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A Note on The Butterflies of Gunung Belumut, Kluang Forest Reserve, Malaysia

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Abstract: Gunung Belumut is a hill dipterocarp forest that contains the third highest peak in Johor. It is surrounded by oil palm plantations and lacking comprehensive biodiversity data. Biodiversity data is important especially for long term monitoring of an ecosystem. To accommodate this, a butterfly survey was done in Gunung Belumut Amenity Forest located within Kluang Forest Reserve, Johor. Sampling was done through manual collection using aerial nets and baited traps. A total of 128 individuals comprising 64 species were collected. Despite the high plant species richness in Kluang Forest Reserve, the butterfly diversity observed within Gunung Belumut Amenity Forest was relatively low when compared to other forested areas in Johor. This may be attributed to the abundance of oil palm plantation surrounding the area.

Keywords: Butterfly, diversity, Gunung Belumut, Johor

1. Introduction

Gunung Belumut Amenity Forest (N 2°3′56.016″, E 103°31′41.138″) contains the third highest peak in Johor, with an elevation of 1010 m a.s.l. The nearest town, Kluang, is located about 30 km away. This hill dipterocarp forest is part of the Kluang Forest Reserve, located within Felda Ulu Dengar and surrounded by oil palm plantations. Unlike Gunung Ledang and TNJER Peta, not many biodiversity studies have been done here. However, a few collections were done on beetles [1], macroinvertebrates [2,3], and freshwater fishes [4]. The Forestry Department of Peninsular Malaysia has also published a series of proceedings during their scientific expedition done in August 2009 [5]. However, none of those studies were on butterflies, in spite it being the most studied insect group in Malaysia [6]. For the record, several butterfly surveys have been done in various amenity forests in Johor such as in Bukit Soga, Batu Pahat [7], Taka Melor, Labis [8] and Gunung Arong, Mersing [9]. Collections have also been done in several hill dipterocarp forests namely Bukit Reban Kambing, Bukit Belading and Bukit Tukau in the district of Tangkak [10]. To fill this gap, a butterfly survey was done in Gunung Belumut. This will allow us to conduct consistent survey and monitoring of the butterfly fauna here. Butterflies make excellent bioindicators due to their small size and quick reproductive rate [11]. These characteristics make them highly sensitive to environmental changes. Therefore, butterflies are an excellent group to monitor environmental changes at specific sites. To the best of our knowledge, this is the first time a study on butterfly diversity is done in Gunung Belumut.

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2. Methods

2.1 Butterfly Sampling and Identification

Sampling was done along the forest trails of Gunung Belumut Amenity Forest on 6 – 8 May 2017, 26 – 28 September 2017 and 21 – 23 January of 2018. Each sampling occasion lasted for about three days. Butterflies collected in the field were paralyzed by gently pinching the thorax. They were then preserved temporarily in glassine envelopes prior to being transported to the laboratory. In the laboratory, each specimen was softened, spread out, pinned, and dried in the oven for at least one week at 40 °C. Identification was done using keys from [12-16], based on their wing patterns, palpi, and sex organ. The two general criteria in distinguishing species were noted, namely wingspan/size and color/pattern. Wingspan measurements were taken from curated and spread samples. The wings were measured from the tip of the left forewings. Also, the specimens were brought to the Centre for Insect Systematic, Universiti Kebangsaan Malaysia (CIS-UKM) and Forest Research Institute Malaysia (FRIM) for verification. Identified specimens were deposited at the Centre of Research for Sustainable Uses of Natural Resources, Faculty of Applied Sciences and Technology, Universiti Tun Hussein Onn Malaysia (UTHM) as a reference collection.

2.2 Data Analysis

To analyze our butterfly species assemblages, Paleontological Statistics (PAST)[17], and EcoSim [18] were used. Measuring species richness though the number of species (S) alone has been proven to be weak in terms of discriminating sites [19]. In the same study, compound diversity measures such as Shannon Index of Diversity (H′) were proven to be the best index used to discriminate site, especially when combined with evenness (E_H) measurement.

Species diversity was analyzed using Shannon diversity index (H′). Shannon diversity is an information statistic index that assumes all species in a sample are represented and randomly sampled. It is used to measure the alpha diversity within a single study area. It basically determines the species diversity in a community, which is based on the number of species and the number of individuals in each species. Areas with high H′ value have a high diversity. The formula used to calculate Shannon Index (H′) is shown in Equation 1:

$$H' = -\sum_{i=1}^{s}(p_i)(\ln p_i) \quad (1)$$

[16]

where:

H′ = Shannon diversity index,
p_i = the proportion of individuals belonging to the species, and
s = number of species.

