TERMITE FAUNA OF MARAI PARAI - GURKHA HUT, KOTA BELUD, SABAH, MALAYSIA

Homathevi Rahman*,[1], Marcellus Nicholsonn -Sanai@Marcus[2], & Ginik Lunsin[3]

[1]Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, Jalan UMS, 88400, Kota Kinabalu, Sabah, Malaysia.

[2]Faculty of Tropical Forestry, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia.

[3]Kinabalu Parks, P.O Box 6, 89308 Ranau, Sabah, Malaysia.

*Corresponding Authors: homa@ums.edu.my

ABSTRACT

Termites are essential for soil health, breaking down organic matter and recycling nutrients, which supports plant growth and biodiversity, making their species composition crucial for maintaining the balance and resilience of natural ecosystems. This paper presents a preliminary checklist of termite species collected from Nunuk Subcamp, part of Marai Parai Gurkha Hut area. Termites were manually collected using standardized 100 m x 2 m belt transect. A total of 19 termite species of 13 genera of two families (Rhinotermitidae and Termitidae), were documented within the forest sites of Nunuk Subcamp. The assemblage is dominated by the family Termitidae (90%), the largest and most common family comprising of both soil and wood dwelling termites. Wood feeders dominated the assemblage, making up 48% of the composition, indicating their prevalence in the study area, followed by soil-feeders at 42%, highlighting their significant presence in the local termite community. The termite diversity in this area is notably lower compared to what is typically found in Malaysian primary forests, where all the mentioned termite species are commonly observed.

Keywords: *Termite, Termitidae, Belt-transect, Marai Parai, Nunuk Camp, Sabah*

INTRODUCTION

Termites play a critical role as key members of soil macrofauna in tropical regions. Their prevalence in these ecosystems stems from their effective utilization of abundant cellulose-rich dead plant material (Abe, 1995). Termites are pivotal in ecological processes such as organic matter decomposition (Wood & Johnson, 1986; Bignell et al., 1997) and serve as soil ecosystem engineers in tropical forests (Bignell & Eggleton, 2000). They significantly contribute to soil structure improvement, mineral and organic material redistribution, and the formation of organo-mineral complexes (Brussaard & Juma, 1996; Lavelle, 1996). Termite distribution is influenced by environmental factors such as climate, altitude, soil type, and vegetation cover, which determine suitable habitats and food sources. Understanding these factors is essential for conservation efforts and ecosystem management.

Natural disturbances and human activities, such as land use changes and pesticide use, play significant roles in shaping termite populations and their spatial distribution across ecosystems. Termite assemblages serve as sensitive indicators of habitat disturbance caused by human activities, exhibiting characteristic changes in species richness and functional group composition along disturbance gradients, including those induced by logging and the conversion of natural forests to plantations or agricultural fields (Collins, 1980; Eggleton et al., 1997, 1999).

This paper presents a preliminary list of termite species collected from Nunuk Subcamp during the Marai Parai Gurkha Hut Scientific Expedition from 7th to 20th October 2023. The results were then compared with previous studies using the same sampling protocol in other forest ecosystems.

METHODOLOGY

Termite sampling was conducted at Nunuk Subcamp along the Marai Parai main trail. Nunuk Subcamp is located approximately at latitude 116.500°E and longitude 6.040°N, at an elevation of 1,215 meters above sea level (Figure 1). This elevation places the site within a unique forest ecosystem, characterized by diverse microhabitats that support a wide range of invertebrates. These microhabitats, including dead wood, tree root systems, and subterranean nests, provide critical niches, making it an important location for biodiversity studies. Termites were sampled using two belt transects, each measuring 100 x 2 meters, at different locations. Sampling followed the protocol described by Jones and Eggleton (2000). Successive 5-meter sections of the transect were sampled by two people for 30 minutes per section. All microhabitats known to contain termite species were explored, including carton runways on tree trunks and above-ground vegetation, dead wood in various stages of decay, root mats, tree root systems and buttresses, surface soil, subterranean and epigeal nests, nests inside wood, and arboreal nests up to 2 meters above ground level. Additionally, casual sampling was conducted at other locations along the main expedition trail.

