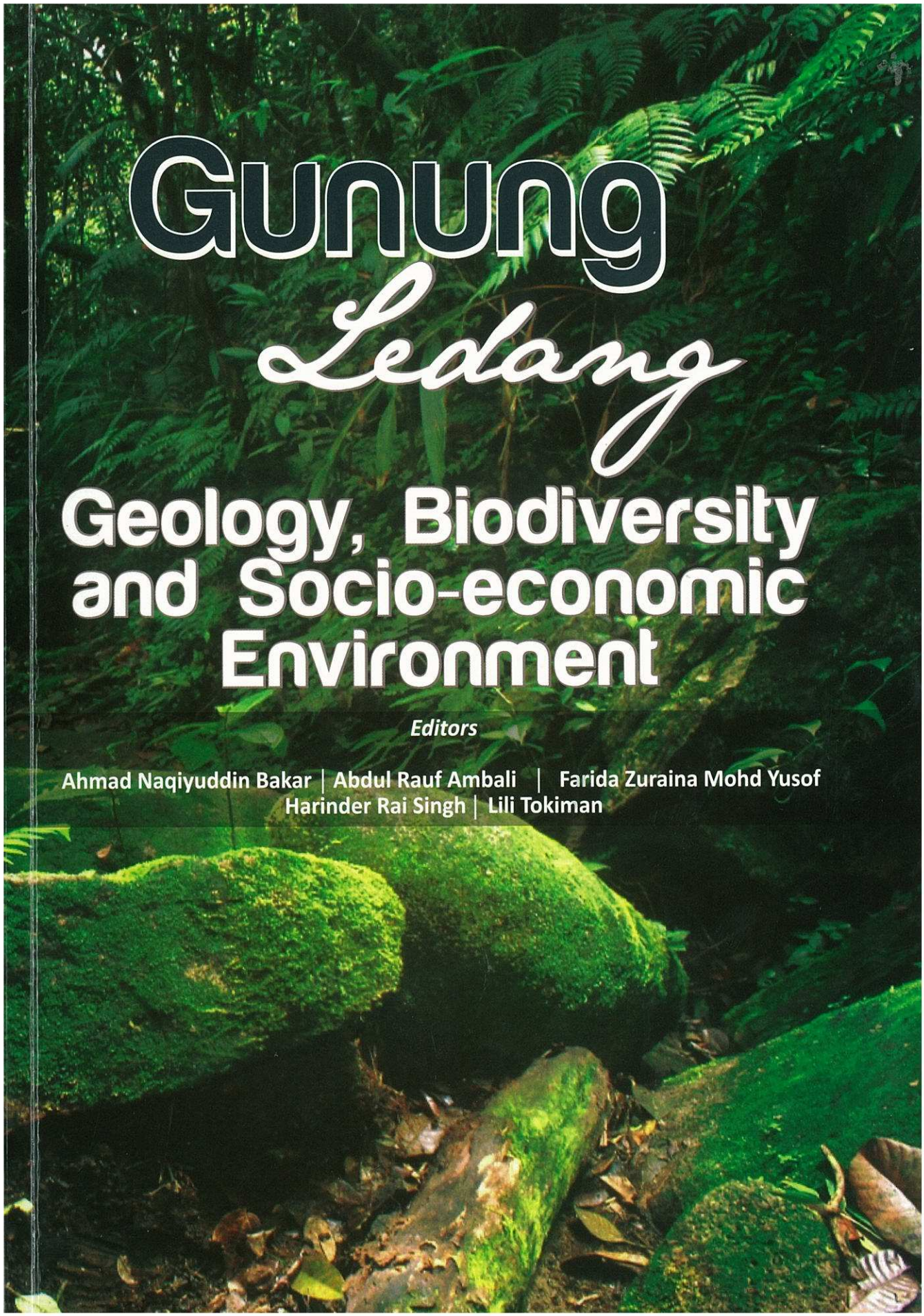
Gunung
Ledang
Geology, Biodiversity and Socio-economic Environment
Editors
Ahmad Naqiyuddin Bakar | Abdul Rauf Ambali | Farida Zuraina Mohd Yusof
Harinder Rai Singh | Lili Tokiman

UiTM Press is a member of
MALAYSIAN SCHOLARLY PUBLISHING COUNCIL

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

GUNUNG LEDANG: GEOLOGY, BIODIVERSITY AND SOCIO-ECONOMIC ENVIRONMENT/ Editors Ahmad Naqiyuddin Bakar, Abdul Rauf Ambali, Farida Zuraina Mohd Yusof, Harinder Rai Singh, Lili Tokiman
Includes index
ISBN 978-967-363-466-8
1. Biodiversity--Gunung Ledang (Johor). 2. Biodiversity conservation--Gunung Ledang (Johor). 3. Scientific expeditions-- Gunung Ledang (Johor). 4. Gunung Ledang (Johor)--Environmental conditions. 5. Gunung Ledang (Johor)--Social conditions. 6. Gunung Ledang (Johor)--Economic conditions.
I. Ahmad Naqiuddin Bakar. II. Abdul Rauf Ambali.
III. Farida Zuraina Mohd. Yusof. IV. Haridner Rai Singh.
V. Lili Tokiman.
333.951609595119