The value of H′ varies from 0 for communities with a single taxon to higher values for communities with multiple taxa represented by a number of individuals. The value of H' obtained from empirical data usually falls between 1.5 and 3.5 and would surpass 4 when they are huge numbers of species in a sample [20].

Evenness was then measured with which individuals were divided among all the species present using Evenness Index (E_H). The formula to calculate this is shown in Equation 2:

$$E_H = \frac{H}{\ln S} \quad (2)$$

[16]

where:

E_H = Evenness Index,
H = Shannon Diversity Index, and
S = total number of species.

The value of E_H is close to 0 for communities with uneven distribution among taxa and 1 for communities with the most even distribution among all taxa. It is necessary for us to measure the evenness since a lot of our species are represented by singletons, making them relatively 'rare'.

3. Results and Discussion

A total of 128 individuals comprising 64 species were collected from Gunung Belumut Amenity Forest. All six families were represented in this study. The family with the highest abundance was Nymphalidae. This was followed by Lycaenidae (Fig. 1).

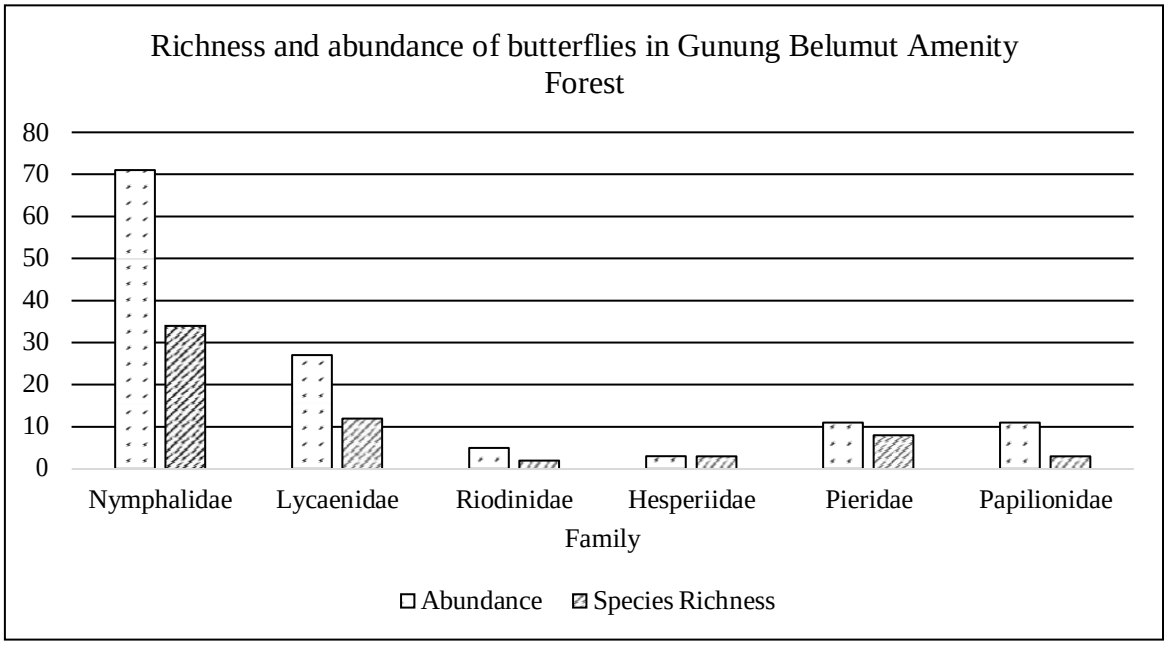

Fig. 1 - Species richness and abundance in Gunung Belumut Amenity Forest according to family

The least represented family was family Hesperiidae with three species recorded. This is not surprising since hesperiids are often difficult to observe due to its cryptic characteristic and erratic flying habits. Skippers (Hesperiidae) are also known to be active for only a few hours at dawn or dusk [21]. This makes the task of recording them in an area a bit more difficult. According to the rank abundance curve, the most dominant species recorded was *Lexias pardalis dirtena* (Nymphalidae)(Fig. 2). Traps with rotten fruits that were used to supplement manual collection may have significantly contributed to the high number of nymphalids captured, especially from the subfamily Limenitidinae (*Euthalia* sp., *Tanaecia* sp., *Lexias* sp.,), Morphinae (*Amathusia* sp., *Zeuxidia* sp.), and Satyrinae (*Elymnias* sp., *Mycalesis* sp., *Ypthima* sp.). A similar pattern of species composition was also obtained by [22], who also combined traps baited with rotten fruit together with the manual collection. Butterflies from the family Nymphalidae dominates her collection by 49.2% followed by Lycaenidae at 24.6%. It has already been established by multiple studies that fruit-baited traps will cater almost exclusively to nymphalids [23,24]. However, limiting this study to only manual collection and observation will further restrict the sampled butterflies to slow and low-flying ones that are conspicuously visible.

