓	✓	-	-	-
2	<i>Macrotermes gilvus</i>	-	-	✓	-	-
3	<i>Coptotermes curvignatus</i>	-	-	-	✓	✓

Note:

✓ = found

- = not found

- Location 1 (the area of GSG Building)
- Location 2 (the area of UNIB Library Building)
- Location 3 (the area of UNIB Rectorate)
- Location 4 (the area of English Center)
- Location 5 (the area between Darul Ulum Mosque and Building A)

There were differences in the types of termites found in the area of the University of Bengkulu campus with previous studies in different places. This is due to different research locations because each type of termites prefers certain locations such as high soil moisture, the presence of tree canopies, and the existence of food sources in the form of cellulose for their survival. According to [3] that at each location, most of the subterranean termite species have different diversity and distribution. This is strongly influenced by certain criteria such as food sources, high soil moisture, and tree canopy. The presence of termites at each location point can be seen in Table 2. Of three types of termites found, two of them were found in two different locations, namely *Microtermes inspiratus* found in location 1, and 2 and *Coptotermes curvignatus* found in location 4 and 5. This is presumably because of similarities related to abiotic factors, i. e. soil moisture, light intensity, soil pH, and other biotic factors such as tree canopy.

Macrotermes gilvus was only found at location 3. This is because environmental abiotic and biotic factors at location 3 support the growth of the type of this termite, such as food sources (cellulose), soil pH (5.4 – 6.2) (Table 3) which is relatively lower than other location points, and the presence of water sources. This is in line with the statement of [1] that environmental abiotic and biotic factors, such as water and food sources, greatly affect the diversity of subterranean termites in a certain area.

From all five research locations, location 3 had the highest abundance level of subterranean termite species, namely *Macrotermes gilvus* species with an abundance value of 150.000 individuals/m³. The abundance for each subterranean termite species at five location points is presented in Table 2.

Table 2. The abundance of subterranean termites in the wooden baits in the area of the University of Bengkulu Campus

No.	Species	Location	Location	Location	Location	Location
		1 idv/m ³	2 idv/m ³	3 idv/m ³	4 idv/m ³	5 idv/m ³
1	<i>Microtermes inspiratus</i>	140.000	73.000	0	0	0
2	<i>Macrotermes gilvus</i>	0	0	150.000	0	0
3	<i>Coptotermes curvignatus</i>	0	0	0	81.000	23.000
Total		140.000	73.000	150.000	81.000	23.000

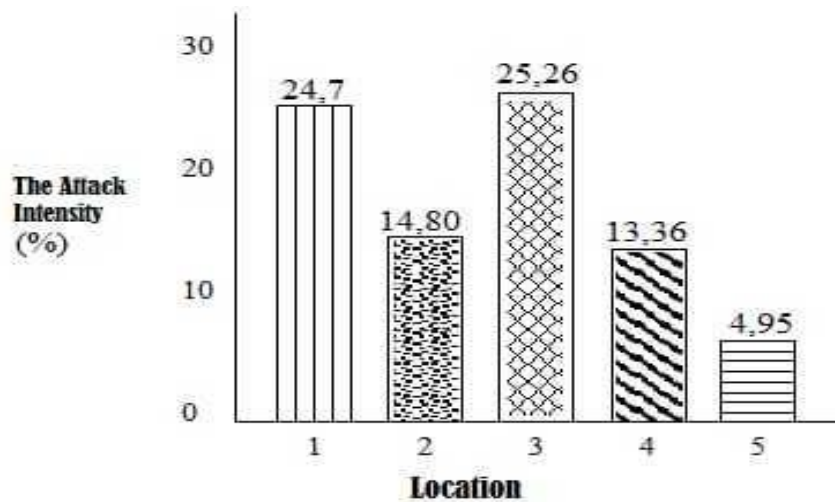


Figure 3. The histogram of attack intensity of subterranean termites on the wooden baits in all location

In Table 2, it can be seen that the abundance value of *Macrotermes gilvus* is the highest and found in location 3. This is presumably because of soil moisture (40 – 45%) that is relatively higher compared to the other four location points (Table 3) and light intensity (704 – 745 lux) that is relatively lower than the other four location points (Table 3). This result is in line with a study conducted by [10] regarding the distribution and morphological characters of *Macrotermes gilvus* in natural forest habitats. The result of their study indicated that *Macrotermes gilvus* prefers areas with soil moisture between 38 – 65%. [4] also stated that *Macrotermes gilvus* built a nest in the soil which has a light intensity of 400 – 800 lux and is close to materials containing cellulose such as wood, organic trash, or hummus. Furthermore, the abundance value of *Coptotermes curvignatus* is the lowest and found in location 5. This is presumably because of a lack of food source factor for the survival of termites, namely materials containing celluloses at that location. The highest intensity of subterranean termite attack was found at location 3 with a total attack rate of 25.26% (Figure 3) so that the level of wood damage at this point can be classified as a severely damaged category.

