Data on species composition and distribution of termites (Insecta: Isoptera) in different habitats of Xuan Mai area, Hanoi.

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Abstract

The research was carried out in the Xuan Mai area, Hanoi in 2012. The results found 26 species belonging to 10 genera and 4 subfamilies in the studied area. Among them, the subfamily Macrotermitinae had the highest number of species (12 species, equal to 46.15% of total species), followed by Termitinae (10 species, 38.46%), Coptotermitinae (3 species, 11.54%), Amitermitinae (1 species, 3.85 %). The distribution of termites in the different habitats showed that the mixed plantation forest (MPF) had the highest number of species and relative abundance (RA) (13 species, RA: 29), followed by the grassland (GL) (10 species, RA: 26), the uniform plantation forest (UPF) (7 species, RA: 14), and the tea plantation (TP) (3 species, RA: 14). The MPF had the highest biodiversity indices and the TP had the lowest. In addition, the proportion of soil-humus feeding to wood-leaf feeding termites was highest in the GL (1.36) and declined in the UPF (0.27) and the MPF (0.21).

Key words: soil-humus feeding termites, relative abundance, biodiversity, habitats.

Introduction

Termites are known for species causing significant economic damage. Some species are highly destructive pests that feed on wooden components of buildings in urban areas while others cause damage to living trees, crop plants, railway sleepers, etc. However, termites are extremely important components of tropical ecosystems (Lee & Wood, 1971; Swift, Heal, & Anderson, 1979; Wood & Sands, 1978), because they are the key decomposers in tropical terrestrial ecosystems (Abe *et al*., 2000), and ecosystem engineers. Their activities help improve soil structure and nutrient cycling (Jones *et al*. 1994). Moreover, termites are a supplementary source of protein for many species of animals, e.g. birds, amphibians, reptiles and lizards. The Xuan Mai area is situated about 30 kilometers southwest of Hanoi, Vietnam, and is becoming one of the five satellite cities of Hanoi in the near future. In order to ensure the sustainable socio-economic development of Hanoi, particularly Xuan Mai area, the conservation of biodiversity including termites is essential. Most previous research on termites in Xuan Mai had largely

focused on determining the main harmful species and looking for solutions for controlling them (Nguyen, 2001). In those studies, the applied sampling methods were mainly qualitative. In fact, the application of the quantitative sampling method to study features of termite distribution in different habitats and the use of termites as a bioindicator for assessment of effects of human activities on the variety of habitats has not been carried out in Xuan Mai area. Our present study will partially fill that gap of knowledge of the distribution of termites in Xuan Mai.

Materials and methods

Study location

The study was conducted in the region of Xuan Mai hills, Chuong My district, Ha Noi, from April 2011 to June 2012. The studied area is situated between 20° 55' 4.026" N to 20° 54' 12.320" N latitude and 105° 33' 46.660" E to 105° 34' 34.334" E. Xuan Mai hills are mainly plantations of several kinds of trees, e.g. pines, eucalyptus, acacias. The altitude is about 200 meters to around 20 meters above the sea level. The area is affected by tropical climate with some special characteristics, namely four seasons in a year (spring, summer, autumn, and winter), the average rainfall is 1630 mm; humidity, 87%; average temperature, 23.1^{o}C. Four studied habitats were chosen with the features shown in Table 1.

Table 1. The features of the four studied habitats

	Habitats			
	MPF	**UPF**	**GL**	**TP**
Vegetation	Acacias, pines, eucalyptus and other trees	Only acacia	Only grasses, without woody trees	Only tea trees
Canopy height	5 – 7 m	2 – 7 m	-	-
Human activity	Occasionally	Occasionally	Rarely	Frequently

*(**MPF**: mixed plantation forest; **UPF**: uniform plantation forest; **GL**: grassland; **TP**: tea plantation)*

Termite sampling and identification

The sampling followed the method of Jones and Eggleton (2000). One belt transect was conducted in each habitat. A transect was 100 m long and 2 m wide and divided into 20 successive quadrate sections of 5 m x 2 m. Two people collected termites in each section for 30 minutes (a total of one hour of collecting per section). Termites were collected in whole sections by way of searching all potential microhabitats including wood, leaf litter, and surface soil down to 10–15 cm deep, visible nests, and galleries up to the height of 2 m in trees. Due to the heterogeneity of spatial distribution of termites and

the complexity of the habitats, besides collecting termites in the belt transects, we also applied the qualitative termite sampling methodology of Nguyen (1976). Termite sampling was carried out randomly along a line transect of 500 to 1000 meters long.