CONTENTS

Rapid Assessment of Vertebrate Fauna in Gunung Ledang Johor National Park

Madinah Adrus[1], Mohd Isham Mohd Azhar[1], Mohamad Fizl Sidq Ramji[1], Mohd Hanif Ridzuan Mat Daud[1], Muhammad Fadzil Amran[1], Sarina Mat Yasin[1] and Mohd Tajuddin Abdullah[1*]

INTRODUCTION

Gunung Ledang National Park is located about 12 km from Tangkak town in the Muar district, Johor. It was gazetted as a national park on 3rd October 2003 covering an area of 8675.20 hectares. There are four vegetation types that can be found in Gunung Ledang which includes lowland dipterocarp forest, hill dipterocarp forest, lower montane forest and montane ericaceous forest (Kiew, 1992). The highest point of this mountain is referred to as Mount Ophir at an elevation of 1,276 m above sea level Gunung Ledang is primarily known to the locals for its famous legendary myth about a princess. However, not many people know that Gunung Ledang is also the highest point in southern Peninsular Malaysia which holds a rich biodiversity that has been poorly explored (Chuan *et al.*, 2006).

It is apparent that different forest types (e.g. mix dipterocarp forest, heath forest, mangrove, etc.) within Malaysia harbours different taxonomic composition of vertebrate fauna. Biodiversity surveys of vertebrate fauna in Malaysian tropical rainforest has largely focused on the lowland rainforest (e.g. Balambangan Island: Tuen *et al.*, 2002; peat swamp forest in Sarawak: Abdullah *et al.*, 2006; Krau Wildlife Reserve: Kingston *et al.* 2006; Niah National Park: Khan *et al.*, 2008; Lubuk Sembilang Recreational Park-Langkawi Island: Eileen *et al.*, 2012; Kuala Atok-Taman Negara Pahang: Tingga *et al.*, 2012), whereas research on the fauna from Malaysian montane rainforest is generally lacking with very few published literature (e.g. Mount Santubong: Tuen *et al.*, 2000; Mount Penrisen: Jayaraj *et al.*, 2006; Mount Jerai: Shahrul-Anuar *et al.*, 2006; Mount Murud: Khan *et al.*, 2007; Mount Silam: Besar *et al.*, 2009; Gunung Panti Forest Reserve - Johor: Chan *et al.*, 2010b). Therefore, it is necessary to increase research attention to these areas where endemism due to elevation separations and possibilities of finding new species is high.

Gunung Ledang National Park which include a diverse range of habitats through different vegetation type is an example that potentially consist rich vertebrate fauna assemblage that has yet to be explored. Therefore, a rapid survey aimed at documenting the terrestrial vertebrate fauna (mammals, birds and anurans) of Gunung Ledang was carried out by Universiti Malaysia Sarawak (UNIMAS) during an expedition organized by UiTM and PTNJ from 8th to 14th November 2011.

MATERIALS AND METHOD

Study Sites

Sampling sites covered two different elevations. The first site is the Plateau camp site (N 02°22'04.8" E 102 36'45.0" E; 1,054 m; from the 9th to 11th November 2011) located close to Gunung Ledang summit and consist of montane and hill forest, whereas the second site is nearby Gunung Ledang National Park headquarters (N 02°20.802" E102 38.181" E; 62 m; from 12th to 13th November 2011) covered with lowland dipterocarp forest (Figure 1).

Sampling Methods

Mammals sampling methods

Direct and indirect methods were used to record the presence and absence of mammals in Gunung Ledang National Park area. Direct methods used in the assessment include mist netting, harp trapping and cage trapping whereas indirect method includes vocalisation, defecation and foot prints. Volant small mammals were trapped using 20 mist nets (three shelves × 9 meter long) and two four-bank harp traps while for non-volants small mammals, 35 standards cage traps were used. Mist nets and harp traps were set across forest trails, open areas, forest fringe and across streams. The nets and harp traps were attended from 1830 hours till 2230 hours and again at 0600 hours for one hour on the next day. Cage traps were set along trails of approximately 350 m in length. These traps were placed on branches and ground placed 10 m apart from each other. Baits including banana and tapioca were used. Cage traps were checked twice daily and the baits were replenished twice daily (morning and evening). Mammal observation surveys were also conducted early morning (0600 to 0800 hrs) and late evening (1730 to1900 hrs).

