

Termite Fauna of Gunung Telapak Buruk, Berembun Forest Reserve, Negeri Sembilan, Malaysia

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ABSTRACT

Termites have great importance in a tropical terrestrial ecosystem, especially in the decomposition process, mediate ecosystem processes and facilitate in improving the structure and quality of the soil. Termite survey was conducted at Gunung Telapak Buruk, Berembun Forest Reserve, Negeri Sembilan, during a scientific expedition from 30th March to 1st April 2019. This study aims to provide the first checklist of termite fauna in Gunung Telapak Buruk. Termites were collected using the casual collection method at selected trails around Gunung Telapak Buruk. A total of 21 termite species were recorded in this study. The termite assemblage comprises two families, namely Rhinotermitidae and Termitidae. Family Termitidae dominated the termite assemblage with 90.5% (19 species). The collected termite species in this study comprises 12% of recorded termite species of Peninsular Malaysia by Tho in 1992. The genus *Odontotermes* from the family Termitidae dominated the assemblage with five species. Four types of feeding groups were identified in this study. The wood feeders recorded highest number species with 66.7%, followed by soil feeders (14.3%), epiphyte feeder (9.52%), and wood-litter feeders (9.52%). All the recorded species are new record for this forest reserve as no previous record was available for this area.

Keywords: Diversity, forest, highland, mountain, termite fauna

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INTRODUCTION

Systematic study on termites in Malaysia has started since 1980s, whereby two main termite identification guide books for Malaysia were published in the year 1981 by Thapa and 1992 by Tho. Since then, termite research in Malaysia have covered the area of fundamental and application studies (Eggleton *et al.*, 1997; Jones & Brendell, 1998; Jones *et al.*, 1998; Homathevi *et al.*, 2002; Lee, 2004; Abdul Hafiz *et al.*, 2007; Abdul Hafiz & Abu Hassan, 2009; Hanis *et al.*, 2014; Nivaarani & Homathevi, 2015; Kori & Arumugam, 2017; Rahman *et al.*, 2018; Saputra *et al.*, 2018; Visheentha *et al.*, 2018; Alia Diyana *et al.*, 2019; Arumugam *et al.*, 2019). However, the pest problem caused by termites and the development in science and technology has reduced the focus on forest termite diversity study, especially in Peninsular Malaysia. There is a high necessity for termite diversity study to update the number of termite species of Malaysia, where the final collection list was made by Tho (1992). There are

still many unexplored places in Peninsular Malaysia. Hence, this study was focused on Gunung Telapak Buruk (GTB), Berembun Forest Reserve. This study is the first scientific termite study conducted at GTB to identify the termite species composition.

Termites are classified under the order Blattodea (Inward *et al.*, 2007). From the listed 3106 living and fossil termites, 175 termite species have been recorded in Peninsular Malaysia (Tho, 1992; Krishna, 2013). They are one of the significant organisms that contribute to the decomposition process in the forest (Wood & Johnson, 1986). Termites also provide other ecosystem services in the forest such as improvement of soil structure and quality, facilitation of nutrient cycles (carbon and nitrogen cycle), and continuation of the food chain (Wood & Johnson, 1986; Bignell & Eggleton, 2000; McGavin, 2001; Inoue *et al.*, 2006). The termite community also can be used as an environmental bioindicator to observe changes in land use (Pribadi *et al.*, 2011). However, 10% of

the total termite species are documented as pests in the world (Kirton, 2005). The termites have caused severe structural damage and, consequently, high economic losses in many countries (Adams & Raj, 2005; Gibb & Oseto, 2006).

The eusocial termite's colony comprises four main castes, which are king, queen, soldiers, and workers (Gibb & Oseto, 2006). King and queen are the winged reproductive and responsible for the reproduction in the colony. Soldiers are the caste protecting the colony. Soldiers can be differentiated from other castes with the appearance of either mandible or rostrum on their head. Workers are the sterile individuals in the colony that take care of the egg-laying queen, provide food for the colony and construct new tunnels and chambers (Higashi *et al.*, 2000; Gibb & Oseto, 2006). Termites can be classified into different groups according to their feeding and nesting behaviour. Termites were grouped based on the classification system proposed by Eggleton *et al.* (1997) as follows: wood-feeders, litter forages, micro-epiphyte feeder, soil-feeders, and soil-wood interface-feeders. The nesting group comprises wood nesters, arboreal nesters, epigeal nesters, and hypogeal or subterranean nester (Bignell & Eggleton, 2000).