Termite specimens were kept in small vials with 75-80% alcohol and deposited at the Laboratory of Biodiversity, Department of Invertebrate Zoology, Faculty of Biology, VNU University of Science.

The morphological identification of termites was performed with the use of the documents: Key to Malayan Termites (Ahmad, 1958), Termite (Isoptera) of Thailand (Ahmad, 1965), Termites of Sabah (East Malaysia) (Thapa,1981), The identification of worker Casters of Termite Genera from Soils of Africa and the Middle East (Sands, 1998), Fauna Vietnamese – Termites (Isoptera), Vol.15 (Nguyen et al., 2007).

Results and discussion

The species composition of termites in Xuan Mai area, Hanoi

A total of 134 samples collected in 2012 and 127 samples from previous studies, which had been preserved in the laboratory were analyzed. A total of 26 species belonging to 10 genera, 4 subfamilies was recorded (Table 1). The subfamily Macrotermitinae had the highest species number (12 species, equal to 46.15%), followed by Termitinae (10 species, 38.46%), Coptotermitinae (3 species, 11.54%), Amitermitinae (1 species, 3.85 %). The species number per genus fluctuated between 1 and 6, the average was about 3 (species) in the whole studied area. The genus Odontotermes dominated with 6 species (20.08%), and three other genera, namely Euhamitermes, Microtermes and Dicuspiditermes, had the lowest number of species (only 1 species each, 3.85%).

In comparison with the previous studies by Nguyen (2001), we have found 10 additional speciesin Xuan Mai (*Coptotermes havilandi*, *Coptotermes curvignathus*, *Macrotermes barneyi*, *Odontotermes angustignathus*, *Odontotermes maesodensis, Odontotermes proformosanus, Dicuspitermes garthwaitei, Procapirtermes minutus, Pericapritermes sermarangi*, *Pericapritermes latignathus*). There was still one dry-wood termite species (*Cryptotermes domesticus*) in the previous list of termite composition in Xuan Mai of Nguyen (2001), whose specimens were not collected during our sampling.

Table 2. The genus composition of termites in Xuan Mai area

No.	Scientific name	Species number	Percentage (%)
	RHINOTERMITIDAE		
	Coptotermitinae Holmgren	**3**	**11.54**
1	Coptotermes Wasmann	3	
	TERMITIDAE		
	Macrotermitinae Kemner	**12**	**46.15**
2	Hypotermes Holmgren	3	
3	Macrotermes Holmgren	2	
4	Microtermes Wasmann	1	
5	Odontotermes Holmgren	6	
	Termitinae Sjostedt	**10**	**38.46**
6	Dicuspiditermes Krishna	1	
7	Pseudocapritermes Kemner	2	
8	Procapritermes Holmgren	3	
9	Pericapritermes Silvestri	4	
	Amitermitinae Kemner	**1**	**3.85**
10	Euhamitermes Holmgren	1	
	∑	**26**	**100**

Distribution of termites in different habitats

Four types of habitats, the mixed plantation forest (MPF), the uniform plantation forest (UPF), the grassland (GL) and the tea plantation (TP) were chosen for quantitative sampling to analyze characteristics of termite distribution in Xuan Mai area. 18 species of 9 genera, 3 subfamilies were recorded in those four studied habitats (Table 3).

Among four habitats, MPF had the highest species number and relative abundance (RA) (13 species, RA: 29), followed by GL (10 species, RA: 26), UPF (7 species, RA: 14) and TP (only 3 species, RA: 14).

