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CHECKLIST OF ANTS OF SELECTED HILL DIPTEROCARP FORESTS OF PENINSULAR MALAYSIA

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ABSTRACT

A survey of ants (Hymenoptera: Formicidae) in six hill dipterocarp forests in Peninsular Malaysia recorded 187 species (=morphospecies) from seven subfamilies and 50 genera. Gunung Angsi Forest Reserve yielded the highest species richness (87 species) while Ulu Gombak Forest Reserve, the lowest (60 species). Twenty five genera were recorded for the subfamily Myrmicinae, while the subfamilies Ponerinae, Formicinae and Dolichoderinae had 12, 7 and 3 genera, respectively. Cerapachinae, Aenictinae and Pseudomyricinae recorded one genus each. Myrmicines were the most speciose and abundant among the ant subfamilies, comprising 50.8% of total ant species and 50.6% of all ants collected, followed by Ponerinae (21.4% and 35.7%), Formicinae (17.6% and 11.6%), Dolichoderinae (5.4% and 5.8%), Aenictinae (2.1% and 0.2%), Cerapachyinae (1.6% and 0.2%), and Pseudomyrmicinae (1.1% and 0.1%,

respectively). *Pheidole* was the most speciose genera, comprising 12.8% of ant species found. *Lophomyrmex bedoti*, *Odontoponera transversa*, *Odontomachus rixosus, Diacamma scupturatum*, *Gnamptogenys modiglianii* and unidentified species of *Pheidole*, *Pachycondyla*, *Pheidolegeton* and *Pseudolasius* were common species present in all the forest reserves sampled.

Key Words: Ants, Hymenoptera, Formicidae, Diterocarp Forest, Peninsular Malaysia

ABSTRAK

Bancian terhadap kehadiran semut (Hymenpoptera: Formicidae) di enam buah hutan tanah bukit di Semenanjung Malaysia telah berjya merekodkan sebanyak 187 spesies (=morfospesies) di dalam 50 genera. Hutan Simpan Gunung Angsi mencatatkan kekayaan species yang tertinggi (87 spesies) manakala Hutan Simpan Ulu Gombak mencatatkan kekayaan spesies terendah (60 spesies). Dua puluh lima genera adalah di dalam subfamili Myrmicinae manakala 12 genera dalam subfamili Ponerinae dan diikuti oleh Formicinae (7 genera), Dolichoderinae (3 genera), dan masing-masing satu genus Cerapachinae, Aenictinae and Pseudomyricinae. Subfamili Myrmicinae juga mencatatkan kekayaan spesies tertinggi dengan 50.8% diikut oleh Ponerinae (21.4%, 35.7%), Formicinae (17.6%, 11.6%), Dolichoderinae (5.4%, 5.8%), Aenictinae (2.1%, 0.2%), Cerapachyinae (1.6%, 0.2%), dan Pseudomyrmicinae (1.1%, 0.1%). *Pheidole* merupakan genera yang mempunyai paling banyak species merangkumi 12.8%. *Lophomyrmex bedoti*, *Odontoponera transversa*, *Odontomachus rixosus, Diacamma scupturatum*, *Gnamptogenys modiglianii* dan spesies yang belum dikenalpasti dari genus *Pheidole, Pachycondyla*, *Pheidolegeton* dan *Pseudolasius* adalah antara spesies yang biasa didapati di semua hutan kajian

Kata Kunci: Semut, Hymenoptera, Formicidae, tanah bukit Semenanjung Malaysia

INTRODUCTION

Several extensive studies on ant diversity, taxonomy and ecology have been carried out in Malaysian Borneo (Chung, 1995; Brühl et al. 1998), but not much is known about ant taxonomy or ecology in Peninsular Malaysia. Only a few preliminary studies of ant diversity have ever been carried out in Peninsular Malaysia (Fiala et al. 1994; Liefke et al. 1998). The most comprehensive studies of ant diversity in Peninsular Malaysia took place in the lowland dipterocarp forest of the Pasoh Forest Reserve in Negeri Sembilan (Bolton, 1998; Moog et al. 2003). A total of 427 species from nine subfamilies have been documented at Pasoh Forest Reserve (Malsch, 2000). This study aims to provide a checklist of ants of selected hill dipterocarp forest of Peninsular Malaysia that will serve as baseline information of ant diversity studies in Peninsular Malaysia.