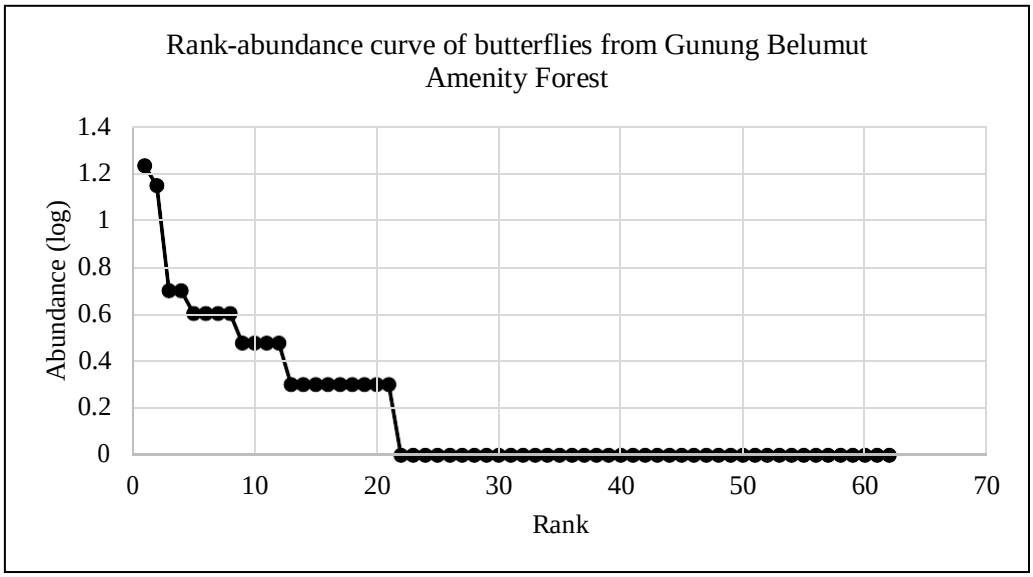

Fig. 2 - Rank abundance curve of butterflies in Gunung Belumut Amenity Forest

Forty-one singletons were recorded in this study, accounting for 64.1% of the sample. Some of the singletons include *Lassipa tiga siaka*, *Neptis duryodana nesia*, and *Terinos terpander robertsia* (Nymphalidae). Two species are new records for Johor, namely *Pithauria stramineipennis stramineipennis* (Hesperiidae) and *Dacalana cremera ricardi* (Lycaenidae). It is interesting to note that two specimens of *Dacalana cremera ricardi* was recorded in Hugh R.M. Storeys collection accumulated between 1968 to 2003 around Peninsular Malaysia [25]. His collection is now in the Repository of the Department of Museums, Malaysia. The H′ Index for this sample site is 3.688 with a relative E_H value of 0.8935. By comparison, the diversity of butterflies in Gunung Belumut Amenity Forest is comparatively lower than other forested areas in Johor [26]. This may be due to a few reasons such as under sampling or high disturbance factor. Sampling in Gunung Belumut was done near the waterfall. Since this study did not involve any elevational sampling, it is possible that some species went unrecorded, especially those that thrive in higher elevations. Some small range-sized butterfly species may exclusively inhabit regions with higher elevations such as Gunung Belumut [27]. Apart from that, the surrounding area of Gunung Belumut composed of mainly oil palm plantations, making Gunung Belumut a 'forest island'. Expansion of surrounding agricultural area might have contributed to the low butterfly diversity obtained. [28] emphasized that oil palm plantations are poor substitute for either primary or degraded forest since it supports fewer forest species that other agricultural options.

4. Conclusion

While this study has managed to provide a checklist of butterflies in Gunung Belumut Amenity Forest, part of Kluang Forest Reserve, there are some limitations. Since this study did not venture into higher altitudes of Gunung Belumut, future works could include this as part of their sampling site. It is possible that new records of species can be obtained in this area. Constant monitoring of the biodiversity in Gunung Belumut and other forested areas surrounding Johor is important due to the nature of rapid development in the state.