All small mammals caught were identified based on taxonomic keys in Medway (1969), Kingston *et al.* (2006) and Francis (2008). Standard measurements such as weight and sex of each individual were taken. For chiropteran and rodents, tissue samples from muscle and liver were taken for future DNA studies from a maximum of three individuals per species. Voucher specimens were deposited at the Zoological Museum of Universiti Malaysia Sarawak (Abdullah *et al.*, 2010).

Birds sampling methods

Twenty ground mist-nets were set to capture birds. The nets were stretched using wooden poles with the bottom part of the net not more than 30 cm above the ground. The nets were opened from 0600 hr until 1800 hr and checked every two hours. Bird observations were conducted early morning (0630 to 0900hr) and late afternoon (1700 to 1900hr) using binoculars. For the first three days, mist-netting was conducted along the ridges of the summit road using 10 mist-nets. The remaining nets were deployed within the forest edges near Gua Masjid. Meanwhile, at the lower elevation mist-netting were conducted along main trails around Sungai Ayer Puteh waterfall.

Birds caught from the net were immediately transferred into cloth bags before banding. All captured birds were weighed using PESOLA® light spring-loaded scales model (Switzerland); 50 g, 100 g and 300 g, measured using 30 cm stiff steel ruler and a Mitutoyo® digital caliper (Japan), and identified following Robson (2007). All data such as bill length (BL), bill width (BW), bill depth (BD), head bill (HB), wing length (WL), wing span (WS), tail length (TA), total length (TL), tarsus length (TR), and weight (WT) were recorded. Before release, the birds were fitted with aluminum tags (ring bearing UNIMAS number) on their legs to identify recaptured birds.

Anurans sampling methods

Five sampling sites were chosen for anuran sampling, namely, Sungai Ayer Puteh, Plateau camp site, Sungai Ayer Panas, Sungai Asahan and Empangan Tangkak. Sungai Ayer Panas is located near Gunung Ledang Resort while Sungai Asahan is located at the edge of Gunung Ledang National Park, which is the recreational place for tourist. The surveys were conducted for four night (1900 hr until 2100), from 9th to 12th November 2011.

For the anurans survey, only three field apparatus were used ie plastic bags, torch light with yellow light and marker pens. Anurans were captured by hand and kept in plastic bags. The data including time, date, location, rectal temperature, and substrate where the frog was found, were recorded. Anuran species were identified according to Inger and Stuebing (2005). The following measurements were taken: snout-vent length, tibia length and weight, using caliper, ruler and PESOLA® light spring-loaded scales model (Switzerland).

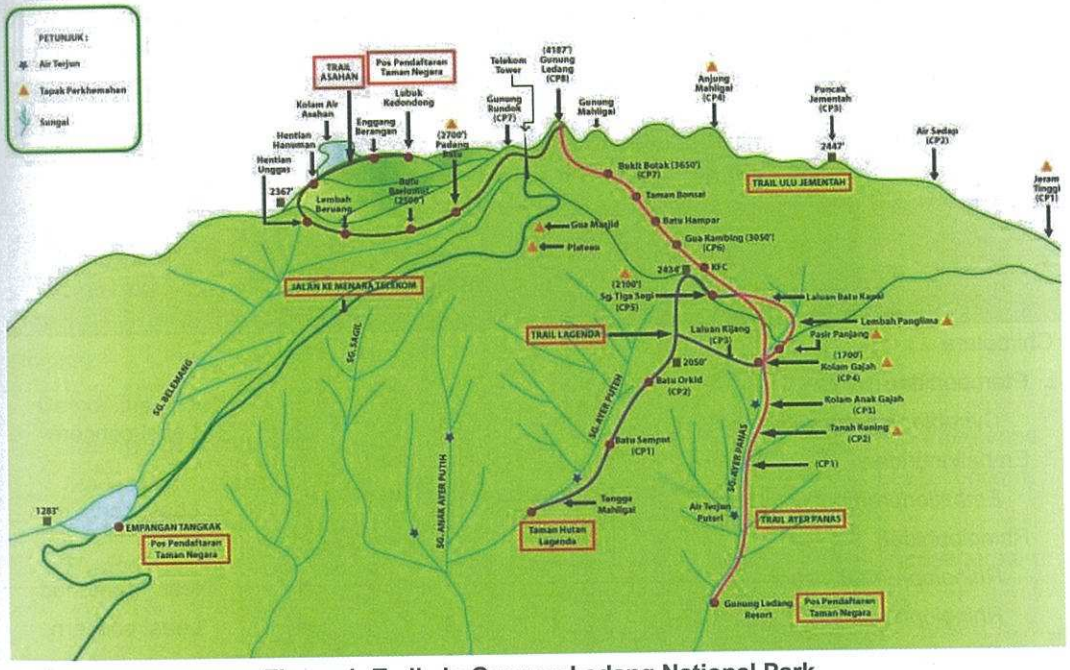

Figure 1: Trails in Gunung Ledang National Park

(Source: Johor National Parks Corporation)