MATERIALS AND METHODS

Study site – The study was conducted in March 2008 and 2009, at six Virgin Jungle Reserves (VJRs) in Peninsular Malaysia. Sampling took place in experimental plots established within each VJR as part of the *"Conservation of Biodiversity through Improved Planning Tools project"* (CBioD, a FRIM-UNDP-GEF-ITTO project). The VJRs were the Semangkok and Ulu Gombak Forest Reserves in Selangor, the Berembun and Gunung Angsi Forest Reserves in Negeri Sembilan, the Gunung Tebu Forest Reserve in Terengganu and the Kledang Saiong Forest Reserve in Perak. Each plot measured 20 x 80 m and was divided into four square subplots. Within each subplot, four 10 x 10 m quadrats were established. Each plot was considered one sampling unit.

Sampling Methods – Four sampling methods were employed to thoroughly survey ant diversity, target ants present in different strata, and capture ants with different functions. The sampling methods chosen to sample leaf litter and soil-inhabiting ants were ground pitfall traps (Fichter, 1941), baiting (Keeler, 1980) and leaf litter sifting (Olson, 1991). Arboreal pitfall traps (Samson et al.,

1997) were also set up to sample arboreal ants. To avoid potential bias from ant recruitment to baits, baits were placed 10 m away from other traps. In each subplot, two each of arboreal pitfall, bait and ground pitfall traps were set, and one leaf litter sifting procedure was performed.

Baiting. A teaspoon of tuna and a cotton ball moistened with a 20% honey and 80% water solution were placed on transparent plastic plates in quadrats 2 and 4 of each subplot, for a total of eight replicates in each plot. After 30 minutes, visual counts of all ants at the baits were completed and identifications were recorded to morpho-species. Opportunistic hand collections of ants using soft forceps were also carried out.

Ground Pitfall Traps. Each ground pitfall trap was established in quadrats 1 and 3 in each subplot by embedding a hard plastic cup (5 cm diameter) in the soil until the mouth of the cup was even with the soil surface. 20 ml of water mixed with fragrance-free detergent was placed in the cup to serve as a killing agent. A coarse wire net was placed over the mouth of the cup to exclude larger organisms and to support a transparent plastic plate (15 cm diameter) approximately 2.5 cm above ground that shielded the trap from rainfall. All pitfall traps were left in the field for 48 hours before they were retrieved for species identification in the laboratory.

Arboreal Pitfall Traps. Arboreal pitfalls were constructed by twist-tying disposable plastic cups with snap-on lids onto tree trunks (5–20 cm dbh) at a height of 1.3 m in quadrats 1 and 3 of each subplot. Arboreal pitfall traps were baited and filled with killing agent and left for 48 hours before they were collected.

Leaf Litter Sifting. Ant diversity within leaf litter were surveyed in quadrat 3 of each subplot, for a total of four replicates in each plot. We sieved leaf-litter for 30 minutes in each quadrat by screening batches of the leaf litter over a 100 x 80 cm white sheet using a coarse (5 x 5 mm) rectangular (15 x 30 x 3 cm) wire sieve. All sieved ants were collected in vials.

Identification – Collected specimens were brought to the laboratory where pinning and identification were conducted to the genus level according to Bolton (1994) and Hashimoto et al. (2001). When possible, specimens were identified to the species level; but otherwise left as morphospecies. Identifications to species were made by direct comparison of collected specimens to the collection at Kagoshima University (collector: Seiki Yamane).

RESULTS AND DISCUSSION

A total of 168 species (=morphospecies) of ants from 50 genera and 7 subfamilies were collected (Appendix 1). Gunung Angsi Forest Reserve yielded the highest species richness with 87 species while Ulu Gombak Forest Reserve, the lowest with 60 species. Other sites recorded species richness as follows: Semangkok Forest Reserve (74 species), Gunung Tebu Forest Reserve (67 species), Keledang Siong Forest Reserve (75 species) and Berembun Forest Reserve (69 species).

