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STICK INSECT OF TAMAN NEGARA JOHOR, GUNUNG LEDANG ACCORDING TO THE ALTITUDES

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ABSTRACT

Stick insects (Phasmida) are important herbivores in tropical ecosystem. To date, only few studies that had been conducted on phasmids diversity in Malaysia. We conducted a study on the diversity of phasmids in Gunung Ledang National Park, Johor, Malaysia. Our objective is to determine whether there is a variation in phasmids diversity at different elevation levels. Besides that, this study was aimed to provide an inventory of phasmids in Gunung Ledang for different altitudes. Samplings were denoted by four locations based on altitude i.e. Location L1 (altitude 1000 – 1200m), L2 (700 – 900m), L3 (200 – 350m) and L4 (100 – 120m). Samplings were done by active samplings for every location using torch light between 2000 to 2230 hours during a dark moon phase. This was based on twelve sampling occasions conducted from November 2012 until October 2013. A total of 765 individuals of phasmids comprising 46 species in 22 genera under 5 families (Phasmatidae, 4 spesies in 3 genera; Heteronemiidae, 35 spesies in 15 genera; Aschiphasmatidae, 4

spesies in 1 genus; Bacillidae, 2 spesies in 2 genera; Phyllidae, 1 spesies, 1 genus) has been recorded for Johore National Park, Mount Ledang. The Margalef's Species Richness index (R') based on altitude shows the highest at L4 (R'= 4.857) and lowest at L1 (R' = 3.765). Analysis of Shannon Wiener Diversity Index (H') following the altitude was highest in altitude L2 (H' = 2.547) and L3 shows the lowest value (H' = 1.6). The Evenness Index, E' = 0.6072 was highest at L4 and lowest at L3 (E' = 0.1981). Species Accumulation Curve was not reaching the asymptotes; hence, further samplings are needed in order to obtain better results to represent species richness of phasmids for these areas.

Keywords: Phasmatodea, inventory, faunistic aspect, altitude

ABSTRAK

Serangga ranting (phasmid) merupakan herbivor yang penting dalam ekosistem tropika. Terdapat hanya beberapa kajian yang telah dijalankan ke atas kepelbagaian phasmid di Malaysia. Kami telah menjalankan kajian mengenai kepelbagaian phasmid di Taman Gunung Ledang Negara, Johor, Malaysia. Objektif kajian ini adalah untuk menentukan sama ada terdapat perubahan dalam kepelbagaian phasmid pada ketinggian yang berbeza. Selain daripada itu, kajian ini bertujuan untuk menyediakan inventori phasmid di Gunung Ledang bagi ketinggian yang berbeza. Sampel yang telah diambil mewakili empat lokasi kajian berdasarkan ketinggian iaitu Lokasi L1 (ketinggian 1000 - 1200m), L2 (700 - 900m), L3 (200 - 350m) dan L4 (100 - 120m). Pensampelan serangga ranting dilakukan secara pencarian aktif menggunakan lampu suluh berintensiti tinggi bagi setiap lokasi. Persampelan dijalankan antara 2000-2230 jam semasa fasa bulan gelap. Kajian ini berdasarkan 12 kali persampelan yang dijalankan dari bulan November 2012 hingga Oktober 2013. Sebanyak 765 individu serangga ranting

yang terdiri daripada 46 spesies dalam 22 genera di bawah 5 famili (Phasmatidae, 4 spesies 3 genus; Heteronemiidae, 35 spesies dalam 15 genera; Aschiphasmatidae, 4 spesies 1 genus; Bacillidae, 2 spesies 2 genus; Phylliidae, 1 spesies, 1 genus) telah direkodkan untuk Taman Negara Johor Gunung Ledang. Analisis berdasarkan indeks kekayaan Margalef (R') berdasarkan ketinggian menunjukkan nilai paling tinggi pada L4 (R' = 4.857) dan terendah di L1 (R '= 3.765). Indeks Kepelbagaian Shannon Wiener (H') menunjukkan nilai tertinggi di L2 (H' = 2.547) dan L3 menunjukkan nilai yang paling rendah (H '= 1.6). Bagi indeks kesamarataan (E'), E ' = 0.6072 adalah paling tinggi di L4 dan terendah di L3 (E' = 0.1981). hasil dari kajian, lengkung pengumpulan spesies tidak mencapai asimptot dan persampelan lanjutan diperlukan untuk mendapatkan keputusan yang lebih baik bagi mewakili spesies kekayaan serangga ranting untuk kawasan ini.

