DIVERSITY OF ANTS (HYMENOPTERA: FORMICIDAE) AT KUALA LOMPAT, KRAU WILDLIFE RESERVE, PAHANG, MALAYSIA

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ABSTRACT

Studies of ants diversity in Peninsular Malaysia are limited. A few focusing on species inventory resulted in the establishment of local species checklist. There was a research gap between Peninsular Malaysia and Malaysian' Borneo states (i.e., Sabah and Sarawak) as the latter was well sampled and studied. This study aims to investigate the diversity and species composition of ants at lowland forests at Kuala Lompat, in Krau Wildlife Reserve, Temerloh, Pahang. Data were collected for three days in Mac and May 2013, respectively. Two methods were used, i.e., handpicking and trapping. Ground and arboreal traps were set-up to collect ground-dwelling and arboreal ants. Overall, 3077 individual of ants were captured; 2282 individuals were recorded in Mac 2013 and only 795 individuals in May 2013. In Mac, 25 species had been identified from five subfamilies and 18 genera. However, in May, a total of 33 species were recognized, an increased in the number of species captured. The number of subfamilies and genus were similar. The most abundant species that has been recorded in this study was *Euprenolepis procera* (979 individuals) followed by *Oecophylla smaragdina* (774 individuals). Shannon's diversity index showed that collection in May 2013 (2.26) was more diverse than Mac 2013 (1.89). Rarefaction curve for May 2013 data set was surpassing that of Mac 2013, but showing incomplete surveys. In general, ant diversity at Kuala Lompat, Krau Wildlife Reserve is diverse. This is supported by the rarefaction analysis where the curve for May data increasing steadily although March data set showing sign of reaching asymptote with increasing sampling effort. We suspected that unfavorable wet weather during sampling in May affecting the catch, hence the analysis. Fewer specimens and more species were recorded in May increased the diversity index value. *Oecophylla smaragdina* was found in great number for both months, but confined to the open areas. *Euprenolepis procera* only dominant in Mac and this is expected since being a ground dwelling species, *E. procera* probably prefer drier ground to search for food. The finding is still premature. More samplings and techniques such as sifting will be needed to demonstrate ants diversity in the study area. A complete dataset is useful to facilitate conservation program, thus warrant further research.

Keywords: Diversity, Formicidae, lowland forest, species composition, rarefaction

INTRODUCTION

Sundaland is a landmass comprising mainly the Malay Peninsula, Borneo, Sumatra and Java plus many small islands in the South China Sea are rich in biodiversity. Malaysia, together with other countries surrounding the South China Sea is one of the 25 mega biodiversity hotspot (Myers *et al*., 2000). This region is very rich with species and many endemic flora and fauna found here including several species from the family Formicidae, generally known as ant. Borneo is the third largest island in the world; shared with three nations which are Brunei, Indonesia and Malaysia. Pfeiffer *et al.* (2011) reported a total of 717 species from 12 subfamilies of ants from this island which is almost two-third of total subfamilies found there. More than 400 species of ants were reported by Majer and Delabie (1994).

Studies on ant diversity in Peninsular Malaysia are scarce. Only a handful of research was conducted here. One of the most comprehensive studied was done in Pasoh Forest Reserve in Negeri Sembilan by Malsch (2000). Nine subfamilies and 120 species were reported. Another study was conducted at Temenggor Forest Reserve (Nur-Zati *et al*., 2011a) found a total of 211 ant species from nine subfamilies. Meanwhile, such studies in the east coast of Peninsular Malaysia were limited except in Bachok, Kelantan and Gunung Tebu, Terengganu. An inventory made at Melawi beach, Bachok yielded 28 species of ants (Nurul Ashikin and Rosli, 2010) and at Gunung Tebu recorded 67 species (Nur-Zati *et al*., 2011b).

Ant communities can be divided into two groups which are arboreal and terrestrial assemblages. Arboreal ants usually live on trees and at canopy top (Yanoviak and Kaspari, 2000) and it is differ to the ground ant which usually dominated the forest floor. Arboreal ants build their nest at the tree crown and they are quite aggressive. Moreover they have their own territories and will dominate the area (Majer, 1976).

