
Short Notes

Butterfly Fauna in Kadamaian Area, Kota Belud, Sabah: A Survey during Borneo Geographic Expedition 2019

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Abstract

During the Borneo Geographic Expedition 2019 in Kadamaian area in Kota Belud, a survey on butterfly fauna was conducted for four days from 21st to 24th October, 2019. Three sites selected for the butterfly sampling were Site 1, Site 2 and Site 4. The methods applied were fruit and carrion baited traps, and aerial netting. A total of 56 individuals were sampled and belonged to 25 species from four families (Nymphalidae, Pieridae, Lycaenidae and Papilionidae). Nymphalidae was the dominant family with *Ragadia makuta* recorded as the most abundant species. About 60% of the butterflies sampled in the area are forest species, while 40% of the overall species have narrow geographical distribution restricted to Sundaland. The butterfly fauna in Kadamaian area is comparable to other forest types in Sabah in terms of their diversity and species richness. The findings reflected the potential of Kadamaian area as a nature tourism site, and the area could also serve as a corridor for the conservation of flora and fauna as it is located adjacent to Kinabalu Park.

Keywords: Butterflies, diversity, forest species, Kadamaian area, conservation

Introduction

The Malaysian State of Sabah, as part of Borneo, is well-known as one of the world's biodiversity hotspots, including diverse insect species. Many beautiful and endemic species of butterflies can be found in Sabah. There are about 950 species of butterfly species that have been recorded on Borneo (Otsuka, 2001), of which 81 species (8.5%) are endemic (Gohun et al., 2021). Butterflies are classified under the order Lepidoptera and suborder Rhopalocera. They play an important role as a pollinator by transferring pollens to the stigma of flowers (Webb, 2008). Butterflies are also widely accepted as a bioindicator of habitat quality as they are very sensitive to subtle changes in their surrounding (Mobeen et al., 2016).

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The Borneo Geographic Expedition 2019 was carried out in Kadamaian in Kota Belud, Sabah. This expedition was co-organised by Universiti Malaysia Sabah and Sabah Parks and conducted from 14th to 25th October, 2019. Among the objectives of the expedition was to survey the biodiversity of flora and fauna in the area, including the butterfly faunal composition which consists of five families.

Methodology

a. Background of the study area

Kadamaian is located at the north-west of Sayap substation (Kinabalu Park) (Figure 1). Three sites were surveyed for this study namely Podos-Nopunguk Trail (Site 1), Melangkap Noriou (Site 2), and Kampung Tinata (Site 4). A basecamp site was set up in Kampung Podos at Podos Heritage Homestay (N06°12'44.2" E116°30'31.2") at about 417 m.a.s.l (Figure 2).

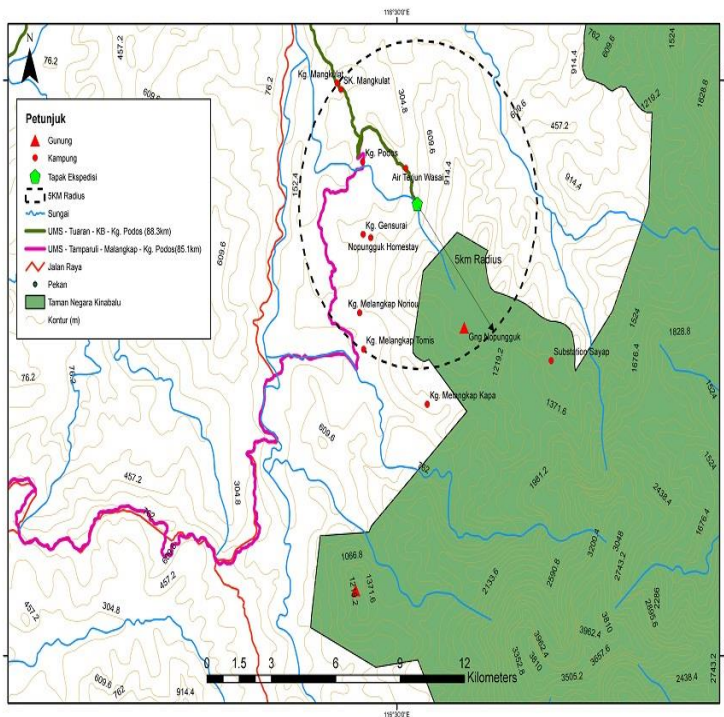


Figure 1. Map of the expedition area



Figure 2. Basecamp site at Podos Heritage Homestay, Kg. Podos

b. *Sampling methods*

The butterfly samplings were conducted from 21st to 24th October, 2019. The sampling was done from 8.00 am until 6.00 pm. Baited-traps and aerial netting techniques were used to sample the butterflies. Both techniques were used simultaneously in this survey to increase the sample size.