RESULTS

Mammals

A total of 17 species of mammals from 10 families were recorded in this survey. Thirteen species of mammals were caught through the traps while another four species were recorded through observations (Table 1). Four species of small mammals were caught from upper elevation (site 1> 1,000 m): *Emballonura monticola*, *Rhinolophus robinsoni*, *Tupaia glis* and *Sundasciurus tenuis* with only one individual each. Meanwhile, 10 species with a total of 20 individuals of small mammals were trapped from lower elevation (site 2; < 100 m). This includes *Myotis muricola, Miniopterus medius* and *Tupaia glis* with only one individual each, whereas *Rhinolophus affinis* (4 individuals) (Plate 1) was recorded with highest abundance followed by *Rhinolophus lepidus* (3 individuals) (Table 1).

For volant small mammals, insectivorous bats with a total of 17 individuals (9 species) was the most abundant captured and recorded during the survey compared to frugivorous/ nectarivorous bats where only two individuals (one species) were caught. Meanwhile for non-volant small mammals, three species were captured throughout this survey, namely, *Rattus rattus, T. glis* and *Sundasciurus tenuis*. *T. glis* were captured using cage traps that were set nearby the park headquarters (site 2) and at Plateau camp (site 1) while *R. rattus* was only trapped at the park headquarters (site 2). *S. tenuis* was accidently caught in the mist-net in the forest at Plateau camp (site 1). Through indirect methods of mammal observation, four species were recorded: *Callosciurus prevostii, Trachypithecus obscura, Macaca fascicularis* and *Hylobates lar* (Table 2). *Callosciurus prevostii, T. obscura,* and *M. fascicularis* were observed around the base camp areas while *H. lar* were encountered at both elevation where they were heard vocalizing every morning during the survey.

Table 1: Taxonomic List of Mammals Species Captured using Harp Traps and Mistnets at Upper and Lower Elevation and Number of Individuals

Order Family Species	Plateau camp site (Site 1)	Park head-quarters (Site 2)	Total	IUCN status (2012)
Chiroptera				
Pteropodidae				
Cynopterusbrachyotis	-	2	2	Least concern
Emballonuridae				
Emballonuramonticola	1	-	1	Least concern
Rhinolophidae				
Rhinolophusrobinsoni	1	-	1	Near threatened
Rhinolophusaffinis	-	4	4	Least concern
Rhinolophuslepidus	-	3	3	Least concern
Megadermatidae				

Order Family Species	Plateau camp site (Site 1)	Park head-quarters (Site 2)	Total	IUCN status (2012)
Megadermaspasma	-	2	2	Least concern
Hipposideridae				
Hipposideroscervinus	-	2	2	Least concern
Hipposiderosbicolor	-	2	2	Least concern
Verpertilionidae				
Myotismuricola	-	1	1	Least concern
Miniopterusmedius	-	1	1	Least concern
Rodentia				
Muridae				
Rattusrattus	-	2	2	Least concern
Sciuridae				
Tupaiaglis	1	1	2	Least concern
Sundasciurustenuis	1	-	1	Least concern
Total number of families	3	7	8	
Total number of species	4	10	13	
Total number of individuals	4	20	24	

Table 2: Taxonomic List of Mammals' Species Through Observation

Order Family Species	Plateau camp site (Site 1)	Park head-quarters (Site 2)	IUCN status (2012)
Rodentia			
Sciuridae			
Callosciurusprevostii		+	Least concern
Primate			
Cercopithecidae			
Trachypithecusobscura		+	Near threatened
Macacafascicularis		+	Least concern
Hylobatidae			
Hylobateslar	+	+	Endangered

Birds

A total of 12 species from 17 individuals of understorey and ground level birds were netted from both sampling sites from a total of five trapping days (Table 3). The bird number species represented five orders, namely, Apodiformes (swifts), Coraciiformes (kingfishers), Falconiformes (falcons), Passeriformes (others), and Strigiformes (owls), that belongs to 10 families (Alcedinidae, Apodidae, Dicaeidae, Falconidae, Laniidae, Motacillidae, Muscicapidae, Pycnonotidae, Strigidae, and Turdidae).