This study found 50 of 90 genera previously recorded for Borneo (Hashimoto et al. 2001) and 39.7% of the 126 genera recorded for the Indo-Australian region (Bolton 1994). Twenty five genera were recorded for the subfamily Myrmicinae, while the subfamilies Ponerinae, Formicinae and Dolichoderinae had 12, 7 and 3 genera, respectively. Cerapachinae, Aenictinae and Pseudomyricinae recorded one genus each (Table 1). These results follow Bolton's (1994) findings that Myrmicinae held 50.7% of ant genera throughout the world and followed by the Ponerinae, Formicinae, Dolichoderinae, and Pseudomyrmicinae. Subfamily composition was also similar to that reported by Brühl et al. (1998). This study collected 43.1, 52.2, 33.3 and 25.0%, respectively, of the myrmicines, ponerines, formicines and doclihoderines previously recorded for the Indo-Australian region (N = 58, 23, 21 and 12, respectively). One genus from three previously recorded genera of Cerapachinae was collected in this study and the single genus in the subfamily of Pseudomyrmicinae and Aenictinae were also recorded.

Table 1: Number of genera by subfamily, of ants recorded from the Peninsular Malaysia hill dipterocarp survey and for the Indo-Australian region

Subfamily	Number of Genera		Percentage of genera recorded (%)
	Present study	Indo-Australian region[1]	
Myrmicinae	25	58	43.1
Ponerinae	12	23	52.2
Formicinae	7	21	33.3
Dolichoderinae	3	12	25.0
Aenictinae	1	1	100.0
Cerapachyinae	1	3	33.3
Pseudomyrmicinae	1	1	100.0
Total (Σ)	50	126	39.7

[1]Figures from Bolton (1994)

Myrmicines were the most speciose and abundant among the ant subfamilies, comprising 50.8% of total ant species and 50.6% of all ants collected, followed by Ponerinae (21.4% and 35.7%), Formicinae (17.6% and 11.6%), Dolichoderinae (5.4% and 5.8%), Aenictinae (2.1% and 0.2%), Cerapachyinae (1.6% and 0.2%), and Pseudomyrmicinae (1.1% and 0.1%, respectively; Table 2). The most speciose genus making up 12.8% of the species pool was

Table 2 : Species richness and abundance by subfamily, of ants recorded from a survey of six hill dipterocarp forests in Peninsular Malaysia

Subfamily	Number of species		Abundance	
	Total	Percentage (%)	Total	Percentage (%)
Myrmicinae	95	50.8	1156	50.6
Ponerinae	40	21.4	887	35.7
Formicinae	33	17.6	287	11.6
Dolichoderinae	10	5.4	143	5.8
Aenictinae	4	2.1	5	0.2
Cerapachyinae	3	1.6	3	0.1
Pseudomyrmicinae	2	1.1	3	0.1
Total (Σ)	**187**	**100.0**	**2484**	**100.0**

Pheidole, with 24 species (Table 3). Contributing over 50% of species were 11 genera: *Pheidole*, *Camponotus*, *Polyrhachis*, *Lordomyrma*, *Crematogaster*, *Pachycondyla*, *Paratrechina*, *Pseudolasius*, *Paratopula*, *Pheidologeton* and *Tetramorium*. Sixteen genera were each represented by at least one species, while the remaining 22 genera were each represented by two to four species.

Table 3 : Distribution of species by genus for ants sampled from six hill dipterocarp forests of Peninsular Malaysia. No. of species followed by percentage of total in brackets.