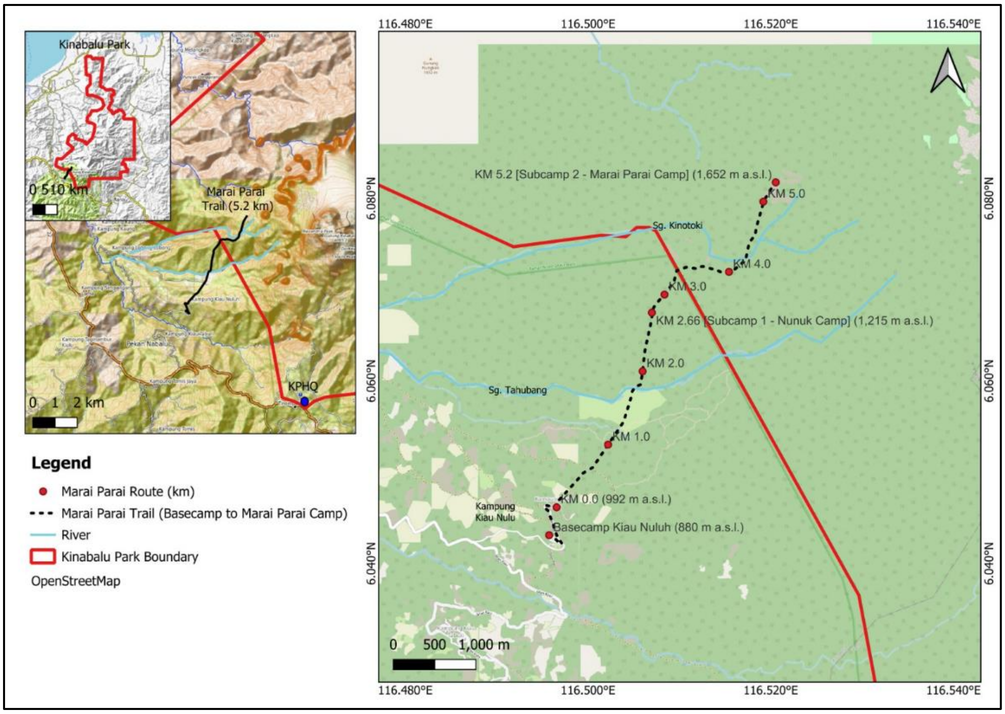

Figure 1. Map showing the location of Nunuk Subcamp and the sampling sites along the Marai Parai main trail (Sabah Parks).

The samples collected were preserved in 80% alcohol and subsequently identified or assigned to morphospecies by referencing Thapa (1981), Collins (1984), and Tho (1992). Specimens were also compared with the termite collection from the BORNEENSIS at the Institute for Tropical Biology and Conservation. Feeding and nesting groups were classified according to Eggleton et al. (1997) and Jones & Brendell (1998).

RESULT AND DISCUSSION

A total of 19 termite species, belonging to 13 genera across two families (Rhinotermitidae and Termitidae) were documented within the forest sites of

Nunuk Subcamp (Table 1). The assemblage is dominated by the family Termitidae (90%), the largest and most common family comprising both soil and wood-dwelling termites. This family is represented by three subfamilies: Termitinae, Macrotermitinae, and Nasutitermitinae, which are common in most tropical forests. Among them, Termitinae and Nasutitermitinae are the largest groups, each comprising eight species, while Macrotermitinae is represented by a single species, *Macrotermes* sp..