In comparisons, 13 individuals from eight species were recorded at the Plateau camp site with 3 Purple-naped Sunbird (*Hypogramma hypogrammicum*) (Plate 2) and 3 Siberian Blue Robin (*Erithacus cyane*) caught. This was followed by two individuals of the Collared Scops Owl *(Otus bakkamoena)* and one of each for Ferruginous Flycatcher (*Muscicapa ferruginea)*, Germain's Swiftlet (*Aerodramus germani)*, Collared Owlet (*Glaucidium brodiei)*, Red Eye Bulbul (*Pycnonotus brunneus)* and Tiger Shrike (*Lanius tigrinus).* Four species with single individuals were caught from the park headquarters on the final day of sampling. These included the White-rumped Shama (*Copsychus malabaricus),* Blue Banded Kingfisher *(Alcedo euryzona),* Yellow Wagtail *(Motacilla flava)* and the Japanese Sparrow Hawk (*Accipiter gularis*). The most abundant bird species were the Purple-naped Sunbird, *Hypogramma hypogrammicum* and the Siberian Blue Robin, *Erithacus cyane.*

For the visual observations, nine species from eight families were recorded throughout the survey (Table 4). Seven typical lowland and garden species were observed around the park Headquarters trails including the Yellow Vented Bulbul (*Pycnonotus goaiavier*), Little Spiderhunter (*Arachnothera longirostra*), Rufous-tailed Tailorbird (*Orthothomus sericeus*), Oriental Magpie Robin (*Copsychus saularis*), Rufous Backed Kingfisher (*Ceyx rufidorsus*), Chestnut-winged Babbler (*Stachyris erythroptera)* and Fluffy Back Tit Babbler (*Macronous ptilosus*). Additionally, two fairly common resident species (Black Eagle, *Ictinaetus malayensis* and Moustached Hawk Cuckoo, *Hierococcyx vagans*) were recorded at the Plateau camp site (Table 4). The former was observed soaring just a few hundred metres from the Telekom tower and the latter hitting one of the nets but managed to escape and their roost were found at a nearby tree canopy.

Table 3: Taxonomic List of Bird Species Captured from Both Sampling Sites (S) with Current IUCN Status

Family Species	Plateau camp site (Site 1)	Park head-quarters (Site 2)	Total	IUCN status (2012)
Dicaeidae				
Hypogramma hypogrammicum	3	-	3	Least concerned
Muscicapidae				
Muscicapa ferruginea	1	-	1	Least concerned
Apodidae				
Aerodramus germani	1	-	1	Not listed
Strigidae				
Otus bakkamoena	2	-	2	Least concerned
Glaucidium brodiei	1	-	1	
Turdidae				
Erithacus cyane	3	-	3	Not listed
Copsychus malabaricus	-	1	1	Least concerned
Pycnonotidae				
Pycnonotus brunneus	1	-	1	Least concerned
Laniidae				
Lanius tigrinus	1	-	1	Not listed
Alcedinidae				
Alcedo euryzona	-	1	1	Vulnerable
Motacillidae				
Motacilla flava	-	1	1	Least concerned
Falconidae				
Accipiter gularis	-	1	1	Least concerned
Total number of family	7	4	10	
Total number of species	8	4	12	
Total number of individuals	13	4	17	

Table 4: Taxonomic List of Bird Species Recorded from Visual Observations

Family	Species	Plateau camp site (Site 1)	Park head-quarters (Site 2)
Pycnonotidae	*Pycnonotus goaiavier*		+
Timaliidae	*Macronous ptilosus*		+
	Stachyris erythroptera		+
Nectariniidae	*Arachnothera longirostra*		+
Turdidae	*Copsychus saularis*		+
Alcedinidaae	*Ceyx rufidorsus*		+
Accipitridae	Ictinaetus malayensis		+
Sylviidae	Orthothomus sericeus		+
Cuculidae	*Hierococcyx vagans*		+

Anurans

A total of 57 individual anurans were captured and spotted at Gunung Ledang National Park representing five families from 12 species (Table 5). Most of the anurans were captured and spotted at Sungai Ayer Puteh, which comprised a total of seven species and 31 individuals (Table 5). In addition, choruses of a group of *Ingerophrynus parvus* were heard vocalizing and were found at rock-surrounded small pond formations along Sungai Ayer Puteh after rain at dusk. Eleven individuals from four species of anurans were captured and spotted at Sungai Ayer Panas (Gunung Ledang Resort) where the abundant and most spotted species was *Odorrana hosii* (Poisonous Rock Frog), with a total of five individuals.

One of the species captured, *Kaloula pulchra* (Banded Bullfrog) is a species that is known as human commensal. At Plateau camp site, six individuals from three species were captured and the most abundant species was *Limnonectes laticeps* (Rivulet Frog) with a total of four individuals. At Sungai Asahan, eight individuals (five species) were captured, with *Duttaphrynus melanostictus* (Common Sunda Toad) being the abundant species (three individuals), while at Empangan Tangkak, only one individual from one species were captured and spotted during the survey. Among the anurans captured from five locations in Gunung Ledang National Park, the most abundant species was *Hylarana labialis* (Plate 3) with a total of 16 individuals captured (Table 5).