The high intensity of subterranean termite attack on the wooden baits at location 3 (Figure 3) is caused by the attack of *Macrotermes gilvus* species, which is very aggressive in attacking the wood. This is also related to

the high abundance of subterranean termites at the location (Table 2). [3] stated that *Macrotermes gilvus* is a type of termite that is very greedy to attack wood, especially on wood that is dead and lying on the ground. Besides, the type of used wooden baits also affects the level of subterranean termite attack. [4] also stated that *Macrotermes gilvus* like plantation wood such as rubber and oil palm woods. The results from a study conducted by [12] regarding the diversity of termite types and the intensity of building damage in Alam Sinarsari Housing, Bogor, showed that *Macrotermes gilvus* is a termite type that has the potential to damage buildings in the area. From the results of measurements of soil temperature, soil pH, light intensity, air temperature, and soil moisture, all of them are still in the limited tolerance level for termite life. [13] stated that in general, insects prefer the less extreme environment, namely at an average ambient temperature of 20 – 40°C. [4] stated that subterranean termites generally dislike overly acidic soil structures and usually live-in environments with a pH level of above 5. According to [1] stated that a good light intensity tolerance range for subterranean termites is not more than 1500 lux. According to [4], subterranean termites generally like environments with an air temperature range of 20–40°C. According to [3], the optimal growth of subterranean termites is in the soil moisture range of 10–60. The description of the types of termites found is as follows.

Table 3. Abiotic factors in the area of University of Bengkulu Campus

No	Abiotic factors	Location				
		1	2	3	4	5
1	Soil Temperature (°C)	30–31	29–30	30–31	29–30	29–30
2	Soil pH	6.2–6.9	6.4–6.9	5.4–6.2	6–6.2	6–6.1
3	Light Intensity (Lux)	835–846	805–810	705–745	801 - 898	973–984
4	Air Temperature (°C)	28–29	28–30	28–29	28 - 30	28–29
5	Soil Moisture (%)	10–25	10–20	40–45	20 - 35	30–35

3. 1. *Microtermes inspiratus*

Microtermes inspiratus has round head, head length of 2 ± 0.2 mm (n = 3), head width of 1.8 ± 0.4 mm (n = 3), moniliform antenna shape, and 16 segment antennae (Figure 3 row I). For its soldier caste, it has a light-yellow body, a body length of 5.8 ± 0.3 mm (n = 3) including the head, and fine hairs around the abdomen (Figure 3 row I). [1] stated that the morphological characteristics of soldier caste for *Microtermes inspiratus* is having a round head, 16 segmented antennae, and fine hair on the abdomen.

3. 2. *Macrotermes gilvus*

Macrotermes gilvus has two types of soldier castes, namely termites with the major soldier caste (Figure 3 row II) and those with the minor soldier caste (Figure 3 row III). For its major soldier caste, it has a round and elongated head, head length of 5.2 ± 0.3 mm (n = 3), head width of 3.2 ± 0.3 mm (n = 3), moniliform antenna shape, and 17 segment antennae (Figure 3 row II). Furthermore, it has a reddish-brown body, a body length of 9.9 ± 0.4 mm (n = 3) including the head, and no fine hairs around the abdomen (Figure 3 row II). [1] stated that the major soldier caste of *Macrotermes gilvus* has an elongated and round head, a pair of large black mandibles, an antenna consisting of 17 segments, a

reddish-brown body color, and no fine hair on the abdomen. For its minor soldier caste, it has a round and elongated head, head length of 3.4 ± 0.2 mm (n = 3), head width of 1.5 ± 0.2 mm (n = 3), moniliform antenna shape, and 17 segment antennae ((Figure 4 row III). Furthermore, it has a dark brown body, a body length of 8.2 ± 0.4 mm (n = 3) including the head, and no fine hairs around the abdomen (Figure 3 row III). The difference between the major and minor soldier castes of *Macrotermes gilvus* is body size. The major soldier caste has a larger body. It has also darker body color and a larger mandible. According to [1] that *Macrotermes gilvus* has two types of soldier caste, namely the major and minor soldier castes. The major soldier caste has a larger body size and a larger mandible compared to the minor soldier caste.