Within the forest ecosystem, termite communities are categorized into various trophic groups such as wood feeders, soil feeders, soil-wood interface feeders, epiphyte feeders, litter feeders, and fungus growers. Their abundance and species composition fluctuate based on the type of forest, physical factors and the level of disturbances (Eggleton et al., 1997; Homathevi et al., 2002). Termite communities within the studied area comprised of four trophic groups: wood feeders, soil feeders, soil-wood interface feeders, and litter feeders/fungus growers, each with distinct species compositions. Wood feeders dominated the assemblage, accounting for 48% (nine species) of the composition, which indicates their prevalence in the study area, followed by soil feeders at 42%. The most dominant wood-feeding species were *Bulbitermes flavicans* and *Parrhinotermes* sp., found dwelling within their food sources. This dominance underscores the crucial role wood feeders play in ecosystem processes by decomposing dead wood and contributing to nutrient cycling. Consequently, their abundance highlights the importance of dead wood as a habitat and nutrient source within the ecosystem. Soil feeders were represented by eight species, while fungus growers, also known as litter feeders, were represented by a single species, *Macrotermes* sp., and soil-wood interface feeders were represented by *Homallotermes eleanorae*.

Understanding the trophic diversity of termite communities provides valuable insights into their nesting habits and broader ecological roles within the forest ecosystem, and notably, most termite species were found residing within or in the vicinity of their food sources. The recorded termites were subterranean (hypogeal), mound (epigeal), wood, and arboreal nest-building species (Figure 2). Hypogeal and arboreal nesting termites each constituted 37% of the population, indicating their equal prominence within the community. Epigeal nesters, which build their nests on the ground surface, accounted for 16% of the termite population. Wood-nesting termites made up the smallest group, representing 10% of the community.

Table 1. Termite species recorded from Nunuk Camp, Marai Parai Gurkha Hut: Feeding groups, l = litter feeders, s = soil feeders, s/w = soil/wood interface feeders, w = wood feeders, (f) = fungus growers. Nesting groups, a = arboreal, e = epigeal, h = hypogeal, w = in dead wood.

		Feeding group	Nesting group
	Family: Rhinotermitidae		
	Parrhinotermes sp	w	w
	Schedorhinotermes sp	w	w
	Family: Termitidae		
	Sub-family: Macrotermitinae		
	Macrotermes sp	w/ l(f)	e
	Sub-family: Termitinae		
*	*Mirocapritermes connectens*	s	h
*	*Homallotermes eleanorae*	s / w	e
	Pericapritermes sp 1	s	h
	Pericapritermes sp 2	s	h
*	*Pericapritermes* sp 3	s	h
	Procapritermes sp	s	h
	Syncapritermes sp	s	h
*	*Dicuspiditermes* sp	s	e
	Sub-family: Nasutitermitinae		
	Nasutitermes neoparvus	w	a
*	*Nasutitermes* sp	w	a
	Bulbitermes flavicans	w	a
	Bulbitermes sp 1	w	a
	Bulbitermes sp 2	w	a
	Bulbitermes sp 3	w	a
	Lacessititermes sp	w	a
	Subulitermes grp sp 1	s	h
	Total No of Species	**19**	

* Casual Collection

Dicuspiditermes mounds were notable for their unique shape. These mounds feature multiple connected towers covered on top, resembling mushrooms. The arboreal nests, constructed from wood cartons and faecal materials, were round or oval in shape, with some featuring spikes. These findings highlight the diverse nesting strategies employed by termites, with a significant proportion of the population adapting to both underground and arboreal environments. This diversity in nesting behaviour underscores the termites' adaptability and their crucial role in ecosystem functioning, impacting nutrient cycling and habitat structure.

Figure 2. Different types of termite nest structures: (a) and (b) arboreal nests, (c) wood nest and (d)epigeal nest

The termite species observed in this study demonstrate their adaptability to higher elevations and wet environments. Their abundance may be attributed to the availability of dead wood and favourable conditions, which enable these termite species to thrive and establish larger populations within the area.