Genus	Subfamily[1]	No. Species (%)	Genus	Subfamily[1]	No. Species (%)
Pheidole	M	24 (12.8)	*Aphaenogaster*	M	2 (1.1)
Camponotus	P	14 (7.5)	*Calyptomyrmex*	M	2 (1.1)
Polyrhachis	F	11 (5.9)	*Cardiocondyla*	M	2 (1.1)
Lordomyrma	M	11 (5.9)	*Monomorium*	M	2 (1.1)
Crematogaster	M	9 (4.8)	*Anochetus*	P	2 (1.1)
Pachycondyla	P	9 (4.8)	*Gnamptogenys*	P	2 (1.1)
Paratrechina	F	8 (4.3)	*Leptogenys*	P	2 (1.1)
Tetramorium	M	7 (3.7)	*Odontoponera*	P	2 (1.1)
Pseudolasius	F	6 (3.2)	*Platythyrea*	P	2 (1.1)
Paratopula	M	5 (2.7)	*Anoplolepis*	F	1 (0.5)
Pheidologeton	M	5 (2.7)	*Prionopelta*	F	1 (0.5)
Myrmecina	M	4 (2.1)	*Proatta*	M	1 (0.5)
Acanthomyrmex	M	4 (2.1)	*Cataulacus*	M	1 (0.5)
Dolichoderus	D	4 (2.1)	*Eurhopalothrix*	M	1 (0.5)
Aenictus	A	4 (2.1)	*Lophomyrmex*	M	1 (0.5)
Cerapachys	C	3 (1.6)	*Oligomyrmex*	M	1 (0.5)
Tapinoma	D	3 (1.6)	*Pyramica*	M	1 (0.5)
Technomyrmex	D	3 (1.6)	*Recuvidris*	M	1 (0.5)
Myrmoteras	F	3 (1.6)	*Rotastruma*	M	1 (0.5)
Meranoplus	M	3 (1.6)	*Secostruma*	M	1 (0.5)
Myrmicaria	M	3 (1.6)	*Vollenhovia*	M	1 (0.5)
Strumigenys	M	3 (1.6)	*Discothyrea*	P	1 (0.5)
Hypoponera	P	3 (1.6)	*Diacamma*	P	1 (0.5)
Euprenolepis	F	2 (1.1)	*Odontomachus*	P	1 (0.5)
Tetraponera	Ps	2 (1.1)	*Rhytidoponera*	P	1 (0.5)

[1]Letters in bracket represent the Subfamily of the ants A – Aenictinae, C – Cerapachyinae, D – Dolichoderinae, F – Formicinae, M – Myrmicinae, P – Ponerinae, Ps – Pseudomyrmicinae

Some of the species present in all sampling sites were *Lophomyrmex bedoti*, *Odontoponera transversa*, *Odontomachus rixosus, Diacamma scupturatum* and *Gnamptogenys modiglianii* (Appendix 1). *Odontoponera transversa* (Ponerinae) was the most abundant species comprising 7% of all ants sampled. It was the most abundant species at three of the six sites. *Lophomyrmex bedotii* was the second most common species with more than 100 individuals captured at all sites except Kledang Siong. The presence of *O. transversa*, *O. rixosus* and *L. bedotii* at all the sites is in accord with their known classification as generalist species that are adaptively able to colonize a wide range of habitats. The marked abundance of *O. transversa* concurs with what is known of its abundance and distribution worldwide especially in Southern East Asia (Creighton, 1929). *Lophomyrmex bedotii* is a predator and scavenger commonly found foraging on the forest floor (Rigato, 1994). *Gnamptogenys modiglianii*, a common species found in low numbers (4.7 ± 1.4 individuals) at all sites in the present study, is categorized as a generalist predator (Brown, 1993) with small colonies of a few hundred individuals (Lattke, 1990).

CONCLUSION

There is a high diversity of ants in Peninsular Malaysia, which was only partially captured in this study. Increasing sampling effort is needed in future studies to add to the species checklist of the ants of Peninsular Malaysia.

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Appendix 1

Species checklist of ants of selected hill dipterocarp forest of Peninsular Malaysia.