Kata kunci: Phasmatodea, inventori, aspek faunistik, altitud.

INTRODUCTION

Gunung Ledang Johor National Park is one of the eco-tourism destinations located in district of Muar, Johor state of Peninsular Malaysia. The forest area provide habitat for numerous of flora and fauna species. Gunung Ledang is believed to be one of the mountain forests with a unique plants species which is hard to find in any areas in the world, in facts Gunung Ledang forest is claims as primary forest status. The peak of this mountain is 4186 feet (1276 m) above the sea level as the highest mountain in southern area of Peninsular Malaysia. The forested area of Gunung Ledang was divided into two types of forest, lowland forest and montane forest. Montane forest has lower canopy and their emergence trees are less and small compared to lowland forest. Until now, there is little information about diversity of stick insect recorded from Gunung Ledang. With the

phytophagus feeding behaviour (Whiting et al. 2003), their existence in the various plants communities, the diversity and abundance of stick insects are expected to be high. According to Bluthgen et al (2006), phasmids can be divided into two groups which they had their own common host plants (monophagous) and they fed on a broad spectrum of plant families and can be considered polyphagous. There is 3000 of known species worldwide and 10% from total known species are from Borneo (Bragg, 2001). Until now, there is no specific publication of stick insects in Gunung Ledang. However, there are two species recorded by Seow-Choen (2005) in his book '*A pocket guide to the phasmids of Peninsular Malaysia and Singapore'* from Gunung Ledang which are *Carausius crawangensis* (de Haan) and *Carausius globosus* (Brunner).

MATERIALS AND METHOD

The research was conducted in Gunung Ledang along the Telekom route 02^0 16-26' U, 102^0 33-41' T. The collections were carried out through 12 occasions, from November 2012 until October 2013. The sampling location is divided into four selected areas in Gunung Ledang based on altitude gradients marked as L1 (1000 – 1200m), L2 (700 – 900m), L3 (200 – 350m) and L4 (100 – 120m; Asahan). Samplings were carried out by teams comprising of 5 people. Stick insects are sampled at night using high intensities LED torchlight along the trails. Stick insects were caught and placed in the rearing cage. Representative samples of each species collected were photographed prior to preservation.

The experiment was conducted in the Centre of Insects Systematic, Universiti Kebangsaan Malaysia (CIS-UKM). The specimens were killed in the killing jars containing cotton wools soaked with ethyl acetate. After that, the specimens were oven-dried, pinned, labelled, identified and classified. Identification, species naming and classification of the stick insect specimens were based on Seow-Choen (2000) and Seow-Choen (2005).

The specimens were currently kept at the repository of CIS-UKM. The number of specimen of each stick insect species accumulated from sampling locations and occasions are tabulated to facilitate visualization of some interesting aspects of the stick insect fauna manifested. These included the assessment of faunistic aspect, for example rarity, common and abundant species, and also the calculation and assessment of the stick insect diversity and evenness in each location.

RESULTS AND DISCUSSION

A total of 765 individuals of phasmids were sampled comprising 46 species from five families: Aschiphasmatidae, Bacillidae, Heteronemiidae, Phasmatidae and Phyllidae. There were four families at L1, L3 and L4 whereas all of five phasmids families were present at L2. Referring to Figure 1, in terms of abundance, the most caught individual can be found at L1 with 345 individuals of phasmids. Phasmids are highly depends on host plant because they are phytophagus. For example, *Abrosoma johorensis* shows the most abundance species in altitude 1000-1200 m. This is due to the dense presence of host plants *Clidemia hirta* and *Melastoma malabathricum* along the sampling locations. *Abrosoma johorensis* had a largely restricted diet as it was always found on those plant species from which they were collected. Host plants densities explained distribution patterns in this study. It corresponded with the report made by Seow-Cheon on 1999. Besides that, the *Abrosoma* spp have the highest mating frequency compared to the other phasmids species. This leads to the high production of offsprings. L3 showed the second highest number of individual caught with 225 individuals, followed by L2 (145 individual). Moreover, composition and diversity of phasmids are influenced by anthropogenic activities that occurred in L2 and L3. Road maintenance, indigenous people searching for the food and forest sources are among the numerous anthropogenic activities going on in these areas. 50

individuals were found in L4 and it showed the lowest individual collects as the sampling frequency is low and relatively dense vegetation conditions in location L4. This against the behaviour of phasmids that likes to be in an open habitat.