i. *Baited-trap technique*

This technique is widely used to sample butterflies that belong to the fruit feeding guild, most are members of Nymphalidae (De Vries et al., 1997) and also butterflies that are attracted to carrion (Hamer et al., 2006). In this survey, ten baited traps were set up only at Site 1. The traps were hung on the tree branches and placed at 50 m intervals along a 500 m transect. Ripe bananas and shrimp paste were used as baits. Five traps were baited with ripe bananas while the other five traps were baited with shrimp paste, placed alternately. All traps were checked twice daily (in the morning and afternoon).

ii. *Aerial netting technique*

The aerial netting technique is usually used to sample butterflies that feed on nectar, which cannot be sampled by using the baited-trap technique. At Site 1, the sampling of butterflies using aerial netting was conducted for 10 minutes at each of the trapping stations. Butterflies were captured within a 5 m radius at each station (Figure 3). At Site 2 and Site 4, the butterflies were captured randomly by using this method.

iii. Catch, mark and release

In order to reduce the number of butterflies killed, individuals that could be identified in the field were marked and released. The butterflies were marked with a marker pen at the underside of their wings before they were released (Figure 3). For each of the species sampled and identified in the field, three or fewer individuals were taken as specimens.



Figure 3. Catch, mark and release technique

c. Preservation and Identification

All the individuals that could not be identified in the field were taken as specimens and brought back to the laboratory at the Institute for Tropical Biology and Conservation (ITBC), Universiti Malaysia Sabah (UMS) for the preservation and identification processes. The specimens were identified based on Otsuka (1988) and the collections in BORNEENSIS at ITBC, UMS.

d. Data Analysis

The data were analyzed using descriptive and statistical analyses. The descriptive analysis was done in Microsoft Excel 2010, while the statistical analysis was performed by using Paleontological Statistics Software (PAST) version 4.03. The butterfly diversity was measured using the Shannon-Wiener diversity index (H'), Simpson's Index (D) and Margalef's Index (D_{Mg}).

i. Shannon-Wiener Diversity Index (H')

This index is a measure of diversity that combines species richness and their relative abundance. The diversity in a community increases as H' increases, and the values usually range between 1.5 and 3.5, and rarely exceeds 4 (Magurran, 2004).

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

p_i = proportion of species i in population

S = total number of species

ii. Simpson's Diversity Index (D)

Simpson's Diversity Index is a measure of diversity which takes into account the number of species present, as well as the relative abundance of each species. The value of Simpson's D ranges from 0 to 1. As species richness and evenness increase, diversity increases. With this index, the greater value of D , the greater diversity of the sample (Moore, 2013)

$$D = 1 - \left(\frac{\sum n(n-1)}{N(N-1)} \right)$$

n = the total number of organisms of a particular species

N = the total number of organism of all species

iii. Margalef's Index (D_{Mg})

Margalef's Index is a measure of species richness (Magurran, 2004)

$$D_{Mg} = S - 1 / \ln(N)$$

S = the number of species,

N = the total number of individuals in the sample

Results and Discussion

A total of 56 individuals comprising of 25 species from four families (Nymphalidae, Pieridae, Lycaenidae and Papilionidae) were sampled during the expedition. Nymphalidae was the dominant family with 18 species and 43 individuals (Figure 4). Many members of this family are attracted to ripe fruits, carrion and animal excretion (Corbet & Pendlebury, 1992; De Vries, 1988). Nymphalinae and Satyrinae were the dominant subfamilies with seven species

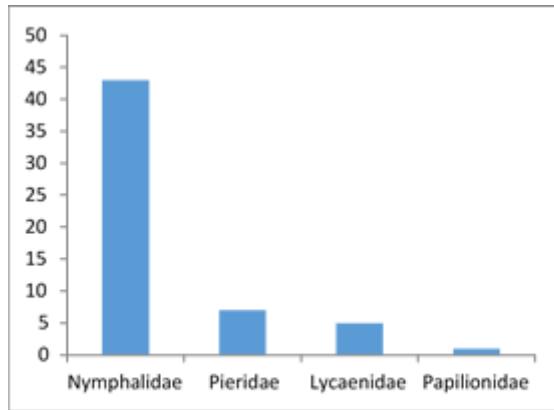


Figure 4. The number of species based on the families

recorded, respectively. In terms of abundance, Satyrinae recorded more individuals (22 individuals) compared to Nymphalinae (15 individuals).