Species[1]	Forest Reserves[2]					
	BE	GA	GT	KS	SE	UG
Acanthomyrmex ferox	11		2	1		
Acanthomyrmex sp 1†			1			2
Aenictus cornutus					1	
Aenictus dentatus	10					
Aenictus glabratus					10	
Aenictus laeviceps		1				
Anochetus sp B		1				
Anochetus sp C	1		1			
Aphaenogaster (Deromyrma) sp 1 †						6
Calyptomyrmex sp C			3			
Camponotus (Colobopsis) leonardi	1					
Camponotus (Colobopsis) sp 62 ‡				2		
Camponotus (Myrmoplatys) sp 89 ‡						4
Camponotus (Myrmosaulus) camelinus					9	
Camponotus (Myrmosaulus) singularis					1	
Camponotus (Myrmotarsus) irritabilis						6
Camponotus (Myrmotarsus) rupifemur	2	24			20	
Camponotus (Myrmotarsus) sp 2 †			11			
Camponotus (Tanaemyrmex) arrogans	4		13	3	22	1
Camponotus (Tanaemyrmex) festinus	2				6	3
Camponotus (Tanaemyrmex) sp 1 †						2
Camponotus (Tanaemyrmex) sp 13 ‡	1		2	6	1	
Camponotus (Tanaemyrmex) sp 15 ‡					10	
Camponotus (Tanaemyrmex) sp 72 ‡	2		21	1	7	2
Camponotus gigas		9	21	5	13	1
Cardiocondyla sp 5 ‡		1		1		4
Cataulacus horridus	1		3			1
Cerapachys crawleyi	2					
Cerapachys sp 33 ‡			1			
Cerapachys sp 5 ‡		1				
Cerapachys sp 8 ‡	1				2	2
Crematogaster baduvi			2			
Crematogaster bouvardi	1		3			
Crematogaster longipilosa						4
Crematogaster modiglianii	19		11			
Crematogaster nr. gavipaga			6		1	4
Crematogaster nr. ocellata	2	30				
Crematogaster sewardi			56			

Species[1]	Forest Reserves[2]					
	BE	GA	GT	KS	SE	UG
Diacamma sculpturatum				1		
Discothyrea sp 1 †				1		
Discothyrea sp 2 †				3		
Discothyrea sp 3 †	1					
Discothyrea sp A						1
Dolichoderus cuspidatus		2			2	2
Dolichoderus sp A		6			2	15
Dolichoderus sp C			237			
Dolichoderus thoracicus	14		57			
Euprenolepis procera	1	17	7		7	1
Euprenolepis varigata				1		1
Euprenolepis wittei		7				
Eurhopalothrix seguensis						2
Gnamptogenys binghamii		1		1		
Gnamptogenys cribrata				1		
Gnamptogenys menadensis		2				
Gnamptogenys sp 1 †	1				1	
Hypoponera sp 10 †						1
Hypoponera sp 2 †	1					
Hypoponera sp 3 †						1
Hypoponera sp 4 †		1				
Hypoponera sp 7 †		3	1	2	1	14
Hypoponera sp 8 †	1					
Leptogenys diminuta	10				1	
Leptogenys kraepalini	1	3		3	1	2
Leptogenys mutabilis	9	6		1		1
Leptogenys myops			10			
Leptogenys parvula			1			
Leptogenys sp 23 ‡						2
Lophomyrmex bedoti	318	176	192	29	127	143
Lordomyrma sp 13 ‡		1				
Lordomyrma sp A	2		9	13	27	
Lordomyrma sp B	1					
Lordomyrma sp C		3			95	
Lordomyrma sp D		1				
Mayriella sp 1 †			1			1
Meranoplus malaysianus		1		9		
Meranoplus mucronatus	27	6			5	53
Monomorium sp 1 ‡			28			15
Myrmecina sp 1 †				1		
Myrmecina sp 2 †		1	2	7	22	3
Myrmecina sp 20 ‡	3	1				
Myrmicaria sp 1 †					4	