Sampling arboreal ants is not easy and usually caused a lot of money to fog the canopy but the results can be very rewarding. The ground-dwelling ants are easy to search; collecting them is less hassle, cheaper and faster. Thus, ground ants assemblages received more attention in biodiversity inventory and monitoring programs as they are also sensitive to environmental changes or disturbance (Agosti and Alonso, 2000). According to Majer (1983), ants also can be used as biological indicators because the changes in ants community in a particular area effecting others insect communities (Majer, 1983). This study is initiated to document ants fauna at Kuala Lompat, Krau Wildlife Reserve.

METHODOLOGY

Study sites

Kuala Lompat (Figure 1) is located in western-central area of Pahang, adjacent to Gunong Benom, in the Temerloh which is at the south of Kuala Lumpur. It is about 10km from Kuala Krau town; the nearest town from the study area. The lowland forest is a virgin forest that has not been logged yet and it is at the northwest of the Gunung Benom. The study area is also near at the meeting point of the Sungai Krau and Sungai Lompat. The climate is tropical, hot and humid all over the year with minimum and maximum of the temperature was 23^0C and 33^0C with annual rainfall of 2000cm.

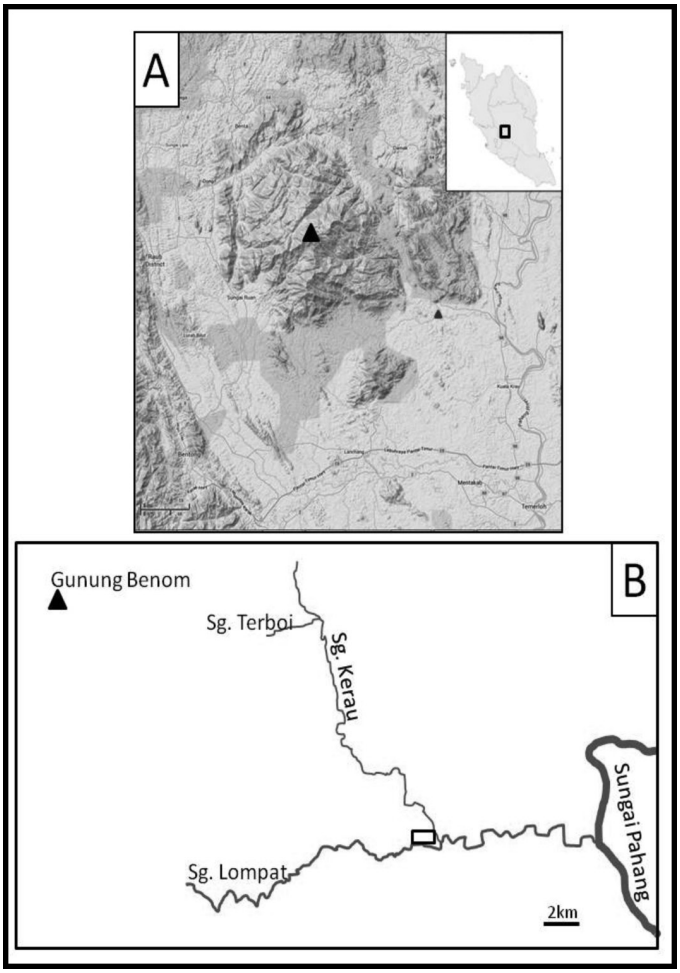

Figure 1. A. The map showing the location of Kuala Lompat field station (red triangle) where the surveys were conducted. The darker shades denote the higher terrain. The black triangle indicates Gunung Benom. Inset is the map of Peninsular Malaysia showing the location of the study area. B. The schematic diagram showing the two main rivers, Sg. Lompat and Sg. Kerau that flow into Sungai Pahang to the right (east). The black rectangle indicates the sampling area located in between the two streams.

Ant sampling

Ants were collected for three days in Mac and May 2013. Two collection methods were employed which were trapping and handpicking. Trappings were done for ground and arboreal ants. Baits were used to attract ants. Two types of baits were used - carbohydrate-based bait and protein-based bait. A cat food tuna was used for protein-based bait and pineapple as carbohydrate-based baits were placed in 20 traps each and were placed at two different locations. The first location was near to the base camp and the other was along the jungle trail inside of the forest. Traps were set-up early in the morning at 0900 hrs and were collected at 2100 hrs on the same day. All samples were placed in urine bottle contained 75% of alcohol and were brought back to General Biological Lab at Universiti Malaysia

Terengganu for identification process. For handpicking method, ants seen at the study sites were picked using a soft-forceps and were placed into a vials contained 75% alcohol. Identification was done at General Biological Lab., Universiti Malaysia Terengganu. All specimens were sorted to genus level using key of Yoshiaki (2003) and then identified to species level whenever possible using reference specimens donated by Prof. Seiki Yamane as well as using internet sources of Antweb.org and Antbase.net. Voucher specimens were kept at General Biology Laboratory, Universiti Malaysia Terengganu under the care of the first author.