Table 3. Species composition and relative abundance of termites in different habitats

Scientific name	Feeding group	Habitats				
		MPF	UPF	TP	GL	∑
Coptotermes havilandi	W	1				1
Macrotermes annandalei	W-L	4	2	2	1	9
Macrotermes barneyi	W-L		1			1
Hypotermes sumatrensis	W-L	4	2		5	11
Hypotermes makhamensis	W-L	1	1		1	3
Microtermes pakistanicus	W-L	4	5	11	4	24
Odontotermes maesodensis	W-L	3				3
Odontotermes hainanensis	W-L	3				3
Odontotermes yunnanensis	W-L	2				2
Odontotermes proformosanus	W-L	2				2
Dicuspiditermes garthwaitei	S/H	1				1
Pseudocapritermes sinensis	S/H		2		3	5
Pseudocapritermes planimentus	S/H	1		1		2
Procapritermes sowerbyi	S/H	1			2	3
Pericapritermes nitobei	S/H		1		4	5
Pericapritermes sermarangi	S/H				1	1
Pericapritermes latignathus	S/H				4	4
Pericapritermes tetraphilus	S/H	2			1	3
Number of species		**13**	**7**	**3**	**10**	
Relative abundance (RA)		**29**	**14**	**14**	**26**	

The calculation of biodiversity indices of termites in the studied habitats is represented in Table 4. The values of Shannon-Wiener index (H') in three habitats (MPF, UPF and GL) were 2.42, 1.76 and 2.12, respectively. Based on these values (1<H'<3)**,** biodiversity of termites in the studied habitats was assessed at the medium level. The remaining habitat (TP) had the lowest biodiversity level, becausethe value of Shannon-Wiener index was 0.65.

Table 4. Biodiversity indices of termites in the studied habitats

Habitats	Species number	Relative abundance	Margalef index	Shannon-Wiener index
MPF	13	29	3.56	2.42
UPF	7	14	2.27	1.76
TP	3	14	0.75	0.65
GL	10	26	2.76	2.12

Regarding feeding groups, the collected termite species in the studied area belonged to three groups (Eggleton *et al.,* 1997): (i) Wood feeding (W), Coptotermitinae, (ii) Wood-leaf feeding (W-L), Macrotermitinae, (iii) Soil-humus feeding (S/H), Termitinae. The MPF had three feeding groups while there were 2 in the remaining habitats (Table 3). Among them, the soil-humus feeding termites dominated in GL (57.69%). In contrast, the wood-leaf feeding termite (W-L) dominated in three habitats, MPF (79.31 %), UPF (78.57%), and TP (92.86%). Obviously, in MPF, UPF and GL the proportion of soil-feeding termites to wood-leaf feeding termites was different.

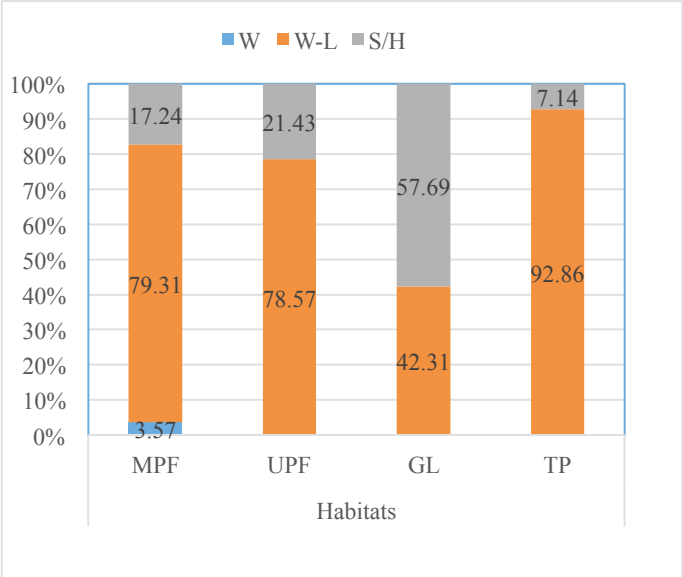

Figure 1. The percentage of termite feeding groups by habitats in the studied area

The results showed that in the habitats where plants were trees (MPF, UPF and TP), the more kinds of trees, the more number of termite species could be found. Moreover, the level of human activities also affected the species composition of termites. In two habitats with monoculture crops (UPF and TP), the

human disturbance in TP was higher than that in UPF, therefore the termite richness in TP lower than in UPF.