Table 5: Checklist of Anurans Captured and Spotted at Gunung Ledang National Park

Taxa Family Species	Sg. Ayer Puteh	Plateau Camp site	Sg. Ayer Panas	Sg. Asahan	Empangan Tangkak	Total	IUCN Status (2012)
Ambhibians: Anurans							
Ranidae							
*Hylarana erythraea**	-	-	-	-	1	1	Least concerned
Hylarana labialis	3(10)	-	(3)	-	-	16	Least concerned
Hylarana picturata	-	-	-	1	-	1	Least concerned
Odorrana hosii	1(1)	-	2(3)	2	-	9	Least concerned
Bufonidae							
Ingerophrynus parvus	1(4)	-	-	-	-	5	Least concerned
Phrynoidis aspera	2	-	1(1)	-	-	4	Least concerned
*Duttaphrynus melanostictus**	-	-	-	3	-	3	Least concerned
Dicroglossidae							
Limnonectes blythii	4	1	-	1	-	6	Near Threatened
Limnonectes laticeps	-	4	-	-	-	4	Least concerned
*Fejervarya limnocharis**	1	1	-	1	-	3	Least concerned
Microhylidae							
*Kaloula pulchra**	-	-	1	-	-	1	Least concerned
Rhacophoridae							
*Polypedates leucomystax**	1(3)	-	-	-	-	4	Least concerned
Total number of families	4	1	3	3	1	5	
Total number of species	7	3	4	5	1	12	
Total number of individuals	31	6	11	8	1	57	

Note: *Number in ( ) represent individuals that are spotted during sampling*
**Species commensally with human*

Plate 1: Intermediate Horseshoe Bat (*Rhinolophus affinis*), the Highest Species Abundance for Mammals Recorded in Gunung Ledang National Park. (Photo by Isham-UNIMAS)

Plate 2: Purple-naped Sunbird (*Hypogramma hypogrammicum*), the Highest Species Abundance for Bird Recorded in Gunung Ledang National Park

Plate 3: White-lipped Frog (*Hylarana labialis*), the Highest Species Abundance for Anurans Recorded in Gunung Ledang National Park. (Photo by Zehan-UiTM)

DISCUSSION

The current study provides preliminary information on the vertebrate fauna of Gunung Ledang National Park. Although this survey was conducted within a short period of time at only two sites, results from this study yielded important information on the distribution and abundance of vertebrate fauna in the Gunung Ledang National Park. It is expected that future surveys in different areas of Gunung Ledang may record higher species diversity in this national park. This would be especially important for mountain specialist species that is yet to be documented from the national park.

For mammal's survey, the insectivorous bats were recorded with highest species diversity. Both *R. affinis* and *R. lepidus*, which are known to forage in groups (Payne *et al.*, 2005), were the most captured species in this study using the harp traps. At the Plateau camp, higher bat activities were observed in canopy covered areas compared to open areas. This could be associated with higher insect abundance under covered forest, compared to open areas where foraging efficiency could be lower (Grindal *et al.*, 1999). Fruit bat abundance was lower at both sites. The usage of mist nets at different forest strata could provide a better result as most of the sampling areas were covered with tall stature forest (Francis, 1994). A single individual of *R. robinsoni* was captured at Plataue camp and it is listed as Near

Threatened by IUCN (2012). It is known to primarily inhabit forested habitats and these forest dwellers are threatened with habitat destruction (Kingston *et al.*, 2006).

Like other mammal species, primates are also threatened by habitat destruction. Out of the three species of primates recorded at Gunung Ledang National Park, *T. obscura* is listed as Near Threatened while *H. lar* is listed as Endangered in the IUCN Red list (2012).

For birds, the Plateau camp site which is predominantly characterized by hill dipterocarp trees such as *Podocarpus* sp. also widely distributed are conifers with red fleshy berry-like fruits that are consumed by most frugivorous birds. Bird species such as bulbuls and sunbirds are potential consumers of small fruits within the lower and mid-story forest (Robson, 2007). The typical association of pitcher plants/crawlers with insects, for instance orchids and *Nepenthes* sp. supports exceptional feeding ground for insect gleaners such as flycatchers and shamas (Smythies, 1999).

As a whole, the numbers of capture and observations were considered low considering the uneven effort of sampling days between both elevations. Adding to this, the transitional period spent to descend down from the upper elevation had probably delayed redeployment of mist-nets at the park headquarters. As a result, the trapped individuals were only banded on the final day due to prolonged heavy rain on 12 November 2012. In reference to the IUCN Red list (2012), most of the captured species are considered least concerned (LC) with only the Blue-banded Kingfisher listed as vulnerable.