Data analysis

Ants diversity indices (Shannon's diversity index, H', Simpson (1-D)) and richness index (Margalef) were calculated using software PAST v2.17. To compare community structure between the two sampling, rarefaction curves were plotted based on individual-based dataset using Ecosims (Gotelli and Colwell, 2010).

RESULTS

A total of 3,077 individuals of ants consist of 38 species from 20 genera and five subfamilies namely Dolichoderinae, Formicinae, Ectatominae, Myrmicinae and Ponerinae, were recorded in this study. In March 2013, 25 species from 16 genera and five subfamilies were recorded. Meanwhile in May 2013, the total number of species recorded was a little higher; i.e., 33 species with an addition of two genera compared to the previous month and the same subfamily number were recorded (Figure 2). The most species recorded in this study was from the genus *Polyrhachis* (eight species) followed by *Pheidole* (five species) and *Componotus* (three species). The most abundant species that had been collected in this study sites was *Euprenolepis procera* with 979 individuals followed by *Oecophylla smaragdina* Fabricius (774 individuals) and *Camponotus arragons* (248 individuals). Meanwhile the least species recorded were *Pachycondyla* sp*., Tetramorium pacificum, Pristomyrmex bicolor* and *Polyrhachis bicolor* with one individual each. There were four species of ants that still cannot be identified until species level which were *Nylanderia* sp. 1, *Nylanderia* sp. 2, *Pachycondyla* sp. and *Gnamptogenys* sp. (Table 1).

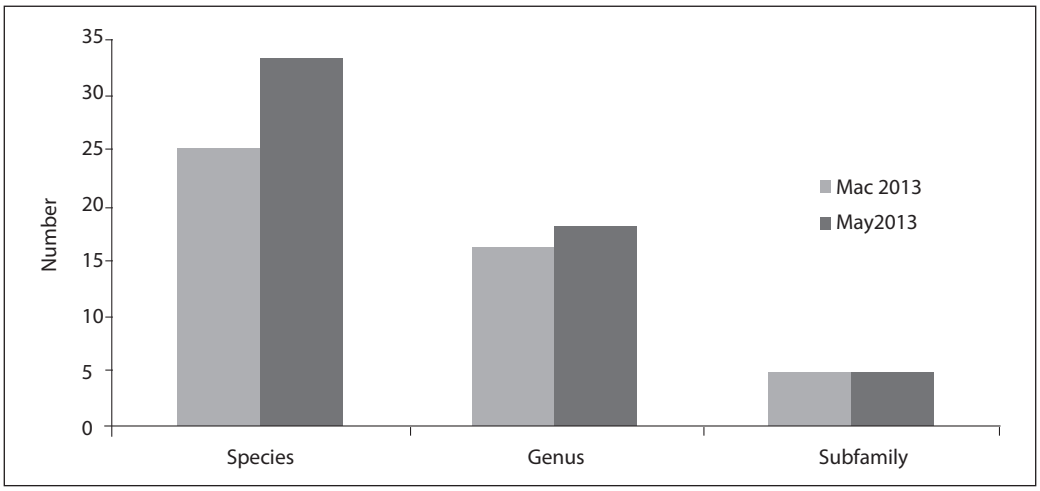

Figure 2. The total number of species, genus and subfamily of ants recorded for Mac and May 2013. More species and genus recorded in May than March 2013 from equal number of subfamilies.