MATERIALS AND METHODS

Termite collection was done at GTB during Gunung Telapak Buruk Scientific Expedition 2019 that was organised by Negeri Sembilan Forestry Department. Gunung Telapak Buruk located at Berembun Forest Reserve in Negeri Sembilan state (2°49'59.8332"N, 102°2'39.2748"E). The data collection was performed from 30th March until 1st April 2019 using casual collection method. Termites were collected at four sampling sites that were surrounded by primary forest, namely Track CP2, Track CP4, Track Transmitter, and main road around the campsite. The elevation of the sampling sites is about 900 m above sea level. Termites (five worker and soldier castes) were collected along the trails manually using forceps. Microhabitats such as mound, nest, mud tubes on a tree trunk, leaf litter, and deadwood were searched for termites (Nivaarani & Homathevi, 2015; Arumugam *et al.*, 2019). Collected termites were preserved in 80% ethanol. Further identification was done at Natural

Resources Laboratory, Faculty of Earth Science (FSB), Universiti Malaysia Kelantan (UMK), Jeli Campus, with the aid of Thapa (1981) and Tho (1992) using a stereomicroscope. Collected termites were deposited at Natural Resources Museum of FSB, UMK, Jeli Campus for future reference.

RESULTS AND DISCUSSION

Termite survey at GTB recorded a total of 21 termite species. The assemblage comprises two families (Rhinotermitidae and Termitidae) and 13 genera (Table 1). Termitidae recorded the highest number of species (19 species) at GTB, as documented in other termite studies across Malaysia (Homathevi *et al.*, 2002; Nivaarani & Homathevi, 2015; Kori & Arumugam, 2017; Arumugam *et al.*, 2019). This is because Termitidae is well known as the largest termite family in the world where the family comprises 75% to 80% of the termite species (Tho, 1992; Brandl *et al.*, 2007). Termitidae also dominated the assemblage with three subfamilies (Macrotermitinae, Nasutitermitinae, and Termitinae) while Rhinotermitidae recorded only one subfamily, Rhinotermitinae. Subfamily Nasutitermitinae and genus *Odontotermes* from the family Termitidae documented the highest number of species with 11 species and five species, respectively (Figure 1).

The feeding group and nesting group of the identified termites were analysed based on Eggleton *et al.* (1997) and Bignell and Eggleton (2000). Wood feeders dominated the assemblage with 66.7%, followed by soil feeders with 14.3%, epiphyte feeders (9.52%), and wood (litter) feeders (9.52%) as shown in Figure 2. The termite assemblage of the study site also comprises hypogeal nesters (52.4%), arboreal nesters (28.6%), and wood nesters (19.05%). However, this result may be due to the sampling strategy conducted in this study. Factors such as collection method and inadequate sampling effort in soil sample of forest floor influence the type of feeders collected at GTB. This may result to the highest number of wood feeders recorded in this study. Standardized line transect method is recommended for future termite study at GTB.

Table 1. Termite species recorded at Gunung Telapak Buruk: Feeding groups, w = wood feeders, s = soil feeders, epy = epiphyte feeders, l = litter feeders, f = fungus growers. Nesting groups, a = arboreal nesters, w = wood nesters, h = hypogeal nesters

	Feeding Group	Nesting Group
Family: Rhinotermitidae		
Subfamily: Rhinotermitinae		
<i>Schedorhinotermes medioobscurus</i> (Holmgren)	w	w
<i>Parrhinotermes aequalis</i> (Haviland)	w	w
Family: Termitidae		
Subfamily: Macrotermitinae		
<i>Macrotermes carbonarius</i> (Hagen)	w/l	h
<i>Macrotermes malaccensis</i> (Haviland)	w/l	h
<i>Odontotermes neodenticulatus</i> Thapa	w(f)	h
<i>Odontotermes oblongatus</i> Holmgren	w(f)	h
<i>Odontotermes prodives</i> Thapa	w(f)	h
<i>Odontotermes sarawakensis</i> Holmgren	w(f)	h
<i>Odontotermes</i> sp.	w(f)	h
Subfamily: Nasutitermitinae		
<i>Bulbitermes flavicans</i> (Holmgren)	w	a
<i>Bulbitermes</i> sp. 1	w	a
<i>Bulbitermes</i> sp. 2	w	a
<i>Havilanditermes</i> sp.	w	w
<i>Hirtitermes hirtiventris</i> (Holmgren)	w	w
<i>Hospitalitermes hospitalis</i> (Haviland)	epy	a
<i>Hospitalitermes umbrinus</i> (Haviland)	epy	a
<i>Leucopitermes</i> sp.	s	h
<i>Longipeditermes longipes</i> (Haviland)	w	h
<i>Nasutitermes regularis</i> (Haviland)	w	a
<i>Subulioditermes major</i> (Thapa)	s	h
Subfamily: Termitinae		
<i>Coxocapritermes</i> sp.	s	h
Total number of species = 21		