For the anurans survey, the abundance and assemblages of the anurans are comparable to other studies (Chan *et al.*, 2010a). The species recorded in this study are also known to occur in other mountainous areas from Peninsular Malaysia. No new distributional and endemic species were recorded at Gunung Ledang National Park. Most of the species caught were human commensals (Inger and Voris, 2001), indicating human encroachment in this national park. This is apparent at Sungai Asahan, where the introduced species *D. melanostictus* was found. Another example is *K. pulchara*, that is commonly found in agricultural areas was found at Sungai Ayer Panas, nearby the Gunung Ledang Resort. A population of the American Bullfrog *L. catesbeianus* which is an introduced species can also be found at Gunung Ledang (Chan *et al.*, 2008). In the checklist of anurans recorded, only one species of anuran, *L. blythii* (Giant Asian River Frog) is listed as Near Threatened in the IUCN Red List while others are listed as least concerned.

Data presented here is the first preliminary data for anurans diversity in this area. The result showed less number of species and individuals than expected. There are few reasons that may have affected the result including external factor (e.g. weather) and internal factor (e.g. breeding status). Furthermore, water quality might affect diversity of anurans here, as Sungai Ayer Panas and Sungai Asahan were contaminated by human waste. Anurans are very sensitive to changes in water content as the anuran skin is permeable to keep the body moist. Tadpoles also depend on water to survive.

CONCLUSION

This survey provided baseline information on the diversity of fauna in Gunung Ledang National Park. Longer sampling period should be conducted in the future to cover all different habitats so that more vertebrate species that are specialized at the different habitats could be documented in future. Gunung Ledang National Park should be maintained as a protected area in order to protect its natural ecosystem and biodiversity. The presence of invasive species in the protected area is an alarming as they may be destructive to the ecosystem in the long term.

ACKNOWLEDGEMENT

We would like to thank Universiti Malaysia Sarawak (UNIMAS) for various administrative supports and the financial support from the Proboscis Genome Research project headed by MTA. Special thank to Mr. Salleh Dain from Universiti Teknologi MARA (UiTM); the organizing committee for the invitation and transportation; and Gunung Ledang Johor National Park (GLJNP) for accommodation and field support during the survey; and Dr. Faisal Ali Anwarali Khan for his critical comments to improve the draft of this manuscript. We also would like to express our appreciation to Mr. Nasir Saad and all undergraduate students from Universiti Teknologi MARA (UiTM) who had provided assistance in the field.

REFERENCES

Abdullah, M.T., Tuen, A.A. and Hanifah M. (2006).The Mammal Fauna. In Abang, A. and Das, I (Ed.), *The Biodiversity of a Peat Swamp Forest in Sarawak.* Universiti Malaysia Sarawak, Kota Samarahan. pp. 137-142.

Abdullah, M.T., Wong, S.F, and Besar K. (2010). *Catalogue of Mammals of UNIMAS Zoological Museum.* Kota Samarahan: Universiti Malaysia Sarawak Publication.

Besar, K., Khan, F.A.A., Marni, W., Sait, I., Lakim, M., Yambun, P.I., Salleh, M.A., Rahman, M.A. and Abdullah, M.T. 2009. Checklist of mammals from Gunung Silam, Sabah, Malaysia. *Journal of Tropical Biology and Conservation, 5*, 6.

Chan, K.O., Wood, P.L.Jr., and Grismer, J.L. (2008). *Lithobates catesbeianus*, geographical distribution. *Herpetological Review, 39*(4), 479.

Chan, K.O., Daicus, B. and Norhayati, A. (2010a). A revised checklist of the amphibians of Peninsular Malaysia. *Russian Journal of Herpetology, 17*, 202-206.

Chan, K.O., Grismer, L.L., Matsui, M., Nishikawa, K., Wood, Jr.P.L., Grismer, J.L., Belabut, D., & Norhayati, A. (2010b). Herpetofauna of Gunung Panti Forest Reserve, Johor, Peninsular Malaysia. *Tropical Life Science Research, 21*(1), 71-82.

Chuan, P.T.H., Abdullah, M.F., Osman, R.B., Ali, A., Sanuar, M.S.M., Jalil, L.A. and Ismail, T.H.T. (2006). *Hidupan Liar dan Alam Sekitar-Era Hijau (Ke Arah Generasi Lestari) No 3*. Kuala Lumpur: Harian Zulfadzli Sdn Bhd.

Eileen, L., Idris, M.I., Marni, M., Mortada, M.J. and Abdullah, M.T. (2012). Species Diversity of Small Mammals in Lubuk Sembilang Recreational Park, Langkawi Island, Kedah. In Mokhtar, M. and Halim, A.S. [eds.] *RIMBA 2: Regional Sustainable Development in Malaysia and Australia*. Universiti Kebangsaan Malaysia, Universiti Malaysia Sarawak and Charles Darwin University. Institute for Environment and Development (Lestari) and Universiti Kebangsaan Malaysia. pp. 124-135.