Table 1. The list of ants fauna recorded in Kuala Lompat, Krau Wildlife Reserve, Pahang

Genus	Species	March 2013	May 2013
Anoplolepis	*Anoplolepis gracilipes*	*	*
Camponotus	*Camponotus arrogans*	*	*
	Camponotus gigas	*	*
	Camponotus festinus	-	*
Crematogaster	*Crematogaster modiglianii*	*	*
	Crematogaster rogenhoferi	*	*
Diacamma	*Diacamma rugosum*	*	*
Dolichoderus	*Dolichoderus cuspidatus*	*	*
	Dolichoderus indrapurensis	*	-
Euprenolepis	*Euprenolepis procera*	*	*
Gnamptogenys	*Gnamptogenys* sp.	*	*
Leptogenys	*Leptogenys diminuta*	-	*
Lophomyrmex	*Lophomyrmex bedoti*	*	*
Nylanderia	*Nylanderia* sp. 1	*	-
	Nylanderia sp. 2	*	-
Odontomachus	*Odontomachus rixosus*	*	*
	Odontomachus simillimus	*	*
Odontoponera	*Odontoponera denticulata*	-	*
	Odontoponera transversa	*	*
Oecophylla	*Oecophylla smaragdina*	*	*
Pachycondyla	*Pachycondyla* sp.	-	*
Pheidole	*Pheidole aglae*	*	*
	Pheidole butteli	-	*
	Pheidole longipes	*	*
	Pheidole rabo	-	*
	Pheidole plagiaria	*	-
Polyrhachis	*Polyrhachis abdominalis*	-	*
	Polyrhachis armata	*	*
	Polyrhachis bicolor	-	*
	Polyrhachis bihamata	*	*
	Polyrhachis furcata	-	*
	Polyrhachis illaudata	-	*
	Polyrhachis nigropilosa	*	*
	Polyrhachis sp.	-	*
Pristomyrmex	*Pristomyrmex bicolor*	-	*
Tapinoma	*Tapinoma melanocephalum*	*	*
Technomyrmex	*Technomyrmex albipes*	*	*
Tetramorium	*Tetramorium pacificum*	-	*

Note: '*' Present, '-'Absent

In March, four species were absent in May 2013 (Table 1). They were *Dolichoderus indrapurensis*, *Nylanderia* sp. 1, *Nylanderia* sp. 2 and *Pheidole plagiaria.* Meanwhile in May 2013, there were eight additional species recorded namely *Camponotus festinus, Leptogenys diminuta, Odontoponera denticulata, Pachycondyla* sp., *Pheidole rabo, Polyrhachis abdominalis, P. bicolor, P. furcata, P. illaudata, Polyrhachis* sp., *Pristomyrmex bicolor* and *Tetramorium pacificum.*

The ecological indices values for May 2013 were higher than March 2013 (Table 2) even though less number of specimens collected. When comparing their community structure based on species collected in this study, species accumulation curve for March seem to archive asymptote but not the subsequent sampling (Figure 3). The rarefaction curve for May generated using Ecosims increase sharply as the number of specimens added to the analysis resulted in the curve progressively escalated.

Table 2. The ecological indices of ant community at Kuala Lompat based on data collected in March and May 2013

Indices	March 2013	May 2013
Shannon's diversity index	1.89	2.26
Simpson's index	0.76	0.82
Margalef index	3.10	4.80