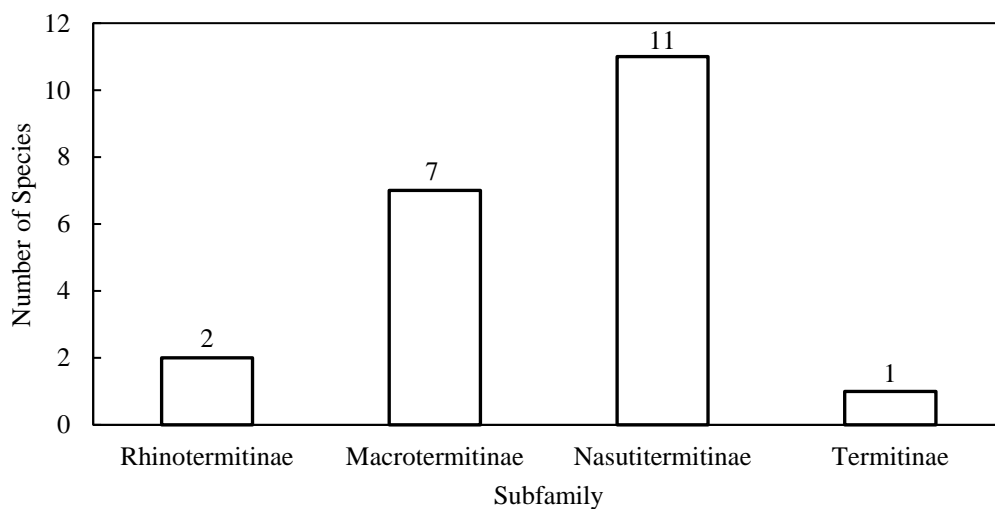


Figure 1. Termite species according to subfamilies at Gunung Telapak Buruk

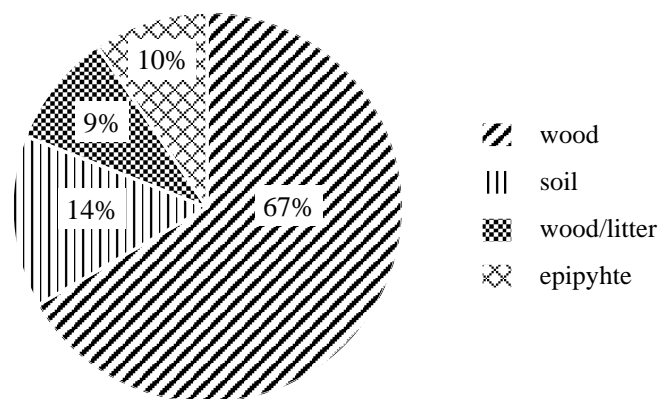


Figure 2. Percentage of termite feeding groups identified at Gunung Telapak Buruk

There are still limited studies on termite in the forest of Negeri Sembilan. Published data shows that a termite study was conducted at Pasoh Forest Reserve (PFR) in Negeri Sembilan by Jones and Brendell in 1998. The site consists of 80 termite species. Study at PFR was conducted at an elevation from 90 m to 150 m above sea level while the current study was conducted at the area above 900 m above sea level. The difference in altitude affects the number of termite species recorded in the forest. Previous studies proved that the number of termite species decreased with the increase of elevation (Gathorne-Hardy *et al.*, 2001; Pratiknyo *et al.*, 2018). PFR recorded higher termite species due to the lower elevation, while GTB recorded a low number of species due to higher elevation.

Approximately 10% of the world termite species act as pests either in the forest, urban, or agricultural land (Kirton, 2005). In forests, termite pests can be observed inside living trees, where this may endanger trees in the future. In this study, forest termite pest is not reported. All the identified termites provide beneficial ecosystem services to the forest as decomposers and soil engineers. This observation contrasts with the study at PFR as the latter recorded genera that are well known as pests in forests, such as *Coptotermes* and *Microcerotermes* (Cowie *et al.*, 1989; Jones & Brendell, 1998). Species from these genera always build their nest on living trees and also attack the tree (Nivaarani & Homathevi, 2015; Kori *et al.*, 2017). In this study, all the termites that were identified in the wood were collected either from dead wood or decaying wood on the forest floor. Termites observed during this study were not found to attack any living tree.

CONCLUSION

In conclusion, Gunung Telapak Buruk recorded 21 termite species from two families and 13 genera. The collected termite species in this study comprises 12% of recorded termite species of Peninsular Malaysia. Genus *Odontotermes* and subfamily Nasutitermitinae from family Termitidae dominated the assemblage with five species and 11 species, respectively. All the recorded species in this study are a new record for Gunung Telapak Buruk as no previous record was available for this area. A comprehensive and longer study period covering the area would definitely increase the number of termite species found in Gunung Telapak Buruk.

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