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Appendix A: Checklist of Butterflies Recorded in Gunung Belumut Amenity Forest

No	Taxa
	PAPILIONIDAE
	Subfamily: Papilioninae
1	*Graphium agamemnon agamemnon* (Linnaeus, 1758)
2	*Graphium evemon eventus* (Fruhstorfer, [1908])
3	*Graphium sarpedon luctatius* (Fruhstorfer, 1907)
	PIERIDAE
	Subfamily: Coliadinae
4	*Eurema ada iona* Talbot, 1939
5	*Eurema andersonii andersonii* (Moore,1886)
6	*Eurema hecabe contubernalis* (Moore, 1886)
7	*Eurema lacteola lacteola* (Distant, 1886)
8	*Eurema sari sodalis* (Moore,1886)
9	*Eurema simulatrix tecmessa* (de Niceville, [1896])
	Subfamily: Pierinae
10	*Leptosia nina nina* (Fabricius, 1973)
11	*Prioneris philonome themana* Fruhstorfer, 1903
	NYMPHALIDAE
	Subfamily: Charaxinae
12	*Prothoe franck uniformis* Butler, 1885

Appendix A (continued)

No	Taxa
	Subfamily: Cyrestinae
13	*Cyrestis cocles earli* Distant, 1883
	Subfamily: Danainae
14	*Euploea doubledayi evalida* (Swinhoe, 1899)
15	*Euploea mulciber mulciber* (Cramer, [1777])
16	*Euploea radamanthus radamanthus* (Fabricius, 1793)
17	*Ideopsis gaura perakana* Fruhstorfer, [1899]
18	*Ideopsis similis persimilis* (Moore, 1879)
19	*Parantica aspasia aspasia* (Fabricius, 1787)
	Subfamily: Heliconiinae
20	*Cirrochroa malaya malaya* C. & R. Felder, 1860
21	*Cupha erymanthis lotis* (Sulzer, 1776)
22	*Terinos atlita teuthras* Hewitson, 1862
23	*Terinos terpander robertsia* Butler, 1867
24	*Vindula erota chersonesia* (Butler,[1879])
	Subfamily: Limenitidinae

25	*Athyma kanwa kanwa* Moore, 1858
26	*Athyma pravara helma* (Fruhstorfer, 1906)
27	*Bassarona dunya dunya* (Doubleday, [1848])
28	*Bassarona teuta goodrichi* (Distant, 1886)
29	*Dophla evelina compta* Fruhstorfer, 1899
30	*Lasippa tiga siaka* (Moore, 1881)
31	*Lexias canescens pardalina* (Staudinger, 1886)
32	*Lexias cyanipardus sandakana* (Fruhstorfer, 1896)
33	*Lexias dirtea merguia* (Tytler, 1926)
34	*Lexias pardalis dirteana* (Corbet, 1941)
35	*Neptis duryodana nesia* Fruhstorfer, 1908
36	*Pantoporia dindinga* (Butler, [1879])
37	*Pantoporia sandaka sandaka* (Butler, 1892)
38	*Tanaecia aruna aruna* (C. & R. Felder, 1860)
39	*Tanaecia iapis puseda* (Moore, [1858])
40	*Tanaecia pelea pelea* (Fabricius, 1787)
	Subfamily: Morphinae
41	*Amathuxidia amythaon dilucida* (Honrath, 1884)
42	*Faunis canens arcesilas* Stichel, 1933
43	*Zeuxidia doubledayi doubledayi* Westwood, [1851]
	Subfamily: Satyrinae
44	*Mycalesis orseis nautilus* Butler, 1867

Appendix A (continued)

No	Taxa
45	*Mycalesis perseoides perseoides* (Moore, [1892])
46	*Ragadia makuta siponta* Fruhstorfer, 1911
47	*Ypthima pandocus corticaria* Butler, [1879]
	RIODINIDAE
	Subfamily: Nemeobiinae
48	*Abisara geza niya* Fruhstorfer, 1941
49	*Taxila haquinus haquinus* (Fabricius, 1793)
	LYCAENIDAE
	Subfamily: Miletinae
50	*Allotinus apries apries* Fruhstorfer, 1913
51	*Allotinus horsfieldi permagnus* Fruhstorfer, 1913
52	*Allotinus leogoron leogoron* (Fruhstorfer, 1916)
53	*Allotinus portunus maitus* Fruhstorfer, 1914
54	*Allotinus unicolor unicolor* C. & R. Felder, [1865]
	Subfamily: Polyommatinae
55	*Jamides malaccanus malaccanus* (Rober, 1886)

56	*Jamides parasaturatus paramalaccanus* Riley & Corbet, 1938
57	*Jamides pura pura* (Moore, 1886)
	Subfamily: Theclinae
58	*Arhopala havilandi kota* (Evans, 1957)
59	*Dacalana cremera ricardi* (Eliot, 1959)
60	*Drupadia ravindra moorei* (Distant, 1882)
61	*Neocherita amrita amrita* (C. & R. Felder, 1860)
	Subfamily: Hesperiinae
62	*Ancistroides gemmifer gemmifer* (Butler,[1879])
63	*Koruthaialos sindu sindu* (C. & R. Felder, 1860)
64	*Pithauria stramineipennis stramineipennis* Wood-Mason & de Nicéville, 1886

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