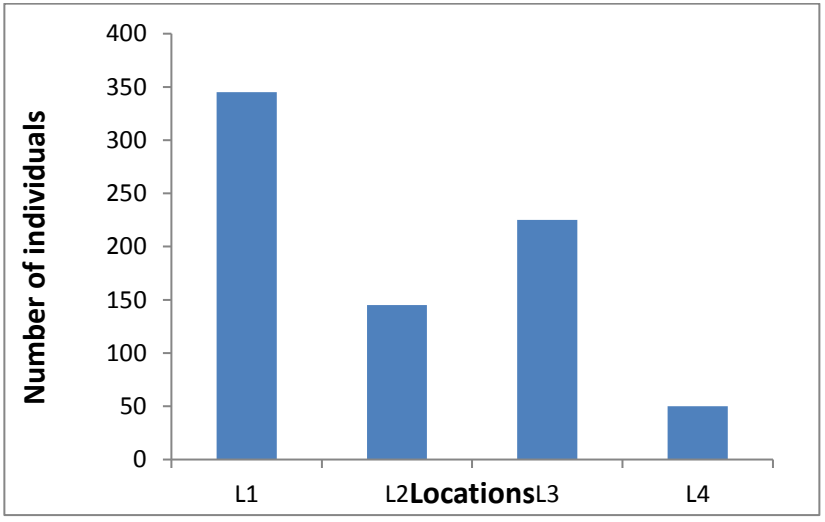

Figure 1 Number of phasmids individual recorded at each sampling sites

Heteronemiidae showed the highest species richness in Taman Negara Johor, Gunung Ledang with 35 species (76%), followed by Aschiphasmatidae and Phasmatidae with each represented by 4 species (9%), Bacillidae (2 species, 4%) and Phyllidae (1 species, 2%) (Figure 2). The number of species obtained for Heteronemiidae is higher than other families because it is the most dominant families with 81 species collected in Peninsular Malaysia (Seow-Choen 2005). These correspond with the number of species gained in this study. Phyllidae recorded the lowest percentage of phasmids (2%) (Wedmann et al. 2006) with one species of *Phyllium bioculatum* Gray collected. The comparison of percentage of phasmids species per the families between Gunung Ledang National Park and Peninsular

Malaysia can be referred in Table 1. Four species from each family of Aschiphasmatidae and Phasmatidae showed the second highest percentage (9%) compared to their existence that have been reported in Peninsular Malaysia with 11 and 12 species respectively. Phyllidae were represented by one species (25%).

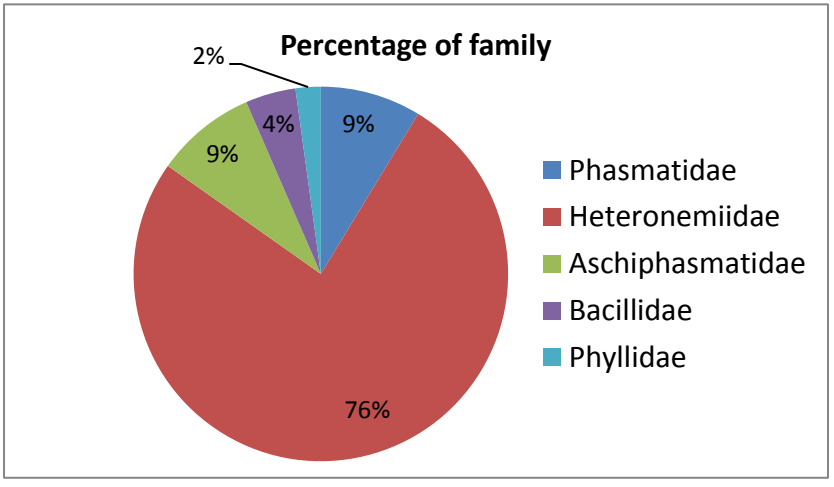

Figure 2 The percentage of phasmids composition by family

Table 1 The comparison of species richness between Gunung Ledang National Park and Peninsular Malaysia (Seow-Choen 2005)

Families	**Number of species**	
	Gunung Ledang	**Peninsular Malaysia**
Heteronemiidae	35 (76%)	81
Phasmatidae	4 (9%)	12
Aschiphasmatidae	4 (9%)	11
Bacillidae	2 (4%)	5
Phyllidae	1 (2%)	4
Total	**46**	**113**

Rarefaction method produced the accumulation curve for phasmids in four sampling sites (L1-L4). From figure 3, the accumulation curve for observed species (Sobs) is still approaching and not even reaching asymptote for phasmids at L1-L4 that show an increasing pattern. This means that the sampling effort inadecuate in all study sites and more species are expected to be met if the sampling extends. Three estimators were used (ACE, Chao 1 and Jack 1) for these abundance data. In Figure 3, Jacknife 1 species richness estimator showed a closer accumulation curve pattern among other estimators with the observed species. According to Jacknife 1 estimator, it is calculated only the single individuals in the sample known as singletons. The presence of singletons is very high in each of the sampling sites for this study.