Francis, C.M. (1994). Vertical stratification of fruit bats (Pteropodidae) in lowland dipterocarp rainforest in Malaysia. *Journal of Tropical Ecology, 10*, 523-53

Francis, C.M. (2008). *Field Guide to the Mammals of South-East Asia*. United Kingdom: Princeton Press.

Grindal, S.D., Morrissete, J.L. and Brigham, R.M. (1999). Concentration of bat activity in riparian habitats over an elevational gradient. *Canadian Journal of Zoology, 77*, 972-977.

Inger R.F. and Voris, H.K. 2001. The biogeographical relations of the frogs and snakes of Sundaland. *Journal of Biogeography, 28*, 863-891.

Inger R.F. and Stuebing R.B. 2005. *A Field Guide to the Frogs of Borneo. Second Edition*, Kota Kinabalu, Sabah: Natural History Publications.

IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 18 August 2012.

Jayaraj, V.K., Khan, F.A.A., Besar, K., Hall, L.S., Abdullah, M.T. (2006). Bat survey of Mount Penrisen and notes on the rare *Kerivoula minuta*, *Kerivoula intermedia* and *Hipposideros coxi* in Sarawak, Borneo. *Journal of Biological Science, 6*(4), 711-716.

Khan, F.A.A., Bujang, M.F., Kassim, M.A., Yuh, Y.S., Aimran, A.A.A., Mawek, Z., Abang Tajudin, A.A.M., Ali, H., Besar, K., Marni, W., Sait, I., Laman, C.J. and Abdullah, M.T. (2008). Diversity and Abundance of Birds and Mammals in Niah National Park, Sarawak using Transect Survey. *Journal of Tropical Biology and Conservation, 4*(1), 23-37.

Khan, F.A.A., Besar, K., Wahap, M., Tuen, A.A., Abang, F., Fong P.H., and M.T. Abdullah. (2007). Small mammal diversity of Mount Murud. In I. B. Ipor, C. S. Tawan, P. Bulan, I. Jusoh, B. A. Fasihuddin, K. Meekiong (eds.). *Proceedings of Conference on Natural Resources In The Tropics*. Universiti Malaysia Sarawak, Kota Samarahan. pp. 157-160.

Kiew, R. (1992). *The Montane Flora of Peninsular Malaysia: Threats and Conservation.* Background Paper, Malaysian National Conservation Strategy. Economic Planning Unit, Kuala Lumpur.

Kingston, T., Lim, B.L. and Akbar, Z. (2006). *Bats of Krau Wildlife Reserve.* Kuala Lumpur : Universiti Kebangsaan Malaysia Publisher.

Medway, Lord. (1969). *The Wild Mammals of Malaya (Peninsular Malaysia) and Singapore.* Kuala Lumpur: Oxford University Press.

Payne, J., Francis, C.M. and Phillipps, K. (2005). *A Field Guide to the Mammals of Borneo.* Kota Kinabalu : The Sabah Society.

Robson, C. (2007). *Birds of South-East Asia.* London: New Holland Publishers (UK) Ltd.

Shahrul-Anuar M.S., E. Nurul 'Ain, M. Nor Zalipah, D. Mark Rayan, D. Shukor, M. Ganesan and Kalimuthu S. (2006). Diversity of small mammals (non-volant) at Gunung Jerai. In Hutan Simpan Gunung Jerai, Kedah: Pengurusan, persekitaran fizikal dan kepelbagaian biologi, eds. M.I. Shaharuddin, W.A. Wan Yusoff, Md. Som, Jalil., M. Yusoff and A. Latiff. Kuala Lumpur: Forestry Department of Peninsular Malaysia. pp 433-442.

Smythies, B. E. (1999). *The birds of Borneo Fourth Edition.* Kota Kinabalu: Natural History Publications (Borneo) Sdn. Bhd.

Tingga, R.C.T., Khan, F.A.A., Mohd Ridwan, A.R., Senawi, J. and Abdullah, M.T. (2012). Small mammals from Kuala Atok-Taman Negara, Pahang. *Sains Malaysiana, 41*(6), 659-669.

Tuen, A.A., Aminah, O. and Christine, P. (2000). Distribution and Abundance of Small Mammals and Birds at Mt. Santubong, Sarawak. *Sarawak Museum Journal* LV, (76), 235-254.

Tuen, AA. Abdullah, M.T, Laman, C.J, Rahman, M.A., Hang, E.S.U, Besar, K., Sait, I. and Marni, W. (2002). Mammals of Balambangan Island, Sabah. *Journal of Wildlife and Parks, 20*, 75-82.

END NOTES

[1]Department of Zoology, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak.

**Corresponding authors: E-mail: tabdullah@frst.unimas.my, Madinah Adrus a.madinah@gmail.com*