Due to performing lower metabolic activity (Jones, 2000), soil-humus feeding termites (S/H) could obtain less energy from a mixture of mineral and humus in GL, where the wood trees were non-existent. That made S/H dominated in GL habitat. Otherwise, MPF and UPF which provided wood from trees with a canopy, rich mineral soil and humus, were suitable for wood feeding termites. By the same logic, the proportion of soil-humus feeding termites to wood-leaf feeding termites was the highest in the GL (1.36) and gradually declined in the UPF (0.27) and the MPF (0.21).

As shown in Figure 1, the proportion of soil-humus feeding to wood-leaf feeding termites was high in the habitats that had low levels of forest restoration (GL), and lower in the habitats with high level of forest restoration (MPF, UPF). These results suggested that this proportion could be used as one of the criteria to assess the level of the process of reforestation of an ecosystem. Nevertheless, the potential of using this proportion should be further studied.

Conclusion

In the Xuan Mai area a total of 26 species from 10 genera, 4 subfamilies were found. Among them, Macrotermitinae had the highest number of species (12 species, account for 46.15% of total species), followed by Termitinae (10 species, 38.46%), Coptotermitinae (3 species, 11.54%), Amitermitinae (1 species, 3.85 %). There were an additional 10 species recorded in the studied area.

In the different habitats, there were differences in the number of species, relative abundances, biodiversity indices, and feeding groups. The MPF had the highest number of species and relative abundance (RA) (13 species, RA: 29), followed by GL (10 species, RA: 26), UPF (7 species, RA: 14), and TP (3 species, RA: 14). The MPF had the highest biodiversity indices and TP had the lowest. In addition, the proportion of soil-humus feeding to wood-leaf feeding termites decreased in habitats as following: GL (1.36) > UPF (0.27) > MPF (0.21).

References

Abe, T., Bigness, D. E., & Higashi, M. (2000). *Termites: evolution, sociality, symbioses, ecology*: Springer.

Ahmad, M. (1958). Key to the Indo-Malayan termites. *Biologia, 4*, 33-198.

Ahmad, M. (1965). Termites (Isoptera) of Thailand. Bulletin of the AMNH; v. 131, article 1.

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*(1), 119-128.

Eggleton, P., Homathevi, R., Jones, D., MacDonald, J., Jeeva, D., Bignell, D., . . . 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: Biological Sciences, 354*(1391), 1791-1802.

Jones, C. G., Lawton, J. H., & Shachak, M. (1994). Organisms as ecosystem engineers. *Oikos*, 373-386.

Jones, D. T., & Eggleton, P. (2000). Sampling termite assemblages in tropical forests: testing a rapid biodiversity assessment protocol. *Journal of Applied Ecology, 37*(1), 191-203.

Lee, K. E., & Wood, T. G. (1971). Termites and soils. *London, UK, Academic Press*.

Nguyen, D. K. (1976). Termite in the North of Vietnam, *Scientific and Technical Publishing House*, *Hanoi* , 1976 (in Vietnamese).

Nguyen D. K. Trinh V. H., Le V. T., Nguyen T. V., Nguyen V. Q., Nguyen T. H., Vu. V. N., Ngo T. S. and Võ T. H. (2007). Fauna of Termites (Isoptera) in Vietnam. *Scientific and Technical Publishing House* (in Vietnamese)

Nguyen, T. M. (2001). Data on termites in Xuan Mai and symbiosis of *Macrotermes annandalei* and Termitomyces. Undergraduate thesis, VNU University of sciences (in Vietnamese).

Pribadi, T. R., Rika Harahap, Idham Sakti. (2011). Termites community as environmental bioindicators in highlands: a case study in eastern slopes of Mount Slamet, Central Java. *Biodiversitas, 12*(3), 235-240.

Sands, W. (1998). The identification of Worker Caster of Termite Genera from Soils of Afrika and the Middle East, Cab international.

Swift, M. J., Heal, O. W., & Anderson, J. M. (1979). *Decomposition in terrestrial ecosystems* (Vol. 5): Univ of California Press.

Thapa, R. S., Termites of Sabah. *Sabah forest Record*, No.12 (1981).

Wood, T., & Sands, W. (1978). Role of termites in ecosystems. *International Biological Programme, 1978*.