CONCLUSION

In conclusion, our study sheds light on the intricate dynamics of termite communities within the forest ecosystems of Nunuk Subcamp. The documented termite diversity across different trophic groups provides valuable insights into their ecological roles and habitat preferences, emphasizing their adaptability and ecological significance. The dominance of wood feeders and the observed diverse nesting strategies underscore the vital role of termites in shaping ecosystem structure and function. While our study significantly contributes to understanding termite ecology in tropical forests, it's crucial to acknowledge its limitations, such as potential seasonal variations and limited sampling periods. Future research could explore these factors in more detail to enhance our understanding of termite dynamics and the drivers behind observed ecological patterns. Collaborative efforts between researchers, conservationists, and policymakers will be essential for translating our research findings into effective conservation and management strategies, preserving the biodiversity and ecological integrity of forest ecosystems in the face of environmental change.

ACKNOWLEDGEMENTS

We would like to thank Sabah Parks and Universiti Malaysia Sabah (UMS) and the relevant staff members for permitting us to conduct this survey at Marai Parai – Gurkha Hut. Thank you to the guides and porters who have assisted the journey to Nunuk Subcamp and Marai-Parai Camp.

REFERENCES

Abe, T. (1995). The termite-symbionts system: How does it work and has it evolved as a super-efficient decomposer in tropical terrestrial ecosystems? Center for Ecological Research, Kyoto University, Kyoto.

Bignell, D.E., Eggleton, P., Nunes, L. & Thomas, K.L. (1997). Termites as mediators of carbon fluxes in tropical forest: budgets for carbon dioxide and methane emissions. In: Watt, A.D., Stork, N.E. and Hunter, M.D. (eds). Forest and Insects. Chapman and Hall, London: 109-134.

Bignell, D. E., & Eggleton, P. (2000). Soil processes and the habitat niche of termites. In T. Abe, D. E. Bignell, & M. Higashi (Eds.), Termites: Evolution, Sociality, Symbioses, Ecology (pp. 97-132). Springer.

Brussaard, L., & Juma, N. G. (1996). Soil fauna and soil fertility management. In J. K. Syers, L. T. West, & D. S. M. Haynes (Eds.), Soil Organic Matter in Sustainable Agriculture (pp. 269-294). CRC Press.

Collins, N. M. (1980). Termite species richness and habitat disturbance in two adjacent rainforest types in New Guinea. Oecologia, 47(1), 126-130.

Collins, N.M. (1984). The termites (Isoptera) of the Gunung Mulu National Park, with a key to the genera known from Sarawak. Sarawak Mus. J. 30: 65-87.

Eggleton, P., Homathevi, R., Jeeva, D., Jones, D.T., Davies, R.G. & Maryati, M. (1997). The species richness and composition of termites (Isoptera) in primary and regenerating lowland dipterocarp forest in Sabah, East Malaysia. Ecotropica. 3: 119-128.

Eggleton, P., Homathevi, R., Jones, D.T., MacDonald, J.A., Jeeva, D., Davies, R.G., Bignell, D.E. & Maryati, M. (1999). Termite assemblages, forest disturbance, and greenhouse gas fluxes in Sabah, East Malaysia. Philosophical Transactions of the Royal Society of London, Series B 354: 1791-1802.

Homathevi, R., Bakhtiar, Y., Mahadimenakbar, D., Maryati, M., Jones, D. T., & Bignell, D. E. (2002). A comparison of Termite (Insecta: Isoptera) assemblages in six primary Forest stands in Sabah, Malaysia. Malayan Nature Journal, 56, 225–237.

Jones, D.T. & Brendell, M.J.D. (1998). The termite (Insecta: Isoptera) fauna of Pasoh Forest Reserve, Malaysia. The Raffles Bulletin of Zoology 46: 79-91.

Jones, D.T. & Eggleton, P. (2000). Sampling termite species assemblages in tropical forests: testing a rapid biodiversity assessment protocol. Journal of Applied Ecology 37: 191-203.

Lavelle, P. (1996). Diversity of soil fauna and ecosystem function. Biology International, 33, 3-16.

Thapa, R.S. (1981). Termites of Sabah. Sabah Forest Record 12: 1-374.

Tho, Y. P. (1992). A guide to the termites of Singapore. Singapore University Press.