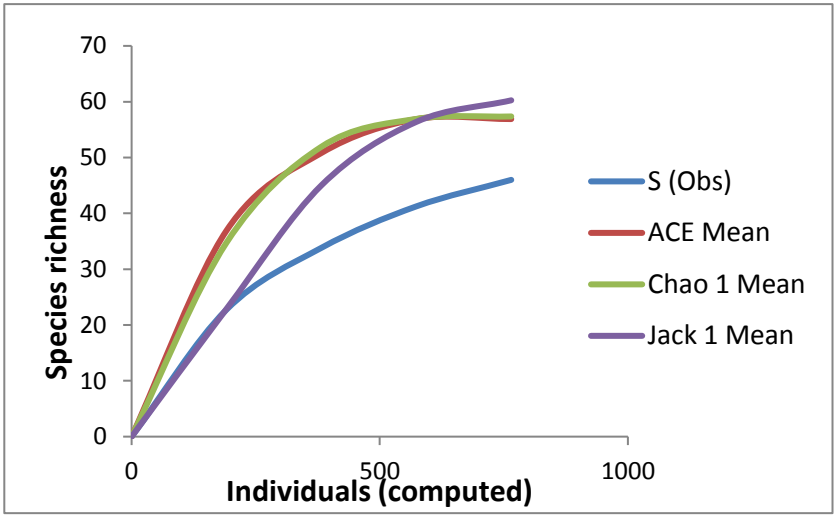

Figure 3 Species accumulation curve of phasmids at four study sites

In Figure 4, phasmids' species were ranked from the most abundant to the least abundant. The slope of plot L3 appeared to be the steeper, indicating the less evenly species were distributed compared other locations. The steepest slope shows there are dominant species in the area. *Abrosoma johorensis* appeared as the most abundant species with 142 individuals in L3.

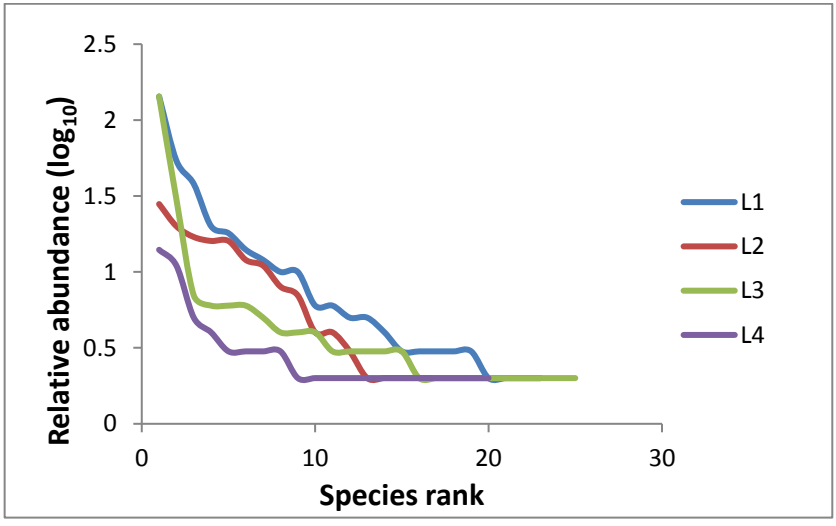

Figure 4 Rank-abundance plot of phasmids in four sampling sites

Based on Table 2, Shannon Diversity Index (H') for phasmids according to the altitude was higher at the location L2 (H'=2.547), followed by L4 (H'=2.497), L1 (H'=2.109) and L3 recorded the lowest value of H'=1.6. Shannon Diversity Index (H') for L2 reached the maximum value as all species in this area almost have the same abundance. The Evenness Index (E') was higher at L4 (E'=0.6072) because the individual number of each species present in this area are distributed evenly. The lowest value of Evenness Index recorded at L3 (E'=0.1981). The distribution pattern shows an uneven pattern for each individual species due to the most abundance species of *Abrosoma johorensis* in L3 and lowered the value of E'. The species is abundant due to the high density of host plants of *Melastoma malabathricum* along L3. The Margalef Richness Index showed L4 contained a higher diversity with (R'=4.857), followed by L3 (R'=4.431), L2 (R'=4.421) and the lowest in L1 (R'=0.3581).