Satyrinae is generally a small to medium-sized butterfly. Its wings are usually dull brown in colour with submarginal eye-spots. Most of the species in this subfamily are weak in flight and prefer shady conditions. The members in this subfamily are frequently found among low herbage, and some species are confined to the forest habitat. The hostplants of this subfamily are mainly Gramineae (grasses) and Palmae (palms) (Corbet & Pendlebury, 1992). Nymphalinae consists of butterflies of medium to large size. Many species have bright and beautiful wing colour patterns. The subfamily Nymphalinae are usually sun-loving butterflies and often can be seen at flowering plants in gardens and forests. This subfamily is known as strong and rapid fliers (Corbet & Pendlebury, 1992). *Ragadia makuta* was recorded as the most abundant species in the survey. The result could be explained by the abundance of the hostplant *Selaginella* spp. in the area (Figure 5). *Ragadia makuta* distribution is highly dependent on the presence of *Selaginella* spp. as the adult and larval hostplant (Hill et al., 2003).

An interesting finding from this survey is more than half (60%) of the total species sampled during this expedition are considered forest species (Table 1). The result may reflect the study area as a suitable forest habitat for many forest species. No species endemic to Borneo were found in this area. However, about 40% of the species sampled have a narrow geographical distribution (restricted to Sundaland) (based on Corbet & Pendlebury (1992), Otsuka (1988) Otsuka (2001). This includes an individual of *Trogonoptera brookiana* which is listed as

protected species under CITES (CITES, 2013) or least concern by IUCN (Malaysia Biodiversity Information System, 2020). This remarkable species is also known as Rajah Brooke's Birdwing and frequents habitats with streams. Phon et al. (2018) reported this species is facing heavy commercial exploitation and habitat loss: between 2001 and 2010, the total reported export trade of wild specimens was 5,060 individuals.



Figure 5. *Selaginella* spp. at the study area

In terms of species diversity, Kadamaian ($H' = 3.04$) is comparable to Kangkawat ($H' = 3.64$), as reported by Norradhihah et al. (2000) where 43 species had been sampled during four days of sampling in this area, which is part of Imbak Canyon Conservation Area, Class 1 (Protection) Forest Reserve. As for species richness, Chung et al. (2019) reported that 17 species of butterflies were recorded in five days during a survey at Sg. Rawog Conservation Area in Segaliud Lokan Forest Reserve, which is a logged-over forest, as compared to 25 species recorded in Kadamaian area.

Table 1. The list of butterfly species and the number of individuals recorded in the study area

Family	Subfamily	Species	No. individual	
Nymphalidae	Nymphalinae	<i>Bassarona dunya</i> ^{a,b}	5	
		<i>Discophora necho</i> ^{a,b}	2	
		<i>Dophla evelina</i> ^a	2	
		<i>Euthalia iapis</i> ^{a,b}	1	
		<i>Junonia atlites</i>	2	
		<i>Kallima limborgii</i> ^{a,b}	2	
		<i>Lassipa heliodore</i>	1	
	Satyrinae	<i>Mycalesis anapita</i> ^{a,b}	1	
		<i>Mycalesis fusca</i> ^{a,b}	2	
		<i>Mycalesis orseis</i> ^a	4	
		<i>Ragadia makuta</i> ^{a,b}	7	
		<i>Xanthotaenia busiris</i> ^a	3	
		<i>Ypthima baldus</i>	1	
		<i>Ypthima pandocus</i>	4	
		Morphinae	<i>Faunis canens</i> ^a	1
			<i>Faunis kirata</i> ^{a,b}	2
			<i>Melanocyma faunala</i> ^a	1
Pieridae	Coliadinae	<i>Taenaris horsfieldii</i> ^{a,b}	2	
		<i>Eurema hecabe</i>	2	
		<i>Eurema sari</i>	2	
		<i>Eurema simulatrix</i>	1	
		<i>Gandaca harina</i>	2	
Lycaenidae	Lycaeninae	<i>Neopithecops zalmora</i> ^a	4	
		<i>Caleta elna</i>	1	
Papilionidae	Papilioninae	<i>Trogonoptera brookiana</i> ^{a,b}	1	
Total	25 species		56 individuals	

Note: Forest species are indicated with 'a' and species with narrow geographical distribution are denoted by 'b' (based on Corbet & Pendlebury, 1992; Otsuka, 1988; Otsuka, 2001)

Conclusion

The findings from this survey highlighted the value of the Kadamaian area for the conservation of butterfly fauna with the occurrence of many forest species as well as species of narrow geographical distribution and also a protected species under CITES. Moreover, the Kadamaian area is located adjacent to Kinabalu Park, and could therefore serve as a corridor for the persistence of many fauna and flora species. Kadamaian also has great potential to be promoted as a nature tourism site. An effective approach needs to be put forward to enhance conservation awareness among villagers and the authorities.

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