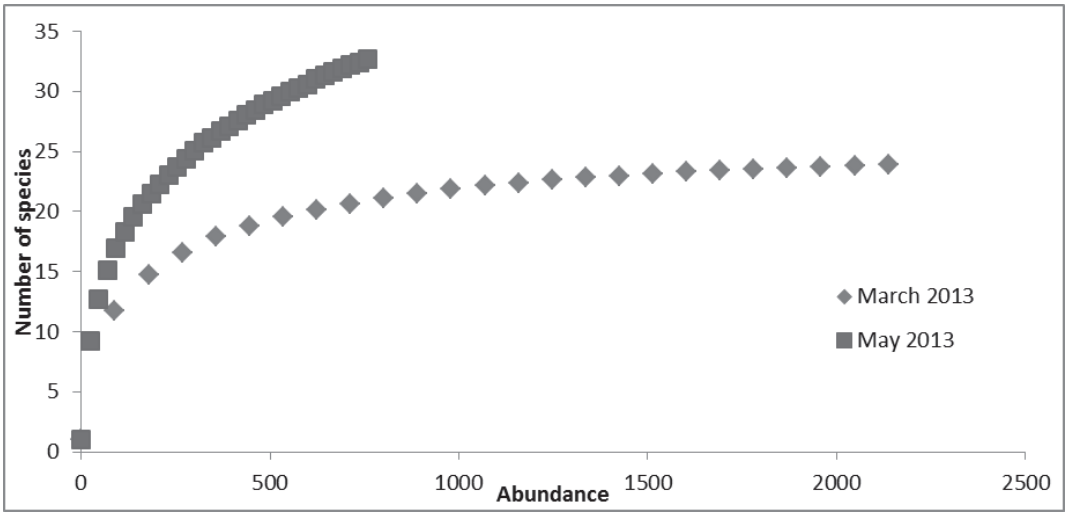

Figure 3. Species accumulation curves for ant fauna collected in March and May 2013, respectively indicated that sampling in March seem to reach asymptote but not May.

DISCUSSION

This study successfully documented ant fauna at Kuala Lompat, Krau Wildlife Reserve, Pahang. This is probably the first report of the ant fauna for this area. In the present study, the most frequent subfamily of ants recorded was Formicinae followed by Myrmicinae. The finding was slightly dissimilar compare to Malsch (2000) and Nur Zati (2011a) as both reported that subfamily Myrmicinae was more common. Both subfamilies were in fact containing diverse members. Pfeiffer *et al.* (2011) stated that two subfamilies consist of two over three of the ants species in Borneo and a handful of them recorded at the study area. .

Weaver ant, *Oecophylla smaragdina* is one of the most common predatory species of ant recorded in this study. The finding of this species at the present study sites is not surprising since many specimens were collected at around the basecamp where many fruit trees were planted. Dejean *et al.* (1997) reported that the present of plant species that produced nectar and honey such as rambutan, mangosteen and mango promote this species. This species is aggressive arboreal foragers that will attack any animals that cross into their territories.

Meanwhile *Euprenolepis procera*, a nomadic mushroom harvesters, unique among ant fauna (LaPolla, 2009) was the most abundant species captured on the ground at the jungle trails. This species of ants is one of the important members in terrestrial ecosystem to plant and fungi. Witte and Maschwitz (2008) were firstly reported on this mushroom-harvesting ant in the tropical rain forest. This is because it has a mutualistic interaction with fungus that provide food to this species (Witte and Maschwitz, 2008). The least number of individual captured were *Polyrhachis illaudata, Polyrhachis* sp., *Pristomyrmex bicolor* and *Tetramorium pacificum* probably the artifact of the sampling method that being employed in this survey. Several species are hard to be trapped and it is more efficient to collect them by direct sampling method such as handpicking, using aspirator or leaf-sifting. These species usually wandering individually thus direct sampling is more efficient to collect since larger habitat can be covered (Nurul Ashikin and Rosli, 2010) where such species may be found. By using direct sampling methods, more species could be found. The number of species from genus *Polyrhachis* was double in May 2013 compared to March 2013 where the new additional species recorded was captured using direct sampling.

Virgin forest usually consists of most flora and fauna compared to the disturbed forest. The value of diversity indices were generally low, but within a short time scale, the number of observed species recorded in this study is rather high despite the limited sampling methods employed in this study. Shannon's diversity index increases from 1.89 to 2.26 for March and May 2013 respectively (Table 2), probably because we increased the sampling effort. Although the number of species in this study is still lower compared to another study in primary forest of Pasoh Reserve Forest that yield more than 100 species of ants (Malsch, 2000), the species richness could be higher if further sampling can be done in this area as the rarefaction curve tend to increase with additional specimens (Figure 3). Sampling over a long period of time could increase more chance to obtain more species as well as sampling over a wider area. This also happen in a study at Costa Rica (Longino *et al*., 2002) where the curve almost reaching it asymptote but after 30 years more species was found.

The number of ant specimens in May decrease more than half if compare to March might be the factor of weather. Rains are known to limit ants foraging activity. Holldobler (1976) stated that rainfall may be able to reduce the ant activity because rainfall may washing away pheromone and lose their way to back home. Despite lack of number of specimens recorded in May, the observed species richness was significantly higher than that of March (Figure 3).

The finding is still premature and more samplings need to be done utilizing various sampling techniques such as sifting, using aspirator and Winkler sac in order to obtain a better picture of ant diversity in the study area. A complete dataset is useful to facilitate conservation program, thus warrant further research.

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