Table 2 Shannon-Weiner species diversity Index (H'), Margalef Species Richness Index (R') and Evenness Species Index (E') per sampling locations.

Locations / Indices	L1	L2	L3	L4
Shannon-Weiner Index (H')	2.109	2.547	1.6	2.497
Margalef Richness Index (R')	3.765	4.421	4.431	4.857
Evenness Species Index (E')	0.3581	0.5553	0.1981	0.6072

CONCLUSION

This study is fundamental to record the composition and diversity of phasmids in different locations. As overall, 765 individuals from five families in 22 genera and 46 species were caught in this study. The highest abundance of species was recorded in L1 with 345 individuals were successfully collected. L3 showed the second highest individuals caught with 225 individuals, followed by L2 (145 individuals) and L4 (50 individuals). As a result, phasmids species richness and abundance varied with altitudes. The presence of host plants and human activities affect the changes diversity of phasmids based on altitude gradients in Gunung Ledang. Host plants (*Clidemia hirta* and *Melastoma malabathricum*) of the specialized phasmid (*Abrosoma johorensis*) is highly common in L3. Considering that there is no information on the diversity of phasmids according to altitudes in Gunung Ledang National Park, Johor, Malaysia, the result obtained in this study may serve as a baseline for future reference for the researchers.

Bil	Spesies	Localities	
	PHASMATIDAE	**Peninsular Malaysia**	**Borneo**
	Phasmatinae		
1	*Phobaeticus serratipes* (Gray)	1	0
2	*Pharnacia* sp01	1	0
3	*Pharnacia cantori* (Westwood)	1	0
4	*Ramulus nematodes* (de Haan)	1	0
	HETERONEMIIDAE		
	Lonchodinae		
5	*Lonchodes brevipes* Gray	1	1
6	*Lonchodes geniculatus* Gray	1	0
7	*Prisomera malaya* (Stal)	1	0
8	*Prisomera repudiosa* (Brunner)	1	0
9	*Carausius globosus* (Brunner)	1	0
10	*Carausius nodosus* (de Haan)	1	0
11	*Carausius spinosus* Brunner	1	0
12	*Carausius tanahrataensis* Seow-Choen	1	0
13	*Carausius* sp01	1	0
	Necrosciinae		
14	*Diardia diardi* (de Haan)	1	1
15	*Lopaphus iolas* (Westwood)	1	0
16	*Asceles malaccae* (Saussure)	1	0
17	*Asceles tanarata singapura* Seow-Choen & Brock	1	0
18	*Asceles* sp01	1	0
19	*Asceles* sp02	1	0
20	*Asceles* sp03	1	0
21	*Calvisia clarissima* Redtanbacher	1	0
22	*Calvisia* sp01	1	0
23	*Calvisia* sp02	1	0
24	*Gargantuoidea triumphalis* Redtanbacher	1	0
25	*Marmessoidea annulata* (Fabricius)	1	0

26	*Necrosia annulipes* Gray	1	0
27	*Necroscia inflata* (Redtenbacher)	1	0
28	*Necroscia punctata* (Gray)	1	1
29	*Necroscia westwoodi* Kirby	1	0
30	*Necroscia marginata* (Gray)	1	0
31	*Necroscia affinis* (Gray)	1	1
32	*Phaenopharus struthioneus* (Wesrwood)	1	0
33	*Sosibia mohamedsaidi* Seow-Choen	1	0
34	*Sosibia brocki* Seow-Choen	1	0
35	*Sosibia solida* Redtenbacher	1	0
36	*Sosibia* sp01	1	0
37	*Orthonecrosia filum* (Westwood)	1	0
38	*Anarchodes magnificus* Brock	1	0
39	*Lobonecroscia subflava* Brock & Seow-Choen	1	0
	ASCHIPHASMATIDAE		
	Aschiphasmatinae		
40	*Abrosoma johorensis* Seow-Choen & Goh	1	0
41	*Abrosoma gibberum* Brock & Seow-Choen	1	0
42	*Abrosoma festinatum* Brock & Seow-Choen	1	0
43	*Abrosoma* sp01	1	0
	BACILLIIDAE		
	Heteropteryginae		
44	*Heteropteryx dilatata* (Parkinson)	1	0
45	*Pylaemenes mitratus* Redtenbacher	1	0
	PHYLLIDAE		
46	*Phyllium bioculatum* Gray	1	1
	TOTAL	**46**	**5**

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