Species[1]	Forest Reserves[2]					
	BE	GA	GT	KS	SE	UG
Myrmoteras diastematum			3		2	
Myrmoteras iriodum			1			
Odontomachus rixosus	36	27	11	15	52	13
Odontoponera transversa	138	212	95	70	178	274
Oligomyrmex sp 12 ‡			24	2		
Pachycondyla (Pseudoponera) amblyops						1
Pachycondyla aff. rubra					1	
Pachycondyla astuta		2			5	
Pachycondyla chinensis	4	10	9			4
Paratrechina sp 1 †	1	9	15	2	16	
Paratrechina sp 16 ‡				3	96	
Paratrechina sp 18 ‡				4		
Paratrechina sp 2 ‡				3		5
Paratrechina sp 3 †	30			1	1	
Paratrechina sp 4 ‡		3		3		
Paratrechina sp 6 ‡				16	13	
Pheidole algae		2		5		
Pheidole aristotelis	25	10	34	26	52	
Pheidole bluntschlii	18	4				
Pheidole butteli			2			
Pheidole cariniceps	2		6			
Pheidole elisae/sauberi		12	24		46	
Pheidole hortensis	1			2	8	1
Pheidole longipes complex	111	16	2	2	35	
Pheidole lucioccipitalis			2		54	
Pheidole megacephala			5			
Pheidole plagiaria		6				2
Pheidole plinii			5			
Pheidole rabo		1		5		1
Pheidole sp 11 †		9				
Pheidole sp 2 †		5				
Pheidole sp 3 †					1	1
Pheidole sp 5 †		9				7
Pheidole tjibodana			1		9	13
Pheidole upeneci		3				
Pheidologeton affinis		1				
Pheidologeton cf. affinis	6	2	21			
Pheidologeton pygmaeus	4	38	86	23		4
Pheidologeton silenus	42	2	34	1		
Pheidologeton sp 5 ‡	16	59	31			
Philidris sp 1 ‡						4
Platythyrea fricuspidata					2	
Polyrhachis (Campomyrma) equina	18					

Species[1]	Forest Reserves[2]					
	BE	GA	GT	KS	SE	UG
Polyrhachis (Myrma) illaudata	2		6	3		6
Polyrhachis (Myrma) obesior					2	
Polyrhachis (Myrma) striata	1	1		1		
Polyrhachis (Myrma) vindex		1				
Polyrhachis (Myrmhopla) arachne					16	
Polyrhachis (Polyrhachis) bihamata		1				
Polyrhachis becarii	3					
Polyrhachis bellicosa		1				
Polyrhachis bihamata	1				5	
Polyrhachis illaudata					3	
Polyrhachis nigropilosa	1			3		
Polyrhachis proxima			11			3
Polyrhacis rupifes	2					
Ponera sp 1 †				3	2	
Prenolepis sp 1 †		2				
Pristomyrmex pulcher				1		
Proatta butelli	5	3	13	3		
Pseudolasius sp 1 †	1			3	6	2
Pseudolasius sp 2 †	2					6
Pseudolasius sp 3 †	32	1				
Pyramica jacobsoni			1			
Solenopsis sp 1 ‡						1
Strumigenys bryanti		2				
Strumigenys koningsbergeri				2		
Strumigenys labidogenys				1		
Strumigenys signaea	3					
Strumigenys sp 1 †					3	
Technomyrmex horni		2			1	1
Technomyrmex kraepelini	1		18		5	2
Technomyrmex modiglianii			1			1
Tetramorium curtulum	4	19	6	3	1	2
Tetramorium insolens		3	1	4	1	
Tetramorium kraepelini	1	3				
Tetramorium meshena	1		1		21	4
Tetramorium noratum			7			
Tetramorium nr aptum				1	2	
Tetramorium pacificum	6		5			
Tetramorium parvum					33	3
Tetramorium scabrum			1			
Tetramorium sp 1 †	20	3				1
Tetramorium sp 2 †						1
Tetraponera attenuata		1			1	

Species[1]	Forest Reserves[2]					
	BE	GA	GT	KS	SE	UG
Tetraponera extenuata				1		
Vollenhovia sp 3 ‡				1	1	

[1]Morpho-species in collections of: (‡) = Seiki Yamane (Kagoshima University), (†) = Nur-Zati Akma (FRIM).
[2]Forest Reserves: BE=Berembun, GA=Gunung Angsi, GT= Gunung Tebu, KS=Kledang Siong, UG=Ulu Gombak, SE = Semangkok.