Furthermore, it has a dark brown body, a body length of 8.2 ± 0.4 mm (n = 3) including the head, and no fine hairs around the abdomen (Figure 3 row III). The difference between the major and minor soldier castes of *Macrotermes gilvus* is body size. The major soldier caste has a larger body. It has also darker body color and a larger mandible. According to [1] that *Macrotermes gilvus* has two types of soldier caste, namely the major and minor soldier castes. The major soldier caste has a larger body size and a larger mandible compared to the minor soldier caste.

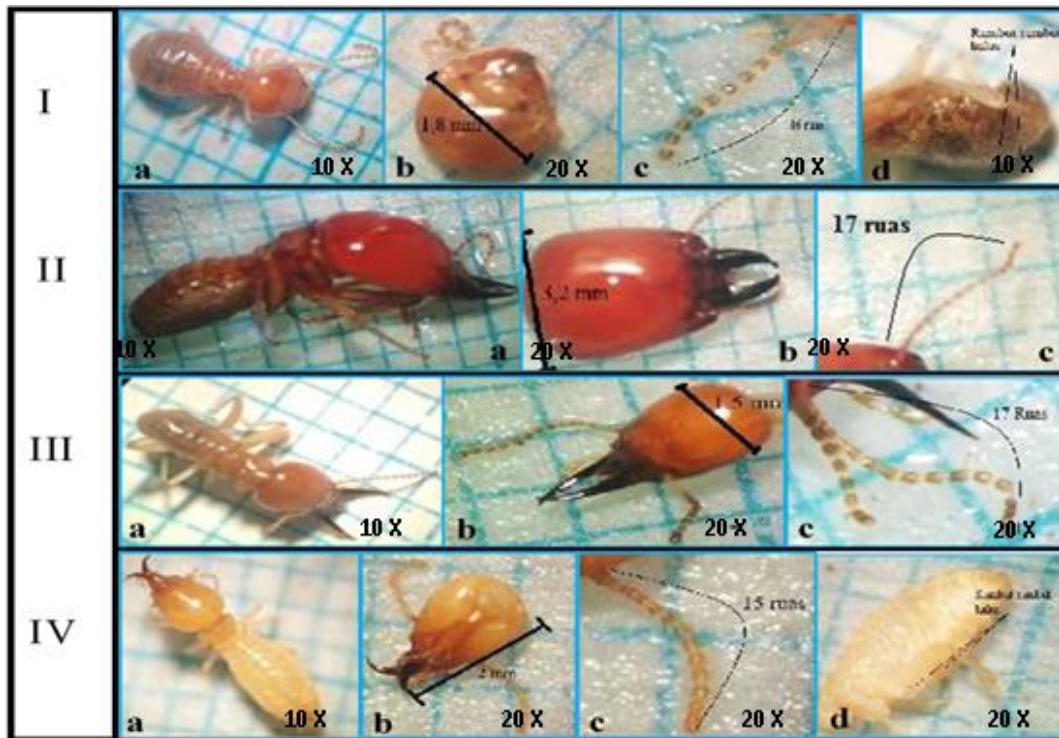


Figure 3. I. *Microtermes inspiratus*: a) soldier caste, (b) head, (c) antenna, and (d) abdomen; II. *Macrotermes gilvus*: (a) major soldier castel, (b) head and (c) antenna; III. *Microtermes gilvus*: (a) minor soldier castel, (b) head, and (c) antenna; IV. *Microtermes curyignatus*: (a) soldier castel, (b) head, and (c) antenna, and (d) abdomen.

3.3. *Coptotermes curvignatus*

Coptotermes curvignatus has a round and elongated head like an egg, head length of 2 ± 0.4 mm ($n = 3$), head width of 1.5 ± 0.3 mm ($n = 3$), moniliform antenna shape, and 15 segment antennae (Figure 3 row III). For its soldier caste, it has a light-yellow body, a body length of 6 ± 0.2 mm ($n = 3$) including the head, and white smooth spikes around the abdomen (Figure 3 row III). [1] stated that the morphological characteristics of the soldier caste of *Coptotermes curvignatus* has a round head like an egg, 15 segments antenna, light yellow body, and white smooth spikes around the abdomen.

4. CONCLUSION

From the results of this study that has been conducted on the types and abundance of subterranean termites (Insecta: Isoptera) in the area of the University of Bengkulu campus using rubberwood as baits, it can be concluded as follows:

1. Three species of subterranean termites were found in the area of the University of Bengkulu campus, namely *Microtermes inspiratus*, *Macrotermes gilvus*, and *Coptotermes curvignatus*.
2. The highest abundance was found in *Macrotermes gilvus* species with an abundance value of 150.000 individuals/m³ around the area of UNIB Rectorate
3. The highest attack intensity was found in *Macrotermes gilvus* species with an attack intensity value of 25.26%.

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